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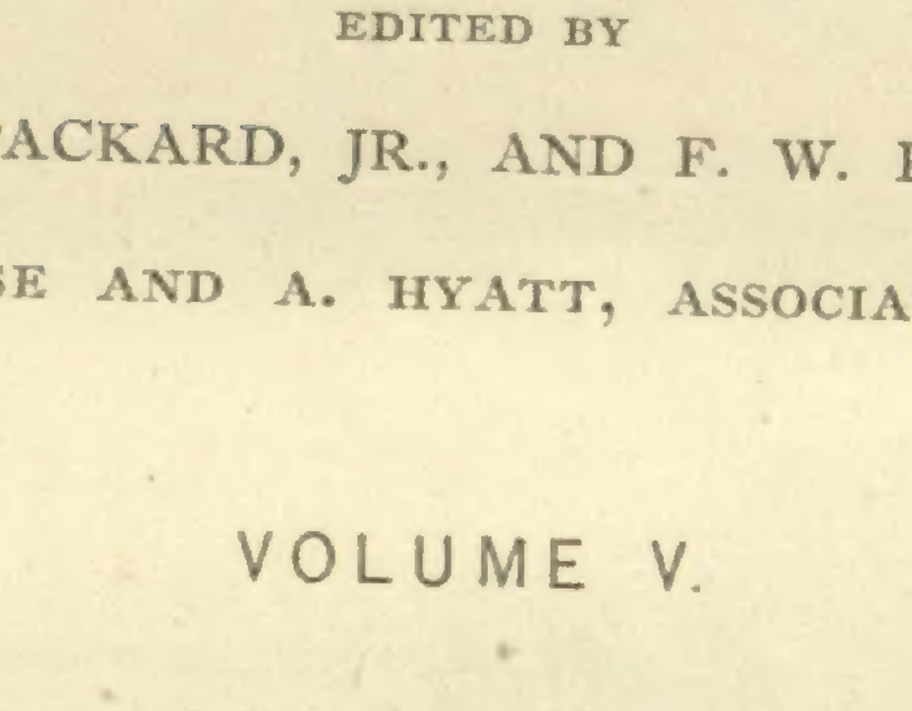
NATURAL HISTORY,

EDITED BY

A. S. PACKARD, JR., AND F. W. PUTNAM.

E. S. MORSE AND A. HYATT, ASSOCIATE EDITORS.

VOLUME V.



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ERRATA.

VOL. IV. — Page 723, line 11 from bottom, insert *more than* before *one*. Page 668, line 4, for *upper* read *outer*, and line 12 from bottom, for *Lichena* read *Lichina*. Page 674, line 15, for *Spermogonea* read *Spermogonia*. Page 675, line 7, for *Prodromous* read *Prodromus*, and line 11, for *Athrocarpa* read *Athroocarpa*. *Parietina*, wherever it occurs, should read *parietinus*.

VOL. V.—Page 493, for second foot-note read †Amer. Jour. Sci. II, XVI, 218. Page 526, line 19, for *Micrencephala*, read *Lissencephala*. Page 531, last line, and page 532, line 21, for *condyloid*, read *glenoid*. Page 532, line 12, after "mammæ abdominal" insert *etypically (in Dermaptera) pectoral;* line 33, for *Todientia*, read *Fodientia;* line 34, for *Tardigrada* read *Tardigrada*, and for *Doricata*, read *Loricata*. Page 564, line 26, for *ventral* read *dorsal;* line 27, dele *and Donacia*. Page 565, line 7, dele *and Coleoptera;* line 8, dele *Donacia*. Page 566, line 9, for *unlike* read *like*. Page 593, last line, for *grade* read *grades*. Page 596, line 15, for *opened* read *open*. Page 596, line 11 from bottom, for *have presented* read *have once presented;* line 15 from bottom, for *width* read *teeth*. Page 598, line 2, for *nominal* read *normal*. Page 600, line 18, for *subdivided* read *undivided*. Page 601, line 10, for *corner* read *cornea;* line 21, for *enjoined* read *enjoyed*. Page 604, line 3, for *might* read *should;* line 4, for *would* read *had;* line 5, omit *have*. Page 605, line 1, for *compulsory choice* read *compulsion*. Page 720, line 13, for *belongs* read *belong*.

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THE
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THE POLARITY OF THE COMPASS PLANT.*

BY W. F. WHITNEY.

The first mention of the so-called "polarity" of the Compass Plant, *Silphium laciniatum*, was made in communications addressed to the National Institute, by General Benj. Alvord, then Brevet Major, U. S. A., in August, 1842, and January, 1843; although the fact was well known to many hunters and others, as subsequent letters have shown. The truth of his statement having been doubted, General Alvord presented another communication at the second meeting of the American Association for the Advancement of Science, held at Cambridge, August, 1849, in which he confirms his own observations by those of other officers, all agreeing in the conclusion that the radical leaves of the plant really present their edges north and south, while their faces are turned east and west, the leaves on the developed stems of the flowering plant, however, taking rather an intermediate position between their normal or symmetrical arrangement on the stem and their peculiar meridional position.

General Alvord's first conjecture, that the leaves might have taken up so much iron as to become magnetic, having been negatived by analysis, he suggested that the resinous matter, of which the plant was full, and from which it was sometimes called "Rosin Weed," might have some agency in producing electrical currents.

As to its geographical distribution, he stated that it extended

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*Read before the Harvard Natural History Society, at Cambridge, Dec. 6, 1870.

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from Texas on the south to Iowa on the north, and from Southern Michigan on the east to three or four hundred miles west of Missouri and Arkansas; its chief habitat being rich prairie land.*

At the same meeting, Dr. Gray stated that "there were plants then growing in the Botanic Gardens here, and these did not present the edges of their leaves north and south, or in one plane more than another." He thought "that the hypothesis of electrical currents was hardly probable, as rosin was a non-conductor of electricity; but that it was due to the fact that the leaves were inclined to be vertical, and the direction of their edges north and south was the one in which their faces would obtain an equal amount of sunlight."

The statement of General Alvord was confirmed by the Rev. Mr. Morris, "who had observed the fact while running lines for surveys on the prairies."

At the nineteenth meeting of the American Association for the Advancement of Science, Rev. Dr. Hill presented a paper on "The Compass Plant," in which he gives additional evidence for the truth of General Alvord's statement.†

In November, 1870, Dr. Gray received a letter from Mr. Charles E. Bessey, of the Iowa State Agricultural School, in which he says: "we have the curious 'Compass Plant,' *S. laciniatum*, growing in great abundance throughout all this region. The polarity of its leaves is very marked. Use is made of it by the settlers when lost on the prairies in dark nights. By feeling the direction of the leaves they easily get their bearings."

From the record of these observers there can be little doubt that the leaves on the prairies do assume a meridional bearing; and the cause assigned for this by Dr. Gray is undoubtedly the correct one, viz.: that both sides of the leaf are equally sensitive to light. It only remains to be shown what renders its two sides thus equally sensitive. It is well known that the two sides of a leaf usually differ in structure, that the number of *stomata*, or breathing-holes, is much greater on the under than the upper surface; and that the tissue of the upper is denser than that of the lower stratum. As the two surfaces of the leaf of *S. laciniatum* appeared somewhat alike, Dr. Gray suggested that it would be well to

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*For his paper see the Proceedings of the Second Meeting of the American Association for the Advancement of Science.

†For an abstract of his paper see the AMERICAN NATURALIST, Vol. IV, p. 495.

examine the leaf microscopically in order to see if it corresponded with ordinary leaves in the above respects, or with truly vertical leaves, the two surfaces of which are usually similar or nearly so; also to compare with it the leaves of other species of *Silphium*, in which no tendency to assume a north and south position is shown. The species observed were the *S. laciniatum*, or Compass Plant in question, *S. perfoliatum*, *S. compositum* and *S. terebinthinaceum;* the magnifying power used was about four hundred diameters; and the results obtained may be tabulated as follows:

NAME OF SPECIES.	Average number of stomata in the field of the microscope at one time, on the	
	UPPER SURFACE.	UNDER SURFACE.
S. laciniatum, ...	20	20
S. perfoliatum, ...	10	30
S. compositum, ...	3	9
S. terebinthinaceum, ...	10	20

The cellular structure of the leaf of *S. laciniatum*, on making a traverse section, appeared to be homogeneous throughout; but, in the herbarium-specimens this could not be determined with certainty. For this, and for more extensive comparison of the stomata of the two surfaces, further examinations should be made in summer upon the fresh plant.

But the observations here recorded appear to show that the meridional position of the edges of the leaf is to be explained by the structure of the two surfaces, which being identical, at least in the important respect of the number of the stomata, seek an equal exposure to the light; — the mean position of equal exposure, in northern latitudes, being that in which the edges are presented north and south, the latter to the maximum, the former to the minimum of illumination.

NOTE. — In Longfellow's reference to this plant, in "Evangeline": —

"Look at this delicate plant, that lifts its head from the meadow,
See how its leaves all point to the north, as true as the magnet.
It is the compass-plant that the finger of God has suspended
Here on its fragile stalk, to direct the traveller's journey
Over the sea-like pathless limitless waste of the desert," —

it is curious to see how he has misapprehended the character and aspect of this coarse and stout plant. — EDS.

THE FAUNA OF THE PRAIRIES.

BY J. A. ALLEN.

In an article in a previous number of the NATURALIST,* attention was invited to some of the distinctive features of the primitive flora of the prairies. In the present paper, which forms in some measure a sequel to that, will be noticed the more prominent peculiarities of the fauna of the same region.†

The general facies of the fauna of the prairies, as well as of the flora, are determined by a few predominating species. The diversity of the animal and vegetable life of a given region being dependent upon the diversity of its physical features, one at all versed in the general principles of zoological and botanical geography, would hence never anticipate finding on level plains the highly varied life one constantly meets with in regions broken by mountain chains and valleys. Woodless regions being also far less prolific in species than wooded districts, the prairies, with their level surface and general absence of timber, hence present conditions in a high degree conducive to the production of the slightly varied fauna and flora they are found to naturally support.

On entering upon the prairies from the eastward, a marked change is met with in the mammalian fauna. Whilst few of the eastern species wholly disappear,‡ many of them become restricted to the narrow belts of woodland that border the streams, so that they thus cease to be either prominent or characteristic. This is eminently true of the wood-inhabiting Rodents and Carnivora, and also especially so of the bats. On the other hand, a few other species, which find their congenial homes in an open country, become at once numerously represented, some of them being peculiar to the prairies. A marked difference between the mammalian life of the prairies and that of the wooded region to the eastward thus results. Although the bats are generally wide-ranging species, most of those inhabiting the Northeastern

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* Vol. IV, pp. 577–585, December, 1870.

† Northern Illinois, and Central and Western Iowa.

‡ See the writer's "Catalogue of the Mammals of Iowa." Proc. Bost. Soc. Nat. Hist., Vol. XIII, pp. 178–194, January, 1870.

States being found throughout nearly the whole continent, they are dependent for shelter upon the forests, or the caverns here and there afforded by a somewhat broken country. On the prairies they are hence primitively few in number, in respect to individuals, and locally restricted, forming no important element in the fauna. As settlements increase, they soon multiply and become more uniformly distributed, the outbuildings of the farms affording them their required shelter.

The feline and ursine Carnivora, as the Bay Lynx (*Lynx rufus*), the Panther (*Felis concolor* Linn.), and the bear, are likewise rare on the prairies, as are also apparently the weasels. But the skunks, minks, foxes and wolves, being less dependent on a forest shelter, not only maintain their relative abundance, but, through the addition of a few strictly prairie species, are represented in more than their usual ratio at the East. Two species of the Western *Canidæ*, the Prairie Wolf (*Canis latrans* Say), and the Swift or Kit Fox (*Vulpes fulvus* Aud. and Bach.), here make their first appearance, as does also the Badger (*Taxidea Americana* Waterh.) and, especially at the southward, the little Striped Skunk (*Mephitis bicolor* Gray).*

The luxuriant and highly nutritious prairie grasses afford ample sustenance to the Herbivora, and in addition to the common Deer of the East (*Cervus Virginianus* Bodd.) the prairies were once preëminently the home of the elk and the buffalo, which have but recently been driven beyond the Missouri.

Of the Rodents, one or two species only are known to disappear near the prairie border. These are the little Chickaree, or Red Squirrel (*Sciurus Hudsonius* Pallas), which is to a great extent a northern and a pine-wood species, and the Woodchuck (*Arctomys monax* Gmel.), which seems to be almost unknown much to the westward of the Mississippi. A Vesper Mouse (*Hesperomys Michiganensis* Wag.), the Mississippi Fox Squirrel (*Sciurus Ludovicianus* Custis),—the latter, of course, a woodland species—two Ground Squirrels (*Spermophilus tridecem-lineatus* Aud. and Bach., and *S. Franklini* Rich.), and the Pouched Gopher (*Geomys bursarius* Rich.),—a singular and strictly prairie animal—add at least five

* This species has but recently been made known as an inhabitant of Central Iowa (see AMERICAN NATURALIST, Vol. IV, p. 376, August, 1870), whence the writer has received two skins of this animal from Professor H. W. Parker, of Grinnell. The writer has also recently learned of its occurrence as a rather common species in Missouri and in Southern Illinois.

of the most characteristic and most numerous species of the prairies. The peculiar habits of the three last named render them also among the most interesting.

The Bird fauna of the prairies presents peculiarities similar to the mammalian. Whilst nearly all the birds of eastern North America occur here,* most of the woodland species exist only as either sparse residents or casual visitors during their migrations, a few either wholly western or strictly prairie species, making up the bulk of the summer residents. The narrow timber belts that intersect the prairies are hence in summer comparatively quiet and tenantless. Even such widely distributed and generally abundant species as the robin, the blue bird and the chipping and song sparrows, are rarely met with in the breeding season in the unsettled districts. The swallows are also rare, as are all the species that depend upon forest shelter for nesting places. The field sparrows of the East, as the Yellow-winged (*Coturniculus passerinus* Bon.), the Field (*Spizella pusilla* Bon.), the Bay-winged (*Poecetes gramineus* Baird), and the Savanna (*Passerculus savanna*), and especially the Black-throated Bunting (*Euspiza Americana* Bon.), and the Western Lark Finch (*Chondestes grammaca* Bon.), are characteristic and predominant kinds which almost alone enliven the broad stretches of the wild prairie. Not less characteristic than either, however, are the Horned Lark (*Eremophila alpestris*), and the Meadow Starling (*Sturnella Ludoviciana* Swain.), whose song is here wilder and far more musical than at the East. Of the blackbirds inhabiting the grassy marshes, one, the Yellow-headed Troupial (*Xanthocephalus icterocephalus* Baird), is also strictly a bird of the prairies.

Other birds not usually common at the East are the Cerulean Warbler (*Dendræca cærulea* Bd.), perhaps the most common warbler of the prairie woodlands, and the beautiful Swallow-tailed Kite (*Nauclerus furcatus* Vigors), whose graceful flight and elegant form one never tires of watching as it skims over the prairies in search of its reptile food. The Prairie Hen forms the chief game bird, and is nowhere else so thoroughly at home. The sluggish Turkey Buzzard (*Cathartes aura* Ill.) is also conspicuous here, and the Sand-hill Crane is also more or less frequent.

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*See the writer's lists of the summer birds of Western Iowa and Northern Illinois, published in the Memoirs of the Boston Soc. Nat. Hist., Vol. I, pp. 493–503, 1868. Also a nominal list of the birds of Iowa, in the Report of the Geological Survey of that State, Vol. II, Appendix, January, 1871.

The reptiles afford mainly negative features. In consequence doubtless of the annual fires that have swept over the country for centuries, all the land species, including the turtles, the snakes and the lizards, are extremely scarce, and form but an insignificant feature.

Of the fishes, doubtless several species are more or less peculiar to the prairie streams and ponds, but I am unable to give at present any facts respecting them.

The land Mollusca have suffered similarly with the reptiles from the fiery ordeal to which for long ages they have been subjected, and are equally scarce and confined chiefly to the timbered river banks and bottoms. The fluviatile species are numerous, but do not appear to essentially differ specifically from those of the western waters generally.

The Insect fauna * presents peculiarities similar to those of the flora, on which their existence is so intimately dependent. Certain groups are represented in an unusual variety of species and abundance of individuals, but the most numerous forms are often exceedingly localized. Other groups are again but sparsely represented. No country, however. it is to be hoped, is richer in Orthoptera (grasshoppers), either in species or individuals: and a few species of butterflies are also especially numerous, of which a small proportion seem to be strictly prairie forms. The Hemiptera and the Neuroptera exist in great abundance. the dragon flies being richly represented, both as respects the number of the species and the gorgeousness of their colors, many of which are rarely or never seen in the Atlantic States. The Hymenoptera, on the other hand, are comparatively few, especially the bees and wasps, notwithstanding the abundance of the flowers. If the Diptera, however, do not make up the equilibrium, it is not because mosquitoes and blood-sucking flies (*Tabanidæ*) are deficient either in variety of species, in number of individuals, in size, or in voracity.

As regards Crustacea, the single family by which this class is mainly represented, the craw-fishes, or *Astacidæ*, seems here to almost find its metropolis; and as for worms, the ponds and streams afford leeches of gigantic size.

In the above sketch, reference is had exclusively to the wild or

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* For a partial list of the Butterflies see the Transactions of the Chicago Academy, Vol. 1, pp. 326–337, 1870.

unreclaimed prairies; but in the long-settled parts of the prairie, great modifications of the original fauna have already taken place. No sooner does the pioneer encroach upon these districts of unrivalled agricultural resources than the larger mammalia at once and forever disappear. The elk, the buffalo and the beaver are the first to be exterminated, and soon after them must follow the deer and the wolves.* The small rodents perhaps for a time increase in numbers, especially the ground squirrels and probably the field mice, as the farmer's crops afford them abundant sustenance, their great fecundity and reclusive habits further protecting them from diminution. The Pouched Gopher, from its remarkable subterranean habits, defies all means, except poison, that may be used for its extermination. Rarely coming to the surface, and only at night, the settler finds it nightly throwing up its little hillocks of earth in his garden, and even around his very door, as with the boldest impunity it digs its extensive galleries, uprooting the farmer's favorite plants, and destroying his fruit trees by feeding in winter upon their roots. The bats, everywhere in our country beneficial to the agriculturalist, soon domicile themselves in his outbuildings, and rapidly increase in numbers.

Scarcely less marked changes in the bird fauna likewise occur, although few of even the larger species are as yet either wholly exterminated or even much reduced in numbers, whilst many of the smaller kinds have rapidly increased. The artificial groves, the orchards and the fields become soon peopled with the half-domestic species that likewise fr ent cultivated grounds at the East. The swallows, no longer restricted to the hollow trees of the limited forests for nesting sites, confidingly occupy the numerous boxes erected for their use, or take advantage of the shelter afforded them by barns and outbuildings. The martin and the barn swallow thus soon become numerous, and colonies of the cliff swallow, migrating perhaps from distant regions, soon construct their nests beneath the eaves of barns and of public buildings, and are not only undisturbed but cordially welcomed. The poor chimney swifts alone seek in vain for a home, for bricks and stone being scarce, the necessary stove-pipe substitute for chimneys, or the various patented devices invented to take the place

*The Prairie Wolf (*Canis latrans*) is well known to have been formerly abundant as far east as Illinois. (See "Notes on Illinois," in the Illinois Monthly Magazine for July, 1861.)

of bricks and mortar, unfortunately rarely afford them convenient nesting places.

In traversing a new country, one is often struck with the differences in the habits that many of the birds present, from those familiar to him as characteristic of the same species in long settled districts. The unsuspiciousness of the blue jay and the crow at the West, teaches us that the distrustfulness of man, exhibited by these birds at the East, is an acquired trait, while one is surprised to see the meadow lark, so wild and cautious in the older states, singing with the utmost confidence from the roofs of the houses in the embryo villages on the newly settled prairies.

In regard to the changes in the numerical proportions of the species of the lower classes of animals, especially of the insects, space would fail, even if they were known, as unfortunately to a great extent they are not, to fully detail the disturbances that follow man's occupation of the country. The destructive influence of the swine upon certain species, when these animals are allowed to run at large, is, in some cases, too patent to be passed over unnoticed, even in the present cursory sketch. The grasshoppers, during their times of periodic abundance, afford them, by no means unsavory meals; but their fondness for the river mussels (*Unionidæ*) is excessive. These they systematically hunt in the shallower parts of the rivers, especially in dry seasons, till for miles, in some cases, they seem to have thoroughly exterminated them; and they also search for the craw-fishes, which everywhere abound in the marshes, with similar avidity, and must soon greatly diminish their numbers. It may be remarked, in conclusion, that the fauna of the prairies is not of so high a type as that of the adjoining, more diversified, wooded districts situated under the same parallels. There are fewer carnivora and more rodents, the preponderance of the latter being greater than at the eastward. In other classes, especially among insects, the lower groups, as compared with the higher, are there both relatively and absolutely more numerously represented. In short, as in the flora, so also in the fauna, there is a simplicity and uniformity that gives to both a comparatively low and uniform character.

THE BARNACLE GOOSE.

BY G. N. LAWRENCE.

During the winter I was much surprised to see at the store of Mr. J. Wallace, Taxidermist, New York, a fine specimen of this species, which he had recently mounted. On inquiry, he stated that it had been sent from Currituck Sound, North Carolina, by a friend of mine, Mr. Elias Wade, Jr., who was there on a shooting excursion. Mr. Wade wrote that he considered it very rare, and wished it carefully preserved.

As it was of much importance to ascertain all the facts concerning it, I immediately wrote to Mr. Wade, for more precise information as to whether it was alone or with others of the same species, or in company with any other kind of geese, etc. I have received his reply, and as his letter gives the desired information, also other interesting facts connected with the locality where the specimen was killed, I have thought best to add a transcript of it.

"Currituck Club House, Dec. 15th, 1870.

Your favor of the 9th inst., was duly received, and I thank you for the information contained in it relative to the goose I sent to be mounted. I regret that I can learn nothing here, about the character or habits of the bird, no one, even among the oldest gunners, having ever seen or heard of anything like it before, and being of course entirely at a loss to account for its presence or origin. This region being a great rendezvous for geese, for time out of mind tens of thousands making it their winter home, it is remarkable that nothing of the kind has ever before been seen by the oldest people. It, of course excited great curiosity among the natives, and gave rise to all sorts of absurd conjectures relative to its origin, mongrel character, etc.

The bird was killed on the 31st day of October, on our grounds, within 600 yards of the club house, from a blind where we had fifteen or twenty live geese decoys set out, and it was evidently attracted by them so far as to bring it within shot, when it was killed on the wing before alighting among the decoys. It came up unaccompanied by any other bird, and whether it would have alighted or not, with the decoys, had it not been shot, of course cannot be told.

Our locality is in Currituck Sound, about 60 miles south of Norfolk, and 30 north-east of Roanoke Island. We have nearly

all the varieties of ducks, which frequent the waters in the neighborhood of Long Island, the Chesapeake, etc., except the brants, which are rarely seen here. The water of the Sound from its head, some forty miles north of us, and for a considerable distance below us, is very nearly fresh, being very slightly brackish, and is everywhere filled with a species of grass, which serves as food for the birds, and for which they seem to have a great fondness. They begin to congregate the last of September, and remain, usually, from the first to the middle of March, furnishing generally the finest kind of shooting during the whole interval.

E. WADE, JR."

The first announcement of the occurrence of this goose in North America, was made by Prof. Baird, in the NATURALIST for 1868 (Vol. II, p. 49). A specimen was received at the Smithsonian Institution, from Mr. B. R. Ross, who obtained it in the Hudson's Bay region. Its acquisition was considered by Prof. Baird a most important one, as thereby its claim to be considered American was fully established. A second specimen now having been procured on the Atlantic coast, thus bringing it within the limits of the United States, it is deemed worthy of record.

SOME RELICS OF THE INDIANS OF VERMONT.

BY GEORGE H. PERKINS, PH.D.

THOUGH more rarely found now, Indian relics were formerly very abundant in many parts of Vermont. Especially favored in this respect are the borders of streams emptying into Lake Champlain, and the higher lands near by, as well as the shores of the lake and its islands. In a few localities the number of domestic implements found indicate the site of a village, or at least of a frequently occupied camping ground. Near some of these, burying grounds have been found, in which the dead were placed in a sitting posture according to the Indian custom.

Remains of ancient fortifications have been found, near which multitudes of flint stones and arrow and spearpoints strewed the ground. Here and there the number of unfinished articles, as well as the trimmings of stone, show where they were manufactured.

On Grand Isle in the lake there was such a place, and in this case the stone used by these primitive workmen was unlike any existing in the neighborhood.

We are told that the country about Lake Champlain was occupied mainly by the Iroquois and Coosucks, though undoubtedly other tribes visited these regions not unfrequently. How many of the implements found were made by members of these tribes is not known, but some of them must date farther back than the occupation of the ground by these tribes, as the style and character of the work is unlike any they have produced.

The greater portion of the relics which have been discovered were made from stone found in Vermont, either in place or as drift, but a few are of different material from anything found in New England.

Pestles and mortars for pounding corn are not uncommon; the latter being usually mere shallow cavities in some hard rock; but sometimes they are deeper. The pestles are usually well made and taper from the middle, toward each end, though the larger ones taper only toward one end. They are usually of compact material, as trap or granite, but some are of softer material,* as slate or schist. I have seen only one that had any kind of ornament upon it. This is a large one, over two feet long, in the Museum of the University of Vermont. It is cylindrical as usual, and is rounded at one end, while the other is carved to resemble the head of some animal, it may be a wolf.†

Small triangular articles are found, which, from the roundness and smoothness of the edges, seem made to rub down the seams in garments. Here, as in every locality in which Indian relics are found, great numbers of arrowpoints and spearheads have been picked up. Many are made of milky quartz and many more of flint or chert. They vary greatly in form and workmanship.

Gouges and chisels are rather common all over the state. The

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*These long implements of soft or slaty stone, generally called "pestles," were probably used for mashing grain on a flat stone or log, by a rolling process rather than by pounding, as the soft material from which they are made, would, if used as a pestle, give rather more grit to the "Indian cake" than even an Indian would be likely to relish.—F. W. P.

† In the collection of the New York State Museum at Albany, there is a long "pestle" of identical pattern and same rough carving as the one described from the Burlington Museum. These are the only ones that have come under my observation, having the handle carved to represent an animal, though most of the longer implements of this character have a knob at the handle as if for the purpose of suspension.—F. W. P.

former vary in shape, some being rounded on each side and some angular; some are grooved throughout the whole length, and some only for a short distance. They are from six inches to a foot in length, and are usually one and one-half inches to two inches broad. The chisels are smaller and less common. Both are made of various kinds of stone, some being of trap, others of granite or syenite, while others are of talcose and mica-schist, and could be of use only in working quite soft substances, or in dressing skins.

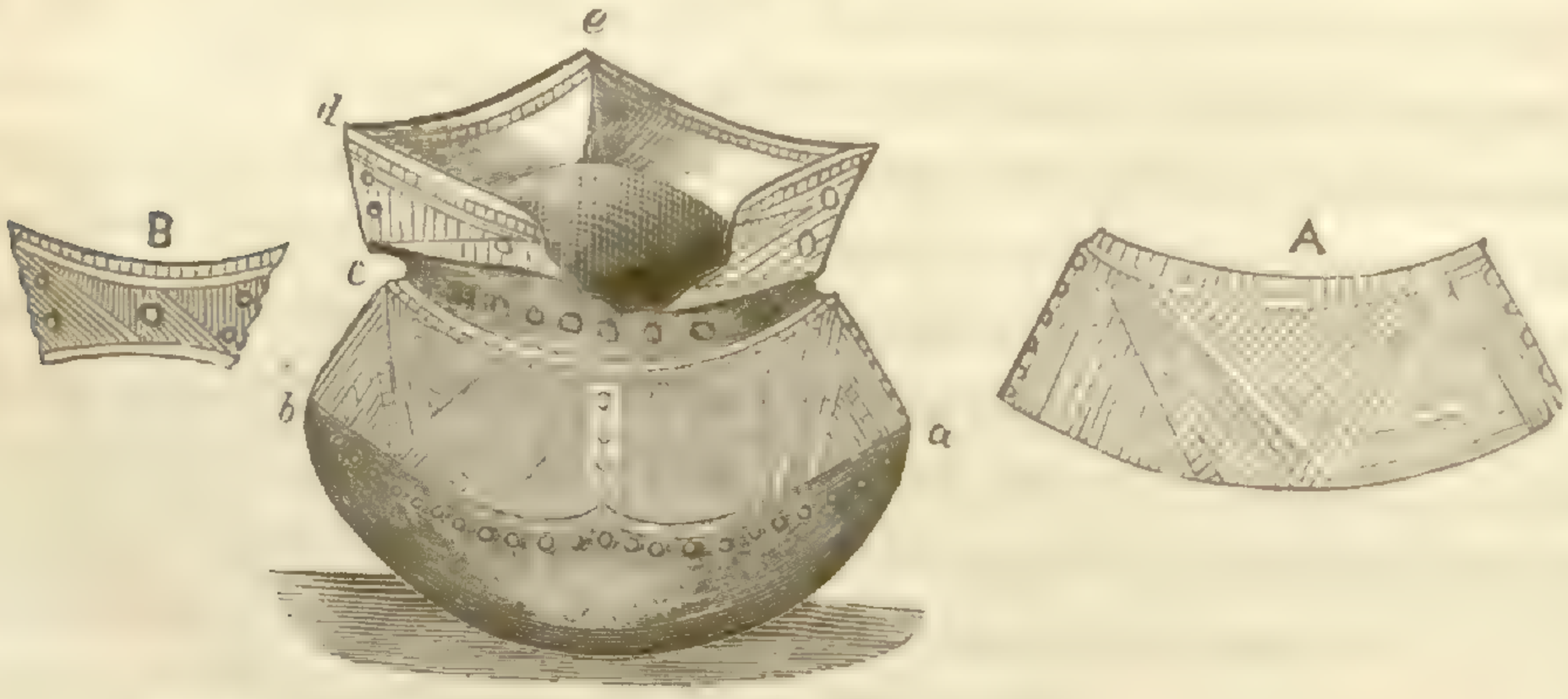
Axes and hatchets of various kinds are found, but not very often. Ornaments or amulets of stone, disc-shaped, with a hole in the centre, are sometimes met with. They are an inch or so in diameter, and one-fourth of an inch thick.

A very pretty pipe is in the Museum of the University at Burlington, and was dug up not far from Burlington. It is shaped like a common clay pipe, but the bowl is smaller and thicker, and the stem shorter. It is wrought from a piece of dark clouded gypsum, and is nicely polished. The stem is two and two-fifths inches long, and one-third of an inch thick at the end, and three-fourths of an inch thick next the bowl. The sides are somewhat angular, and the bore quite large, being one-fifth of an inch in diameter at the end, and growing very gradually smaller towards the bowl. The bowl is one and one-half inches high and nine-tenths of an inch in diameter. It is encircled by two rows of oblong cavities, about one-fourth of an inch broad, and from three-tenths to one-half of an inch long, and one-eighth of an inch deep, no two being exactly alike. There are seven of these in the lower row and eight in the upper, and they were probably inlaid with some ornamental substance.

Pots of various sizes and shapes have been found: one holding twenty quarts. All these are made of burnt clay. There are a few articles of Indian workmanship in the Museum of the University of Vermont which are peculiar and worthy of special notice. One of the most interesting of these is the jar (Fig. 1). This curious relic was found about six miles from Burlington, in the town of Colchester, in 1825. It was found some distance below the surface and covered by a stone over which a root of a large tree had grown; this tree was quite decayed, and the stone itself considerably decomposed. The jar is made of a kind of clay made very coarse by small bits of mica, quartz, and felspar,

and obtained, it may be, by pulverizing granite. This is quite brittle, and inclined to crumble, but is made firm by a coating both on the outside and inside of the jar, of a fine smooth clay which still bears the marks of some smoothing instrument. The jar is very rudely burned, and is much harder near the top than at the bottom. The color varies with the degree of exposure to fire. The bottom is reddish brown, which grows darker toward the top where it is almost black. The interior is considerably darker than the outside, being of a uniform black. The general form is very symmetrical. The lower third is hemispherical, and without ornament. Above this the form is compressed so as to be quadrilateral, and the sides taper towards the top and are quite elaborately ornamented. This ornamentation is entirely made up of straight lines and rings. Beginning below, we have first a row of deeply

Fig. 1.



impressed rings, running around the jar. These are .37 of an inch in diameter, the width of the ring itself .08 of an inch, thus leaving a centre of .29 of an inch in breadth. They are all of very nearly equal size, though some are more deeply imprinted than others, but were evidently made with the same instrument, a cylinder of bone probably; then come two lines very near together. Above these the sides are covered with a series of straight lines running in various directions. Three of the sides are very nearly alike, but the remaining side, instead of having the V-shaped centre filled with horizontal lines surrounded by oblique and perpendicular lines, has the lines differently arranged, as may be seen in Fig. 1, A. The upper edge of each side is bevelled and ornamented by a series of short parallel lines, and a row of four or five rings occupies each corner. Above this the body is much constricted to form a neck. This is circular and about half

an inch wide, and has a row of the same rings around it. Above this neck the top again swells and becomes square like the sides, and the edge curves from the corners toward the centre. It is ornamented with a somewhat different arrangement of lines from that of the sides, as is shown in Fig. 1, *B*. The sides from *b* to *c* are 2.5 inches high, and at the bottom about six inches broad, and five at the top. Two of them are a little broader than the rest. Around the inner edge of the top there is a band of short parallel lines, but with this exception the interior is destitute of markings. All the lines are very distinct, indeed they are narrow grooves rather than lines, being on the average .06 of an inch wide and from .02 to .04 of an inch deep. None of them are exactly straight, though very nearly so. The rings are twice as deep as the lines. The thickness increases from the bottom upwards, a piece broken from the bottom shows a thickness of .22 of an inch; at the neck, where a corner is broken off, it is .32 of an inch, and at the top .37. Other measurements are as follows: whole height 7.5 inches; diameter of top 5.1 inches (inside); diameter of neck 4.6 inches; length of curve, *a* to *b*, 11 inches; circumference of neck 16.5 inches; circumference around *a*, *b*, *i.e.* the largest part, 27 inches; length of one side of top, *i.e.* from *c* to *d*, 5.4 inches; height of *c*, *d*, 1.75 inches. When filled to the very brim, it holds nine pints.

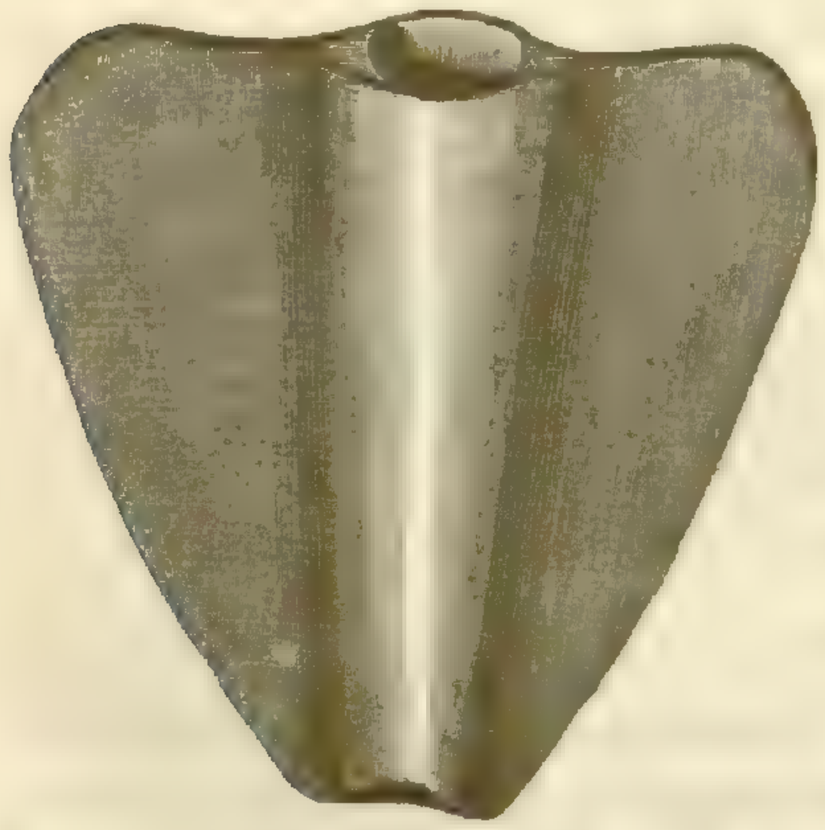
Fig. 2.



Fig. 3.



Fig. 4.



Another larger jar, Fig. 2, was found in Bolton, Vermont, about fifty years ago. It is not ornamented except by a ring about the neck. The general form is spherical, the top being contracted to form a neck. The mouth is wide. The color is a drab, and the whole surface is entirely smooth except the brim. Around this is a band about an inch wide, made up of oblique lines. Below this is a line of notch-like

grooves, and around the top is a narrow band and inside, another, both made up of short parallel lines. This jar is 9.5 inches in diameter at the largest part, and 7.5 at the mouth. The depth is 9.5 inches. It is about one-fourth of an inch thick at the bottom, and half an inch at the top. It is in the possession of J. N. Pomeroy, Esq., of Burlington.

Fig. 5.

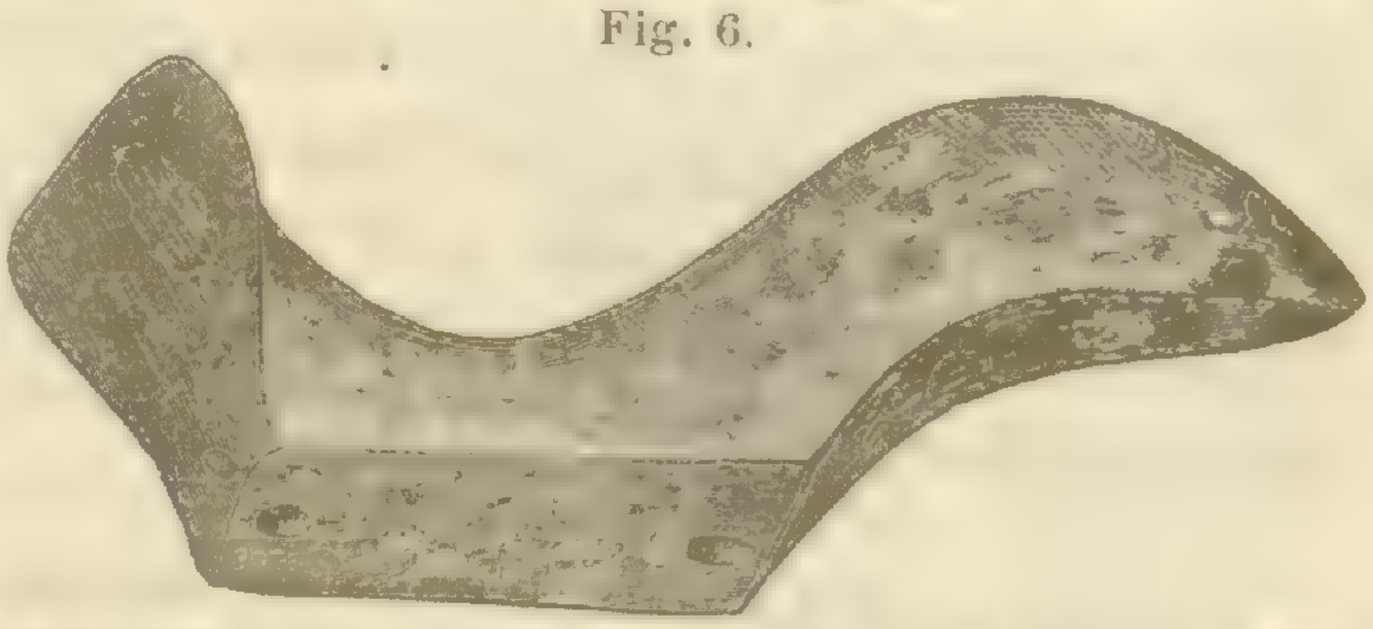


Fig. 3 represents a singular implement resembling a pick. It is made of a greenish sandstone, and is as smooth as the material allows. The length is 8.25 inches. The ends are broad and thin, but at the middle the thickness rapidly increases, and at this point it is 1.75, while the breadth is 1.6 inches. The blunt points are smoother than the rest, bearing evidence of considerable use. This relic was found half a mile south of Burlington.

Fig. 4 is an implement the use of which can only be conjectured.* It is made from a light colored talcose slate, and is quite smooth. The middle is much thickened and perforated by a large hole .55 of an inch in diameter at the base, and somewhat less at the apex. From this central portion the sides diminish in thickness towards the edges where they are quite thin. The whole length of the implement is 4 inches; the breadth at the top is 3.87 inches, and at the bottom 1.5 inches.

Fig. 5 is an arrow or spearpoint of unique style. The material is peculiar, being, instead of flint or some hard stone, of a compact, but not very hard, mica slate of dark gray color. The surface is covered with the marks of the instrument used in making it, and is not at all smooth. The sides are straight, the point rather blunt, the barbs short, sharp and angular. The shank is thick and the edges bevelled. The sides of the shank are scalloped sharply and

Fig. 6.



* These perforated stones are often found and are of various shapes and sizes. Squier and Davis figure one from the mounds, on page 240 of their work, and we have one in the Museum of the Peabody Academy, found in Salem, of nearly the same shape though made of different material. Squier and Davis place them under the head of ornaments, or gorgets.—F. W. P.

regularly. The whole length of this instrument is 2.75 inches. and the greatest breadth 1.33 inches. The shank is .8 of an inch broad and .3 of an inch thick. It was found at Corinth, Vermont.

Fig. 6 seems to be a badge of office, amulet, or something of the sort.* It is made of a very pretty breccia composed of light and dark material. It is finely wrought and very smooth, though not polished. The upper side is worked to a sharp edge, from which the sides round outwards towards the rectangular base, which latter has a hole at each end running obliquely through the ends. The length of the relic is 4.5 inches and the height nearly 2 inches. This was found about a mile north of Burlington, Vt. All these articles, except Fig. 2, are in the Museum of the University of Vermont. Besides such remains other traces of the Indian tribes are seen in the hieroglyphics. At Bellows Falls two rocks were found many years ago on which were rudely traced heads, a large group on one and a single head on the other. Some of these had rays coming from the top. Near Brattleborough, by the side of the river, a large rock was found which was covered with tracings of animals, as snakes, birds, etc., in all, ten figures, some not recognizable as representing any animal.

Such are some of the works which tell us of the former occupants of Vermont.

THE PRINCIPLES OF BEE BREEDING.†

BY FREDERICK WILLIAM VOGEL.

On the programme of the Sixteenth Annual General Convention of German Bee Keepers, held in the City of Nuremburg, on the 14th, 15th and 16th days of September, 1869, the first question was as follows:

*Implements of this singular form and high finish have been found both in the mounds and on the surface throughout the South and West, but never to my knowledge have they been mentioned from any New England State before. They are always made of ornamental stone and perforated at their lower corner. Hardly two specimens are alike in their finish, though all have the singular general form given in the figure above. Squier and Davis (S. I. Contr. I, 239) give figures of three of these stones under the head of ornaments, but question their being simply for that purpose.—F. W. P.

†Translated from the German by Samuel Wagner, Editor of the American Bee Journal. From the Annals of Bee Culture, for 1870.

What is the value of mixed breeds of bees produced by crossing the Italian, the Egyptian, the Carniolian or Heath Bee, with the common Black Bee?

On the general subject of bee breeding thus introduced, but with incidental reference also to the production of improved breeds, Mr. Vogel, an experienced and accomplished bee keeper and breeder, of the Province of Brandenburg, in Prussia, who probably has more diversified, practical and experimental knowledge of it than any other apiarian, submitted the following remarks:

If we carefully consider the topics embraced in No. 1 of our programme, we shall recognize, as the substance of them, this query, "Is it possible to produce an improved breed of bees? And if so, what are the principles of breeding which we must adopt?"

I do not deny that on this question I shall speak with a certain degree of complacency, for that which I have to communicate is not derived from the indulgence of an idle fancy, but is based on observations made at the hive — the only sure, living, and pure source of apistical science.

In a discourse on the production of an improved breed of bees, we have to fix clearly in our minds the distinction between *variety* and *race*, for the two ideas are not unfrequently confounded, or used in a very arbitrary sense. The idea of *variety* includes a certain amount of constitutional properties. In bees there are among others, good or bad temperaments, swarming propensity or the want of it, disposition to build drone comb, etc., etc. Allow me to include all such constitutional properties under the general term *characteristics*. Variety, accordingly, is based on the characteristics. Corporeal markings, size and color, do not come into consideration in determining the idea of "variety." If the bees of any particular district are distinguished by a marked propensity for swarming, or by any other special characteristics, we are warranted in designating them as a "variety." Thus, in my estimation, the heath bees of Luneberg, those of Lower Austria, etc., etc., are simply new varieties of our well-known black bee. The peculiar constitutional properties which characterize varieties are rooted in the psychical or spiritual nature of the insect, and are elicited by the kind or quality of the pasturage, by particular modes of management, by diversity of climate, or some other dominating pecu-

liarity of the district. Accordingly these constitutional properties disappear or are lost by lapse of time, by removal to a different locality, and thus subjecting the insect to other climatic influences and other conditions of management or pasturage. Hence, it is obvious that for the production of an improved breed mere varieties are of very subordinate account. At the same time, however, I contend that the production of an improved breed of *general value* — that is, one *equally suited to all parts* of an extensive country — is an impossibility. On the other hand, I am clearly of opinion that, for each particular district possessing marked peculiarity of climate and pasturage, an improved breed specially suited to those conditions may be produced. And in this aspect, the existing varieties of the honey bees are of high significance and value.

The meaning and extent of the idea expressed by the term *race* have long since been settled by science. The term embraces a certain amount of external corporeal markings, among which are size and color. When the bees of any extensive region, or even of a limited district, are found to be strikingly distinguished by their large or small size, by the color and quality of their pubescence, or of the tint of their dorsal bands, from the common type of the honey bee — assuming as such, for the present, our common black bee, we are warranted in designating them as a distinct *variety* or *race;* and that each variety or race has its own distinguishing constitutional characteristics is generally known.

I am not of opinion, however, that in order to produce or improve breed, recourse *must* necessarily be had to the foreign races which have been introduced among us, though it is often alleged that we should, from the start, have availed ourselves of them, and have endeavored thus to originate an improved breed. But had that course been adopted, we should hardly ever have reached a satisfactory result. The pure races would have disappeared under our hands long before we could have succeeded in substituting an improved breed for them. It was much wiser to labor primarily to secure an ample stock of pure races, while at the same time the peculiar characteristics of each were assiduously studied. And now that both these points have been attained, we are placed in a position favoring and furnishing means and facilities, for the origination and production of an improved breed.

Permit me now to communicate the results of a series of experiments, all of which had for their object to ascertain the principles which should guide and govern us in the endeavor to produce and

establish an improved breed of bees. The experiments instituted were so numerous, that they might be told by fifties or hundreds.

1. *Crossing the black bee with the Italian.*— When the Italian bee was introduced by Dzierzon, it was supposed that the workers produced by the Italian queen, fertilized by a black drone, would show an intermingling of the external markings of the parents. But this was soon found to be a mistake. In the second generation already, degeneration became apparent — the hybrids divided numerically, one portion resembling the Italian, and the other the black bees. For the purpose of experiment, I continued breeding in these two directions, and in the fourth or fifth generation reached again on the one hand the pure Italian bee, and on the other in the fourth degree, the pure black bee. The hybridism was thus again resolved into its *ataval* elements. The facts thus experimentally ascertained are, however, of very subordinate significance, elucidating only the coloration of the hybrids. Of higher and much greater practical value, on the other hand, is the solution of the inquiry: — "Do the constitutional characteristics of the two become commingled in the black-Italian hybrids? Or are those of the one variety or race simply transmitted to the other?" It is well known that very different answers have been given to these questions. Some breeders state that the hybrids of the black and Italian bees possess the constitutional properties of the Italians; while others allege the direct contrary. Some assert that the hybrids are more irascible than the black bees; others again say they are less so. Some declare that they will store more honey, while others say that they will store less, etc. The truth is, the constitutional properties of the two are of an exceedingly subtile nature, which makes it extremely difficult to base a reply on the results of a cross between them. It is only by crossing the black bee with the Egyptian that we can obtain any clear light on the point under consideration.

2. *Crossing the black bee and the Egyptian.* — When the Egyptian bee was consigned to me by the Berlin Acclimatization Society, I was of opinion that this bee was of little, or at most of only slight importance in a scientific point of view, for I supposed then that whatever was to be learned of the proposed mysteries of the bee, had already been revealed by means of the Italians. Now, however, I feel assured that *the future of apistical theory pertains to the Egyptian bee.*

Very soon some of the Egyptian queens became fertilized by

drones. The workers produced by these queens were not perceptibly larger than the pure Egyptian workers, and in other respects still resembled the Egyptian type very much. The drones produced by these queens — since impregnation exerts no direct influence on them — were still pure Egyptian. I now raised some young queens from these impurely fertilized mothers, and employed the Kohler process to secure their fertilization by black drones. According to the experience derived from crossing the black bee and the Italian, the workers produced by such queens should have been numerically one-half black bees, and the other half Egyptian. But when the hybrid workers made their appearance our anticipations were not realized. The hybrids diverged in two directions indeed, but the parental markings showed themselves mingled or melted into each other, in a portion of the progeny. A portion of the workers resembled the Italian workers so perfectly, in color, size, and characteristics, that no expert could distinguish them from pure Italians. Another portion of them still resembled the Egyptian bees, showing a black body covered with a grayish pubescence, and manifesting the constitutional characteristics of the Egyptians. These observations led me to suppose that, probably ages ago, the Italian bee may have originated from a cross of the black bee with the Egyptian. I communicated this conjecture to Dr. Gerstaecker of Berlin and other friends. The latter received the suggestion with great disfavor, regarding it as derogatory and dishonoring the Italian bee, and it required no inconsiderable labor to convince them that the conjecture had no reference whatever to any supposed value or want of value of any variety of the honey bee, but was of a purely scientific nature; and that one variety might in economic value still rank high above another, though it be clearly demonstrated to be of hybrid origin. Dr. Gerstaecker informed me that he was unable to distinguish the workers produced by a cross of the black bee with the Egyptian, from the pure Italian workers; but that I had assigned no reason for my hypothesis, and that the geographical distribution of the honey bee militated against it. I then again carefully studied the excellent little treatise by Dr. Gerstaecker, on "The Geographical Distribution of the Honey Bee," and found that the geographical distribution of the races furnished no conclusive arguments either for or against my views. Here the idea occurred to me that the conjecture would attain to the highest degree of probability, if a

hybrid queen of the second or third generation should be found to produce drones which could not be distinguished from Italians. Impatiently did I await the return of spring. The drones finally made their appearance and diverged likewise in two directions; one portion could not be distinguished from Italian drones, while another portion resembled the Egyptian drones in size, but having black bodies with grayish pubescence. I then raised young queens from an Egyptian hybrid queen of the second degree of degeneration, and arranged to have them fertilized by drones derived from the same mother, but bearing Italian markings. The workers produced by these queens resembled the Italians, while the drones diverged in the two directions adverted to. I now proceeded to breed in-and-in from the hybrids thus obtained, and in the third and fourth generations *all* the drones bore the Italian markings. It might here be objected that on ataval principles, these hybrids must revert to their distinct parental or primal races, as is the case with hybrids of the black bee and the Italians. But I have now before me black Egyptian hybrids of the nineteenth generation, and these still retain their characteristic markings unchanged alike in queens, and drones, and workers, though rather intensified in degree and permanence. Firmly established, therefore, do I regard this fact — *From a cross of the black bee with the Egyptian, a hybrid is produced which no man can distinguish from the Italian bee.*

Now what do these observations teach? For brevity's sake I will express the question thus: — Did Divine Omnipotence, when placing the animal creation upon the earth, provide in each case only *one* primitive pair? Or did He create each race at once in larger groups? And if the latter, were all the animals of the same class perfectly alike as regards size and color? Or did God create directly the different *races* of the honey bee? When we reflect that no mortal eye witnessed the grand act of creation, and further consider that no reply can be deduced from any known laws of nature, they may be regarded as highly presumptuous. But the arrogance apparently involved in them vanishes at once, when I state that I have not deduced the reply from my own mental cogitations, but from facts with which I became acquainted when crossing the common black bee with the Egyptian. My observations constrained me to accept two primitive races for the honey bee. A portion of each of these races certainly existed since the

dawn of history, and these I denominate *original* or *primary* races. In the course of time others arose from the crossing or intermixture of the primary races and these I call *derivative* or *secondary* races, or *varieties*. The black bee and the Egyptian I regard as primary races. The Italians, Crecropians, Syrians, Chinese, etc., etc.—"Who can count the peoples? who name their names?" all these are nothing more than the hybridous products springing from the two original races — mere derivative or secondary races. I venture to say that if all these mixed products be entirely removed, leaving me only the pure black bee and the pure Egyptian, I could speedily reproduce any desired secondary race, by crossing those two primaries. Possibly, the strikingly black honey bee of Madagascar may yet prove to be another primary race.

3. *Crossing the Italian bee and the Egyptian.* — What has hitherto been said is of subordinate importance, so far as regards the production of an improved breed, because it refers only to the color or markings which it may be thought desirable to give to the improved breed. But of higher and more practical importance is the solution of the questions, Is the constitutional temperament of one race transmissible to another? And if so, is this to be effected by means of the queen or drone? Or, again, do the constitutional properties of the two races or varieties become so commingled or melted into each other by the cross, that new and special constitutional properties are the result? In breeding we have hitherto relied mainly on the queen. We said — "this is a choice, populous colony with a fine prolific queen, therefore we must use some of its blood for raising queens." But I do not believe that, in the endeavor to procure an improved breed, it is sufficient to have regard only for the qualities of the queen. According to my observations, those of the drone, too, must be taken into account.

In order to accumulate facts, it became necessary to cross the Italian bee with the Egyptian, because these two are the exact counterparts of each other, as regards constitutional characteristics — the Egyptians having a fiery temperament, while the Italian is of a placid and gentle disposition. The first inquiry was: — Does the temperament reside in the seminal filament, or in the egg? In other words, is the seminal filament the germ of the young bee, or is the egg?

When first the seminal filaments were discovered in the generative fluid, it was thought that each was the incipient germ of a

nascent creature; and that the young animal is nothing more than a fully developed seminal filament. Accordingly, it was assumed that the egg only contained the requisite nutriment for the sustenance and development of the seminal filament. Now, if this were in reality the germ of the nascent creature, the constitutional properties must be inherent in the drone. But every bee breeder is aware of the fact that an unimpregnated queen lays eggs which produce drones exclusively; and he further knows that worker bees occasionally lay eggs from which living creatures are developed, and that these are invariably drones. From these facts it is evident that *the egg contains the germ of the young bee*. Let us now inquire what observation and experiment further teach. I crossed pure Egyptian queens with Italian drones. In the hybrid progeny, the constitutional properties — the temperament — of the Egyptian seemed completely obliterated, as it were, and those of the Italian substituted. I next crossed the Italian queens with Egyptian drones, and the progeny displayed the Egyptian characteristics wholly. Hence, it was manifest that *the temperament of the bee resides in the seminal filament*. Accordingly, in our endeavors to provide an improved breed, our attention must be preëminently directed to the drones by which the selected queen is to be fertilized. We come now to the question whether drones possess diversities of temperament; but the elucidation of this branch of our topic would occupy too much time at present. I may perhaps have occasion hereafter to discuss it.

Some may dissent from the views I have here expressed, but we cannot disagree in our object, namely, by steadfast endeavor and close scrutiny to attain to the knowledge of the truth which the Omniscient has embodied in that very diminutive member of animated nature, the Honey Bee.

HABITS OF THE PRAIRIE DOG.

BY PROF. B. C. JILLSON, PH.D.

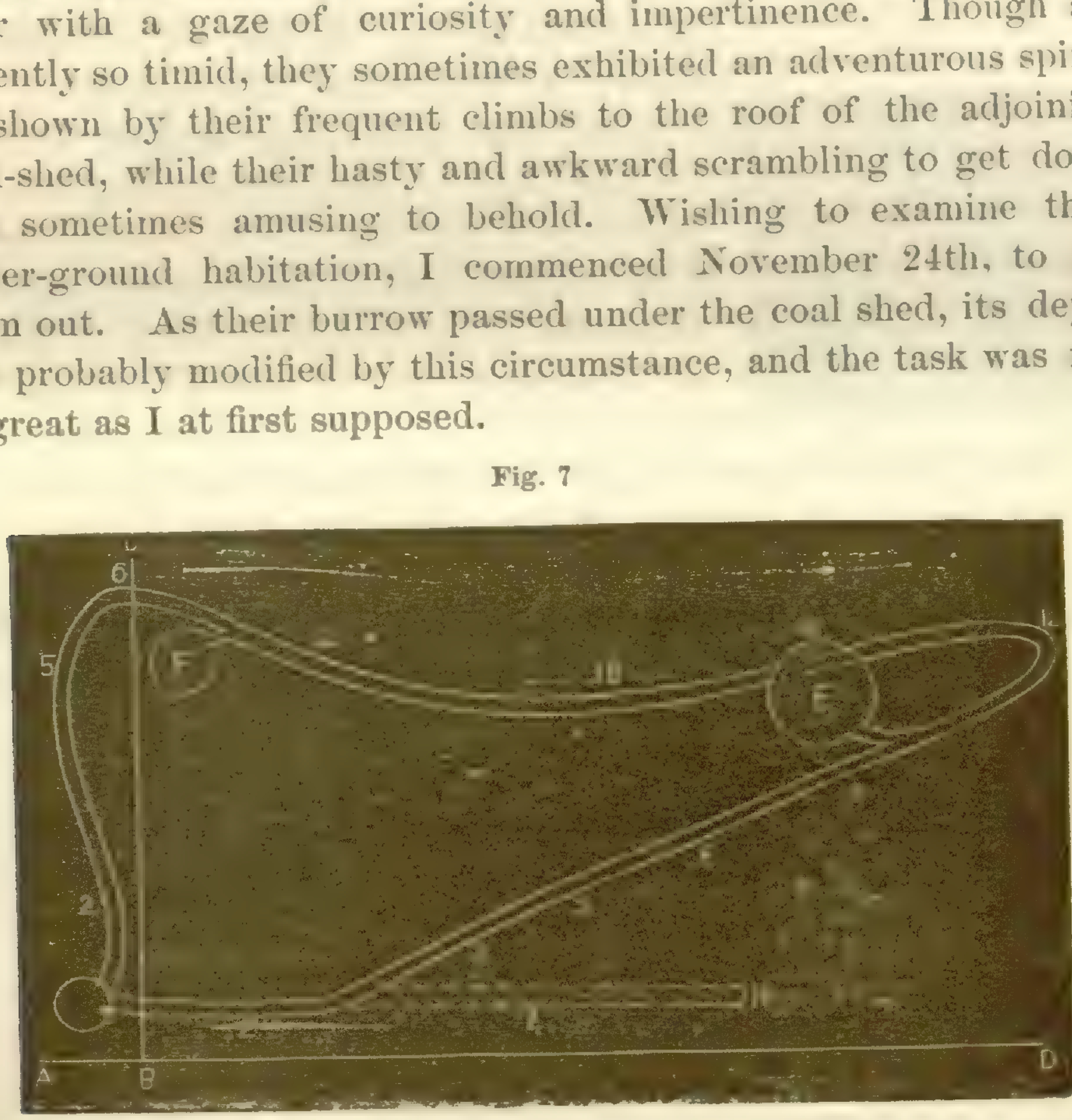
October 26th, 1869, I received two Prairie Dogs, which had been forwarded from Cheyenne, Wyoming Territory. They were about the same size, each measuring thirteen inches in length, the

tail being three and an eighth inches long. For want of a better place they were kept until spring in one of the large rooms of the university building, where a box was assigned for their especial use, with full permission to run about as they chose, provided they remained on their good behavior. Hardly had they been placed in their new quarters when they began to make a foraging expedition about the room, and discovering several boxes of choice mineralogical specimens wrapped in soft paper, pronounced the latter article confiscated, and proceeded to appropriate it to their own use. Seizing the paper with their teeth they would soon strip the specimen, and sitting on their hind legs, and using their paws as hands, would cram their mouth and cheek pouches with the plunder—the long ends protruding—and then with a peculiar ambling gait cross the room, and, having deposited their load under a case of apparatus, quickly return for more. This was continued for several days, till they had gathered an immense quantity of warm material composed of every scrap of wood or paper that could be obtained. Not satisfied with this wholesale plundering, they commenced an indiscriminate gnawing of table legs, cabinet cases, boxes, etc., in fact everything upon which they could exercise their sharp incisors except the stove, which I noticed they carefully avoided after once trying their skill upon it. So troublesome did they at length become, that they were confined to their box, and only occasionally permitted to run at large under a watchful eye. At such times they would amble about the room, occasionally stopping and whisking their tail in a most amusing manner. At the slightest noise they would raise themselves upon their hind legs, with their fore legs hanging down in front, and with a quick, sharp, intelligent look in all directions, endeavor to discover the cause of the disturbance. They soon became very tame, coming when called, and eating from my hand, though they would sometimes give strangers who were too familiar, a pretty sharp nip. Their food consisted of the blade, stock, and grain of corn, the blades and roots of grass, cabbage leaves, celery tops, apples, nuts, etc. Of peanuts they were very fond, but of nuts with a hard shell they seemed to have no conception whatever. Taking them in their paws, they would try their teeth upon them, and then let them drop in apparent disgust; in this respect acting very differently from their near relatives, the squirrels. When the nuts were cracked, however, they seemed to enjoy them as a great luxury. Their peculiar, short, quick and sharp voice

was often exercised for the amusement of my friends. At a peculiar chirrup of mine, they would quickly assume an erect posture, their fore paws hanging in front, their heads raised as high as possible, and with mouth turned upwards, give forth a sound so nearly resembling the yelp of a domestic puppy, as to confer on these peculiar animals, the familiar, though by no means appropriate, name of Prairie Dogs. At each cry they jerked their tails, as if it cost them an effort to speak so loud. They were very affectionate, seldom quarrelling, and often standing with their fore paws on each other's shoulders, rubbing their noses together. I once discovered that one of them had crawled through a small hole, and was wandering about between the laths and outside of the building. As often as I called, it would answer, and at length discovering that it had found its way to the ceiling, I removed a board from the floor of the room above and releasing it, returned it to its companion. The demonstrations of affection which followed would put to shame many a couple of higher intelligence. The next day the other one had not been released ten minutes, when it too passed through the same hole, and probably following the track of its predecessor, was finally removed from the same opening. On being returned to its quarters, demonstrations were indulged in, similar to those of the preceding day. During the greater part of December, January and February, they lay in a dormant state, although there was usually a fire in the room six days in each week. They were generally found occupying the centre of their paper heap, coiled up in such a way as to resemble two small parcels of fur. Their temperature was so much reduced that they seemed cold to the touch, and often provoked the remark from strangers "They are dead, *stone* dead." They never opened their eyes, and showed by their actions that they desired nothing so much as to be let alone. Towards the close of February they began to exhibit signs of returning life, occasionally leaving their box, to which, however, they would soon return. Early in the spring I took them to my home a few miles from the city, and placed them in a large pen where they had abundant opportunity of enjoying their well known digging propensities. Having selected a corner they commenced their labors and were soon out of sight. In a few days they had raised a mound around the entrance one foot and a half in height and two feet in diameter. Their under-ground work, however, seemed never completed, for they were constantly throwing dirt from the hole. In digging.

they used their fore feet, throwing the dirt some distance to the rear with their hind feet. Sometimes they turned around and pushed the dirt before them with their paws. They had a singular habit of using their noses as miniature battering-rams, and were constantly bunting the earth about their pen in this manner. They spent much of their time — sometimes one, and sometimes both — sitting erect on their mound with their paws hanging down in front, apparently taking a survey of their narrow quarters. At the slightest noise, they would dart into their hole shaking their little tails in a most comical and derisive manner. Hardly had they disappeared, however, when their heads would stealthily reappear with a gaze of curiosity and impertinence. Though apparently so timid, they sometimes exhibited an adventurous spirit, as shown by their frequent climbs to the roof of the adjoining coal-shed, while their hasty and awkward scrambling to get down was sometimes amusing to behold. Wishing to examine their under-ground habitation, I commenced November 24th, to dig them out. As their burrow passed under the coal shed, its depth was probably modified by this circumstance, and the task was not so great as I at first supposed.

Fig. 7

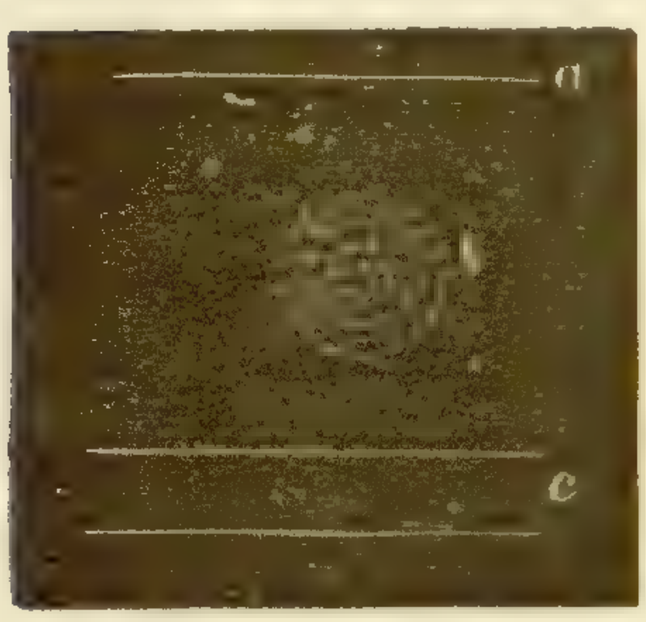


Burrow of the Prairie Dog.

In the above sketch, *A B C* represents the outline of that corner of the pen in which their hole was commenced, and *C B D* the sides of the coal-shed under which they burrowed. The passages were about three and a half inches in diameter, and nearly round, being slightly flattened from above, downward.

Their depth is indicated in inches by the figures in the cut, the measurements being taken from the top of the passage to the surface of the ground. *E* shows the position of a side excavation, spherical in shape, and twelve inches in diameter, which, when opened, was found filled with dried grass, corn fodder, etc. *F* was also spherical, nine inches in diameter, and empty. *H* was a blind passage, or *cul de sac*, three feet in length, packed solid with grass and little masses of dirt, the object doubtless being to keep moist the winter's supply of food; the packing being accomplished by the bunting process already described. The burrow passed under *E* as indicated by the dotted lines, and as shown by the section in the margin, where *a* represents the surface of the ground, *b* one side of the granary *E*, and *c* the passage way beneath. The distance from *a* to *b* was eight inches, the width of *b* at this point six inches, and the distance from *b* to *c* four inches. The total length of under-ground excavation was about twenty-five feet. The question is often asked, does the Prairie Dog require any water? The gentleman who brought mine on, said he had had them two months, during which time he had given them nothing to drink. I received them October 26th, 1869, and from that time to the 1st of May, 1870, I am *sure* they drank nothing. March 11th and April 3d, I placed a dish of water before them. Each time they merely smelt of it, and turned away without drinking a drop. From the 1st of May to the last of November, they occupied their summer quarters, and though always rejecting the water placed before them, they may have received an abundant supply from the falling rain, the dew, and the moist earth. During the month of December, 1870, one of them drank four times, viz., on the 7th, half an ounce; the 9th, two ounces; the 14th, one and a half ounces; the 20th, one and a half ounces, and on the 22d, commenced its winter nap.

Fig. 8.



Section of Burrow.

It is often recorded in the books, that the Prairie Dog, owl and rattlesnake live lovingly together in the same hole. I have seen many "dogtowns" with owls and dogs standing on contiguous, and in some cases, on the same mound, but never saw a snake in the vicinity. I have conversed with many frontiersmen and have

yet to find one who will acknowledge his belief in this singular phenomenon. In a region of country, where snakes are so abundant as in some parts of the West, it would be very strange if they were not occasionally found in "dogtowns" as well as elsewhere. In the room in which my dogs were confined, was a cage containing two full-grown, living rattlesnakes. This gave me an excellent opportunity for testing the friendship of these animals for one another, but my cautious skepticism exceeded my curiosity, and my little friends did not, this time at least, fall victims to scientific experiments.

THE FLIGHT OF BIRDS AND INSECTS.

The few last numbers of the French "Revue des Cours Scientifiques" (Nos. 36, 38, 40, 1870), which has been suspended since the siege of Paris, contain the reports of a course of lectures by M. Marey on this interesting subject. The distinguished lecturer has brought to bear on this difficult theme rare experimental and mechanical tastes, added to a nicety of manipulation characteristic of his countrymen.

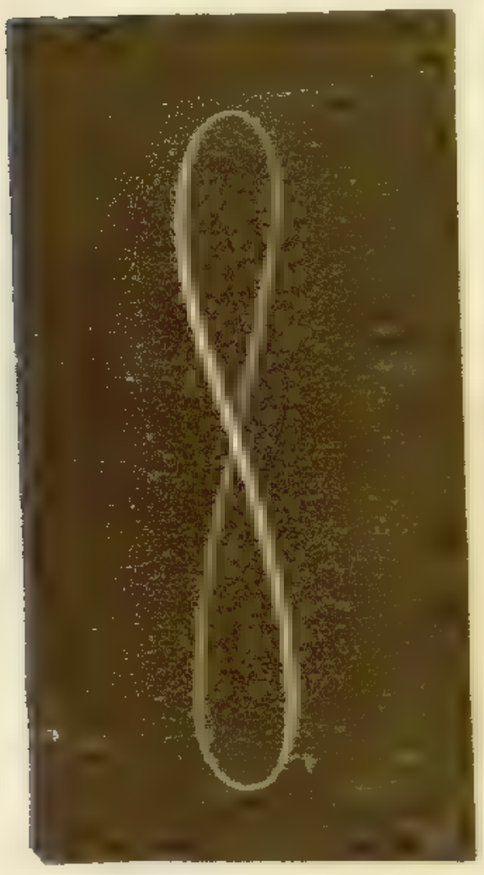
Who of us, as remarked to the translator by an eminent ornithologist, can even now explain the long sustained, peculiar flight of the hawk, or turkey buzzard, as it sails in the air without changing the position of its wings? and, we would add, the somewhat similar flight of a butterfly? It is the poetry of motion, and a marvellous exhibition of grace and ease, combined with a wonderful underlying strength and lightness of the parts concerned in flight.

Before we give a partial account of the results obtained by the delicate experiments of Professor Marey, our readers should be reminded of the great differences between an insect and a bird, remembering that the former is, in brief, a chitinous sac, so to speak, or rather a series of three such spherical or elliptical sacs (the head, thorax and abdomen); the outer walls of the body forming a solid but light crust, to which are attached broad, membranous wings, the wing being a sort of membranous bag stretched over a framework of hollow tubes, so disposed as to give the greatest

lightness and strength to the wing. The wings are moved by powerful muscles of flight, filling up the cavity of the thorax, just as the muscles are largest about the thorax of a bird. Moreover in the body of insects that fly (such as the bee, cock-chafer and dragon fly), as distinguished from those that creep exclusively, the air tubes (tracheæ) which ramify into every part of the body, are dilated here and there, especially in the base of the abdomen, into large sacs, which are filled with air, when the insect is about to take flight, so that the specific gravity of the body is greatly diminished. Indeed, these air sacs, dilatable at will by the insect, may be compared to the swimming bladder of fishes, which enables them to rise and fall at will to different levels in the sea, thus effecting an immense saving of the labor of swimming. In the birds, as everybody knows who has eaten a chicken, or attended the dissection of a Thanksgiving turkey, the soft parts are external, attached to the bony framework comprising the skeleton, the wing bones being directly connected with the central back bone; so that while these two sorts of animated machines are so different in structure, they yet act in much the same manner when on the wing. The differences are clearly stated by Marey, some of whose conclusions we now give almost word for word.

The flight of butterflies and moths differs from that of a bird, in the almost vertical direction of the stroke of their wings, and in their faculty of sailing in the air without making any movements; though sometimes in the course they pursue, they seem to resemble birds in their flight.

Fig. 9.



The flight of insects and birds differs in the form of the trajectory of the wing in space; in the inclination of the plane in which the wings beat; in the rôle of each of the two alternating (and in an inverse sense) movements that the wings execute; as also in the facility with which the air is decomposed during these different movements. As the wings of a fly are adorned with a brilliant array of colors, we can follow the trajectory, or figure, that each wing writes in the air; it is of the form of a figure of eight (Fig. 9), first discovered by Professor J. Bell Pettigrew of Edinburgh.

By an ingenious machine specially devised for the purpose,

Marey found that a bird's wing moves in an ellipse, with a pointed summit (Fig. 10). The insect beats the air in a distinctly horizontal plane, but the bird in a vertical plane. The wing of an insect is impervious to the air; while the bird's wing resists the air only on its under side. Hence, there are two sorts of effects; in the insect, the up and down strokes are active; in the bird, the lowering of the wing is the only active period, though the return stroke seems to sustain the bird, the air acting on the wing. The bird's body is horizontal when the wing gives a downward stroke; but when the beat is upward, the bird is placed in an inclined plane like a winged projectile, and mounts up on the air by means of the inclined surfaces that it passively offers to the resistance of this fluid.

Fig. 10.



In an insect, an energetic movement is equally necessary to strike the air at both beats up and down. In the bird, on the contrary, one active beat, only, is necessary, the down beat. It creates at that time all the motive force that will be dispensed during the entire revolution of the wing. This difference is due to the difference in form of the wing. The difference between the two forms of flight is shown by an inspection of the two accompanying figures (11, 12). An insect's wing is small at the base and broad at the end. This breadth would be useless near the body, because at this point the wing does not move swiftly enough to strike the air effectively. The type of the insectean wing is destined, then, simply to strike the air. But in the bird the wing plays also a passive rôle, i. e., it receives the pressure of the air on its under side, when the bird is projected rapidly onward by its acquired swiftness. In these conditions the whole animal is carried onward in space; all the points of its wing have the same velocity (*vitesse*). The neighboring regions of the body are useful to press upon the air which acts as on a paper kite (*cerf-volant*). The base of the wing also in the bird, is broad and provided with feathers, which form a broad surface on

Fig. 11.



Trajectory of an insect's wing.

which the air presses with a force and method very efficacious in supporting the bird. Fig. 13 gives an idea of this disposition of the wing at the active and passive time in a bird.

The inner half of the wing is the passive part of the organ, while the external half, that which strikes the air, is the active part. A fly's wing makes 330 revolutions in a second, executing consequently 660 simple oscillations; it ought at each time to impress a lateral deviation of the body of the insect, and destroy the velocity that the preceding oscillation has given it in a contrary direction. So that by this hypothesis the insect in its flight only utilizes fifty to one hundred parts (or one half) of the resistance that the air furnishes it.

Fig. 12.



Trajectory of a bird's wing.

In the bird, at the moment of lowering the wings, the oblique plane which strikes the air in decomposing the resistance, produces a vertical component which resists the weight of the bird's body, and a horizontal component which imparts swiftness. The horizontal component is not lost, but is utilized during the rise of the wing, as in a paper kite when held in the air against the wind. Thus the bird utilizes seventy-five out of one hundred parts of the resistance that the air furnishes. The style of flight of birds, is, therefore, theoretically superior to that of insects. As to the division of the muscular force between the resistance of the air and the mass of the body of the bird, we should compare the exertion made in walking on sand, for example, as compared with walking on marble. This is easy to measure. When a fish strikes

Fig. 13.



the water with its tail to propel itself forward, it performs a double task; one part consists in pushing backwards a certain mass of water with a certain swiftness, and the other in pushing on the body in spite of the resistance of the surrounding fluid. This last portion of the task only is utilized. It would be greater if the tail of the fish encountered a solid object. Almost all the propelling agencies employed in navigation undergo this loss of labor (*travail*) which depends on the mobility of the *point d'appui*. The bird is placed among conditions especially unfavorable.

Professor Marey ends his first lecture with a discussion of the division of the muscular force between the resistance of the air and the mass of the body of the bird. His second and third lectures are on the resistance of the air, illustrated by mathematical and physical data, and the exhibition of his peculiar and delicate machinery for solving these problems by actual experiment.

REVIEWS.

The Geology and Physical Geography of Brazil.* — In gleaning after some of the most notable of the world's travellers who have visited Brazil, little enough would seem to be left for another explorer in the same field. By steadily pursuing, however, for the most part one line of study, though a most comprehensive one, our author as a geologist has brought together in this readable book a simple, clear, philosophic account of Brazilian geology in its widest sense, which, while doing justice to the preceding writers, contains a vast deal of novel information and does decided credit to American geographical and geological science. Our really good, carefully prepared books of travel can be counted on the fingers' ends. This new candidate for favor may well be included among the select few. In Humboldt's famous "Travels" and "Views of Nature" we have the results of years of travel by a natural philosopher; in Bates's and Wallace's narra-

*Thayer Expedition. Scientific Results of a Journey in Brazil. By Louis Agassiz and his travelling Companions. Geology and Physical Geography of Brazil. By Professor C. F. Hartt. With illustrations and maps. Boston: Fields, Osgood & Co., 1870. 8vo, pp. 620. $5.00.

tives we receive the impressions of single-minded zoologists as to the natural scenery, the customs of the people, the habits and strange ways of beasts, birds and insects; the works of Herndon, Gibbon, and Orton, are contributions to the geography of the Amazon valley; and in Fletcher and Kidder, and Burton, we see the human aspect of Brazilian life. To fill up these sketches, more or less fragmentary and random, we need a faithful study by a master with the details elaborated with scrupulous care.

To begin with, we need to know how the South American continent was built up, and the history of the changes by which it became so rich and fertile, as well as the physical and climatic peculiarities which have determined the genius of its inhabitants, and will hereafter influence their progress in civilization. The materials for such a work have been most industriously gathered by Professor Agassiz and his assistants, and the present volume, which we owe primarily to the liberal spirit of Mr. Thayer, and to Professor Hartt's ardor in making a second, independent visit, assisted by generous friends in New York, is the first fruits of these new explorations.

The volume before us does not touch specially upon the physical geology of the Brazilian Andes and head waters of the Amazon. The author confines his studies mainly to the geology and geography of the coast provinces from Rio de Janeiro to Pernambuco. Meanwhile, he gives the results of others who have written on the geology of the whole empire, so that the work gradually and naturally enough expanded into a general view of the subject. As a necessary part of the author's especial researches, the marine fauna of the shores between Rio and Pernambuco was quite fully investigated, and the animals collected were placed in the hands of experts for identification. Coral reefs of considerable extent were discovered midway between the cities of Rio and Bahia, the few reef-building species of corals being closely allied to those of the West Indies, while the crabs, star-fishes and sea-urchins scattered over the reefs were largely West Indian species, showing that the whole assemblage of these animals was a southerly extension of the West Indian fauna. Indeed, there is scarcely a break in the continuity of life as we go from the peninsula of Florida to Cape Frio. The differences between the two extremes are often great, but the passage from the one to the other is graduated. The two American continents grew up like

twin brothers under the same laws, and with the same treatment at nature's hands, and stand to-day not rivals, but complements of each other. We do not find those strong contrasts in their physical and biological features, that we do in the opposing lands of Asia and Australia, where two continents almost join hands, and yet are most strangely opposed.

For instance, Professor Hartt, seconded by the decision of Dr. Sterry Hunt, finds that the fundamental gneiss rocks of Brazil are the exact repetition of the Laurentian rocks of Labrador, Canada and the Adirondacks. The gold bearing rocks of the province of Minas, of probable Lower Silurian age repeat (oddly enough even to their geographical names) the characters of the auriferous strata lying about the basin of Minas in Nova Scotia. "The coal basins lie just south of the tropics, but within the range of the palm, and they are a coast formation, corresponding in this respect to the coal basins of Acadia, Massachusetts and Rhode Island." To continue the wonderful parallelism, at a later chapter in the geological history of Brazil, the Triassic Period, were deposited rocks agreeing precisely in physical characters with the New Red sandstones of the Connecticut valley. The Cretaceous rocks embrace species of Ammonites considered by Prof. A. Hyatt as identical with Texan forms, which flourished on both sides of the Andes-Rocky Mountain chain, and lived in a sea which covered Brazil, Peru, and Texas alike, before the appearance of the Isthmus of Panama. The reptilian remains examined by Professor O. C. Marsh indicate crocodiles and gavials and others of the same genera as those found in the marls of New Jersey. The Tertiary clays and sands are less like those of other lands, so far as regards their fossils, the types being more specialized, ushering in the present tropical life of Brazil.

The close analogy to the geological history of our northern continent, is, in the author's view, farther carried out by Agassiz's supposition of a continental Brazilian glacier. Here geologists differ, and most of them dissent from such a startling view. Professors Agassiz and Hartt do not know otherwise how to account for the presence of their "unstratified" "drift" clays and sands, often gold bearing, which are spread over the whole coast area from Rio to Pernambuco, and "in the valley of the Amazonas westward to the confines of Peru." Geologists will more generally credit the truth of the theory of the glacial origin of this thin

sheet of clay and sand, when the rocks beneath are found to be grooved and polished, when the coast clays are found to contain glacial, arctic shells, and the transported boulders described by the authors are more numerous and unmistakably of ice origin. But the grand objection to the theory of the former existence of a continental glacier in tropical America, is the unbroken continuity of tropical life since the close of the Tertiary period. While the coral reefs of Florida were slowly rising above the waves of a heated, equatorial sea, the waters of New York bay, and Massachusetts bay were the home of the walrus, the great auk, and the arctic seals, and the ocean depths were peopled with a truly arctic assemblage of animals and plants. At Charleston, however, the seas, as indicated by the fossils of the post-tertiary period, were not much colder than now, and the Floridian fauna was as tropical as now. Meanwhile in Brazil flourished giant sloths, and other quadrupeds, which roamed over the Pampas, while their ally, the Hairy Mammoth, braved the snows of the northern woods and prairies. It would be difficult for us to imagine that the valley of the Amazon differed so greatly in its climate at that time, and not leave behind the usual marks (at least more than Agassiz and Hartt here indicate) of an ice period. The deposit of Tertiary shells at Pebas, about two thousand miles from the mouth of the Amazon, described by Conrad, and discovered by Professor Orton in Professor Agassiz's Amazonian "drift," must effectually settle the question of the Amazonian beds at least. There may have been local glaciers on the Organ mountains about Rio.

An interesting sketch of the Botocudos, a very degraded Indian tribe, without a belief in a supreme God, is appended to Mr. Hartt's narrative, of which we would not take leave without referring to its value to the colonist and capitalist, from its full accounts of gold and diamond mines, and other natural productions. The Brazilians will remain under lasting obligation to the author, who has given them a most compact and accurate account of the geology and mineral wealth of their magnificent country. Since its publication, Professor Hartt has led a new expedition to Brazil, accompanied by a large corps of assistants, to make fresh explorations about the mouth of the Amazon. The Emperor of Brazil, who has already done so much towards developing the natural resources of his empire, might do much for its advancement by instituting a geological survey under the direction of one so familiar with the subject as our author.

THE CLASSIFICATION OF THE EARED SEALS.—In the review of my paper on the "Eared Seals"* by Dr. Theodore Gill, published in the January number of the NATURALIST.† I was pleased to see that this accomplished zoologist found in it a few things to commend, nor was I surprised to find, knowing his opinions previously, that on a few points we still somewhat differ. I regretted to observe, however, that notwithstanding his accustomed accuracy, Dr. Gill had, in the present article, fallen into several by no means unimportant errors. He quite severely criticises my provisional differentiation of the *Otariadæ* into two subfamily groups, and in so doing has not only questioned the value ascribed by me to the characters alleged to be distinctive of the two groups, but also the *existence of such distinctions*, at least to anything like the extent claimed for them.

The distinctions given as characteristic of the two groups were differences in the character of the pelage, in size, form, the relative length of the ear and the swimming membranes or toe-flaps. Without discussing here the taxonomic value of these distinctions, I propose to examine briefly whether any of them have been shown by Dr. Gill "to be *degraded to absolute nullity*."

First, in regard to the pelage. The *Oulophocinæ* were characterized as having "thick under fur," and the *Trichophocinæ* as being "without under fur." As showing that this character is not a trenchant one, Dr. Gill cites the observation of Dr. Peters that the *Arctocephalus antarcticus* (*Otaria pusilla* Peters) has very thin under fur, and the remark of Dr. Gray that in *Zalophus lobatus* (*Z. cinereus* Gill) the young are "covered with soft fur which falls off when the next coat of fur is developed," both of which objections I had already noticed.‡ To go over the ground again, however, I may state that since Dr. Peters wrote, it has been ascertained that both the *Arctocephalus antarcticus* and the *A. cinereus* are richly provided with under fur, so well so, at least, that these animals are pursued for their fur, which forms an article of high commercial value.§ The remark respecting the tem-

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* Bulletin of the Museum of Comparative Zoology, Vol. II, pp. 1–108. 1870.

† Vol. IV, pp. 675–684.

‡ Bull. Mus. Comp. Zool., Vol. II, p. 41.

§ Ann. and Mag. Nat. Hist., 4th ser., Vol. I, p. 219, March, 1868. Dr. Gray describes the *A. cinereus* as having the "under fur abundant" (Ann. and Mag. Nat. Hist., 3d ser. Vol. XVIII, p. 236, 1868), which remark is confirmed by a young specimen of this animal in the Museum of Comparative Zoology.

porary under fur possessed by the young of *Zalophus lobatus* was made nearly half a century ago, and though often quoted since, has never yet been confirmed, so far at least as I have been able to ascertain. Since such a fact, however, would be contrary to analogy, to say the least, the accuracy of this observation seems to require confirmation. While in the hair seals the homologue of the under fur of the fur seals *may* be considered to exist in the short, stiff, crisp under hairs, — which are so few as only to be discovered by the most careful search, at least in old males of *Eumetopias*, and apparently also in *Otaria* and *Zalophus*, — they do not accord at all in their nature with the fine, soft, abundant, silky under fur of the fur seals. The under fur of the fur seals is known to vary more or less in amount with the season, which variations may have given rise to the observations of Dr. Peters cited by Dr. Gill.

In regard to size, the hair seals were characterized as "large," and the fur seals as "smaller." As the representatives of *Otaria* and *Eumetopias* are several times larger, in respect to bulk, than any of the representatives of either *Callorhinus* or *Arctocephalus*, and the representatives of *Zalophus* are considerably larger than any of the fur seals, I fail to see that the difference in size "seems to be more than reduced to a minimum and to be degraded to absolute nullity."

In regard to form, the fur seals were described by me as being "more slender" than the hair seals. This observation was based upon a comparison of the skeletons of two of the leading genera — *Eumetopias* and *Callorhinus* — and the figures and descriptions of the other species. Not only are all the bones smaller in comparison to their length in *Callorhinus* than in *Eumetopias*, but the limbs are also slenderer and longer in proportion to the size of the body. In the comparison Dr. Gill has attempted to make, in his review, of the form of *Eumetopias* with that of *Callorhinus*, in order to determine whether there was any difference in form in the two groups, a singularly improper basis was adopted, namely, the "ratio of the skull to the length of the male skin." His rather obscure comparative table serves only to represent the individual variation in the specimens of the same species, as exaggerated in stuffed specimens. Had he computed the ratio the length of the skull bears to that of the whole skeleton, data equally at his command, instead of between the skulls and skins, his table

would have had some value as showing the variation in respect to this ratio that obtains between specimens of the same species. But the idea of determining the relative slenderness of two animals by the number of times the length of the head is contained in the total length of the body, is, to say the least, a novel one to me, since slenderness and robustness of form usually involve, as is well known, the head as well as the trunk, as a little reflection will doubtless at once convince my reviewer. That the expression "'form more slender' of the former [*Otolophorinæ*] implies a greater relative total length for these animals *than the head alone would indicate*," is an announcement for which I was quite unprepared.

In regard to the length of the ear in the two groups, it appears that Dr. Gill has also been unfortunate in his generalizations. According to his quoted measurements, the ear in the longest-eared species of the hair seals (*Eumetopias*) scarcely equals that of the shortest-eared species of the fur seals, but he seems to have forgotten that the bulk of *Eumetopias* is several times that of the largest of the fur seals, so that while the ear is absolutely but little longer in the fur seals than in the longest-eared hair seals, it **is relatively very much longer.**

Having said this much in regard to the validity of the characters I gave as distinctive of these two groups, I desire to add a word in respect to the matter of "conservatism." Dr. Gill says, "In the case of doubtful species — at least of those which have *tangible characters*, but the value of which may be dubious — some naturalists refer such at once to species which they appear in their judgment to most resemble, while others — probably most — retain them with reserve, awaiting future information. Of the former school, Mr. Allen is an ardent disciple, and finding a certain range of variation in some known form, he concludes that analogous variations are only of like value." In reply to this, I will only say that my practice is to never reduce to a synonyme any species presenting "tangible characters," or even those which appear to have such characters, or where the probability seems to be that it may be distinct, though not as yet properly characterized. When no evidence of the validity of a given species has been advanced, which in the light of present facts can be so considered. I deem it subservient to the interests of science to refer them to the species to which they seem evidently to belong; as in no

other way will their true character be more likely to be eventually made evident; for those authors who have recognized them as valid will be likely to reinvestigate the subject before submitting to their being dropped from our systems. All zoologists, I think, will admit that the tendency is to a multiplication of nominal species; and all likewise know how difficult it is to eradicate a nominal species from our systems. Probably few naturalists now doubt that many currently received species rest solely on characters of individual variation, and it seems to me unwise to retain such species as are unquestionably of this character in the hope that through some fortunate circumstance they may be some day proved valid. It seems to me impossible, in fact, that any one who has compared a large number of specimens of any well known species with each other, can resist the conviction that, as the number of specimens in our museums increases, the number of species will be greatly reduced, notwithstanding that in the mean time not a few really new ones may be discovered. I have myself found that the more common species of both the birds and mammals of eastern North America—of which I have examined, in many instances, hundreds of specimens of each—vary in size, and even in proportions, in specimens from the same locality and of the same sex, from twelve to twenty per cent. of their average size and form for that locality, and to a corresponding extent in color. Add to this the normal range of the geographical variation each species exhibits, which ordinarily fully equals that of the individual variation,* and it becomes at once evident that with the custom of zoologists to describe species from a single specimen, and often an imperfect one, and their usual want of familiarity with the extent of variation within specific limits in the common species of their own country, the liabilities to an undue multiplication of species have been, and still are, very great. This to many may be a matter of small moment, but to the philosophical zoologist, who desires to carefully investigate the varied phenomena of animal life, it is one of high importance.

Having said thus much in reply to the strictures of Dr. Gill, I now reluctantly turn critic, and pass in review the classification of

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*See on this subject a paper in the Bulletin of the Museum of Comparative Zoology (Vol. II, pp. 186–250) entitled, "On the Individual and Geographical Variation among Birds, considered in Respect to its Bearing upon the Value of Certain Assumed Specific Characters."

the eared seals proposed by this author in his above-cited paper. While still agreeing with him in regard to the comparatively wide separation of *Zalophus* from its nearest allies, and in regard to its being intermediate between the fur and other hair seals in respect to size, but only in this point, I am compelled to still differ with him in respect to its constituting a primary group coördinate with that of all the other eared seals.* Whilst a somewhat aberrant form, it seems to me to be by no means very far removed from *Eumetopias* and *Otaria*. I can, in fact, scarcely comprehend how it has happened that the author in question has overlooked the presence of a well developed sagittal crest in all the genera of the *Otariadæ* except *Zalophus*, as he seems to have done in the differentiation of his two primary groups of this family. The supposition that he has examined only the skulls of females or young males of the other genera is hardly sufficient to explain this oversight, since figures indicating its presence in the males of the other genera have been long published, to say nothing of the many distinct allusions to it by authors. While familiar with the distinctive characters of *Zalophus*, he has failed to indicate them in his diagnoses, the comparatively unimportant character furnished by the rostral outline being far less characteristic than its slender elongated muzzle and other features, which had previously been well pointed out by Dr. Gill, as well as by other writers. The sagittal crest reaches, it is true, its maximum development in *Zalophus;* but any one who has seen the high sagittal crest possessed by old males of *Eumetopias Stelleri*, in which as a thin solid plate it attains the height of 38 mm., or an inch and a half; and the relatively scarcely less developed sagittal crest in old males of *Callorhinus ursinus;* and the figure of old male skulls of *Otaria jubata*, and some of the species of *Arctocephalus*, in which a high sagittal crest is represented; cannot but be surprised to find in what is assumed to be an enumeration of "the most obvious and distinctive characters" of the genera *Callorhinus*, *Arctocephalus*, *Otaria* and *Eumetopias*, a diagnosis contrasting "a sagittal groove from which are reflected the low ridges indicating the limits of the temporal muscles" in these genera, with "a solid, thin, and much elevated sagittal crest" in *Zalophus!* The females of *Callorhinus ursinus* and *Otaria jubata*, and, so far as at present known, of all

*See American Naturalist, Vol. IV, p. 681.

the eared seals, have the "sagittal groove," etc., as above described, as do also the males till they have attained nearly their full size. The sagittal crest in the males of *Eumetopias* and *Callorhinus* rises at first as a double ridge on each side of the sagittal suture, beginning at the hinder part of the skull. It develops most rapidly in its posterior part, and gradually extends anteriorly to a point opposite the orbital processes. Gradually the laminæ of this double plate become soldered into one, uniting first posteriorly, while anteriorly the crest remains composed of two closely applied thin plates, which, in old age, become firmly united the whole length. The sagittal crest in old male skulls of *Zalophus* hence differs from the corresponding crest in *Eumetopias* and *Callorhinus*, only in being relatively somewhat higher, and in being more produced anteriorly. I am not sure, however, that in very aged animals even this slight difference would be constant. In one of the skulls of *Zalophus* I have seen, the two plates were not entirely soldered at their anterior end, thus indicating their development primarily as a double plate, as in *Eumetopias* and *Callorhinus*. The only other character given as separating these two groups—that of the rostral profile—I deem too trivial to require more than the incidental remark already given to it.

In concluding, I may add that the deservedly high standing of my critic as a naturalist seemed to demand from me, in justice to myself, some notice of his sweeping criticisms, especially since not merely the assumed value of the characters given by me as distinguishing what I considered to be two primary groups of the *Otariidæ* were questioned, but also even the existence of such distinctions; but more especially it was due to the interests of science that his incorrect diagnosis of one of the two groups he considers as the two primary groups of this family, should not pass unnoticed, since on this error was based a new classification of the *Otariidæ*. Having done this, the writer will here let the subject rest.—**J. A. A.**

The Early Stages of Ichneumon Parasites.*—These embryological studies were made by Prof. Ganin on the eggs of Platygaster, Polynema, Teleas and Ophioneurus, which are minute

*Beiträge zur Erkenntniss der Entwickelungsgeschichte bei den Insecten. Von M. Ganin, aus Charkow. Siebold and Kölliker's Zeitschrift. 1869. pp. 381–451, with 4 plates. Leipzig.

ichneumon egg-parasites of the hymenopterous family Proctotrypidæ, of which the Platygaster of the Canker worm (Fig. 14) and *Platygaster error* Fitch (Fig. 15, copied from the "Guide to the Study of Insects") are familiar examples. It has been generally supposed that the larvæ of these egg-parasites were little footless, white maggots, like the young of other ichneumon flies. In the valuable and well illustrated memoir before us, however, the author, a Russian professor who pursued these studies under the direction of the distinguished Leuckart of Giessen, shows that the insects pass through a series of remarkable changes before assuming the final, and more normal larval state, the series of changes indicating a succession of metamorphoses, comparable, as Ganin says, to the hyper-metamorphosis of Meloë and Sitaris.

Fig. 14.



Egg-parasite of Canker Worm.

The earliest stages of the embryo of Platygaster were observed in the youngest specimens of Cecidomyia larvæ, or dipterous gall maggots, which live exposed on young willow leaves. The female sometimes lays from twelve to fifteen eggs in the body of the larval Cecidomyia, though usually not so many. When they are numerous they are not all laid at one time, as the embryos are found to be in different stages of development. Usually only one out of the whole number of embryos leaves the body of its host as a fly. The eggs are generally laid in the masses of cells composing the "fatty body," and in the interior of (or beneath, *in innere*) the supracesophageal ganglion of the Cecidomyia larva. Not one species only, but sometimes three species of Platygaster oviposited in the body of a single gall-fly maggot. These differed from each other in the size of the egg, and very strikingly in the form of their first larval stages. One of these Platygasters lays its eggs (from one to six) almost exclusively in the intestines of the gall maggot. The eggs of the other species of Platygaster are usually found in the body-cavity of their host. It is sometimes impossible to find a Cecidomyia larva which is not infested by these parasites. The death of the host occurs shortly

Fig. 15.



Platygaster error.

before pupation, at least Ganin could never find any Platygaster in any other situation than in the larva of Cecidomyia.

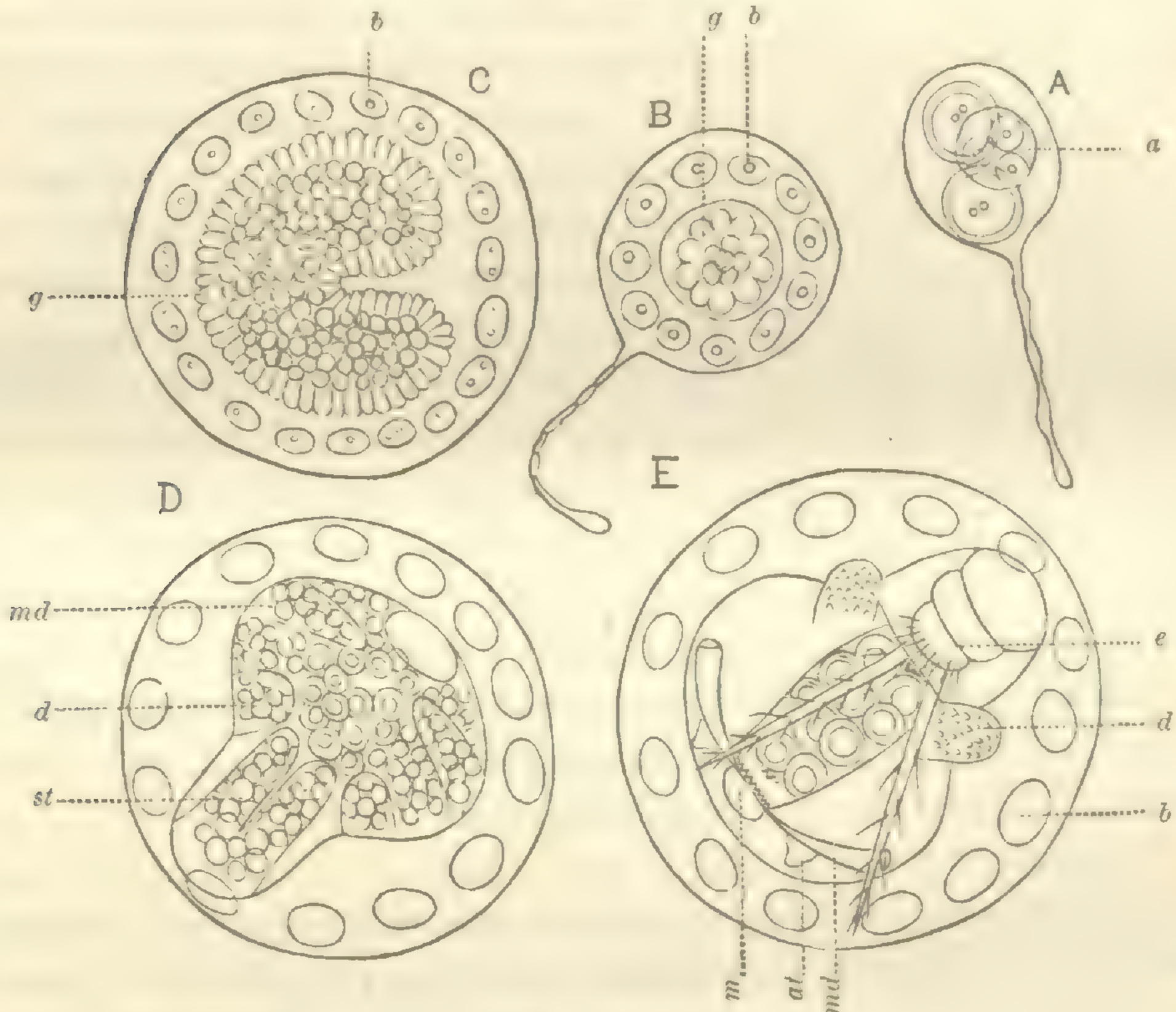
The eggs of Platygaster taken from the ovary of a female two or three days after leaving the pupa, are long, oval, with a long thin stalk, and a very elastic shell (chorion). During the development of the embryo the egg increases in size from ten to fifteen times its original bulk. The eggs of this and the other genera mentioned below, differ from those of other insects in wanting the nutrient yolk-cells (ernährungsdotter). The entire egg consists of the formative yolk-cells (bildungsdotter). This formative yolk appears as a pale, thick, structureless protoplasm, in which the so-called yolk cellules, or nuclei (dotterkörnchen), are wanting. In the central part of the egg we find in the direction of its longer axis, a considerable number of transparent molecular cellules; but at the periphery of the egg, these most minute of all organized histological structures are wanting. The protoplasm of the egg is wholly structureless.

The ovarian egg is formed by the growth of a cell lying at the hinder pole of the egg tube. This egg-cell has at first no membrane; its transparent, viscid protoplasm gives origin to the yolk. The small, sharply contoured nucleus of the egg is no other than the primitive vesicle of the egg. The primitive vesicle disappears when the imago leaves the pupa. Its ground substance, as also that of the granular portion, resembling the white of an egg, is converted into a fine, molecular mass, which is found in the central part of the ripe egg. The number of egg tubes in each ovary is thirty, corresponding to the number of eggs in each tube. The ovary of Platygaster differs from that of all other insects in that it is a closed tube, or sac. Hence it follows that at every time an egg is laid, the egg tube is ruptured. This was also observed in the Sheep tick (Melophagus) by Leuckart, and in certain flies (Limnobia, Psychoda, and Myetobia) by Ganin.

The earliest stage observed after the egg is laid, is that in which the egg contains a single cell with a nucleus and nucleolus. Out of this cell (Fig. 16 *A*, *a*) arise two other cells. The central cell (*a*) gives origin to the embryo. The two outer ones multiply by subdivision and form the embryonal membrane, or "amnion," which is a provisional envelope and does not assist in building up the body of the germ. The central single cell, however, multiplies by the subdivision of its nucleus, thus building up the body of the

germ. Fig. 16 *B*, *g*, shows the yolk or germ just forming out of the nuclei (*a*) ; and *b*, the peripheral cells of the blastoderm skin, or "amnion." Fig. 16 *C* shows the yolk transformed into the embryo (*g*), with the outer layer of blastodermic cells (*b*). The body of the germ is infolded, so that the embryo appears bent on itself. Fig. 16 *D* shows the embryo much farther advanced, with the two pairs of lobes (*md*, rudimentary mandibles ; *d*, rudimentary pad-like organs, seen in a more advanced stage in *E*), and the bilobate tail

Fig. 16.



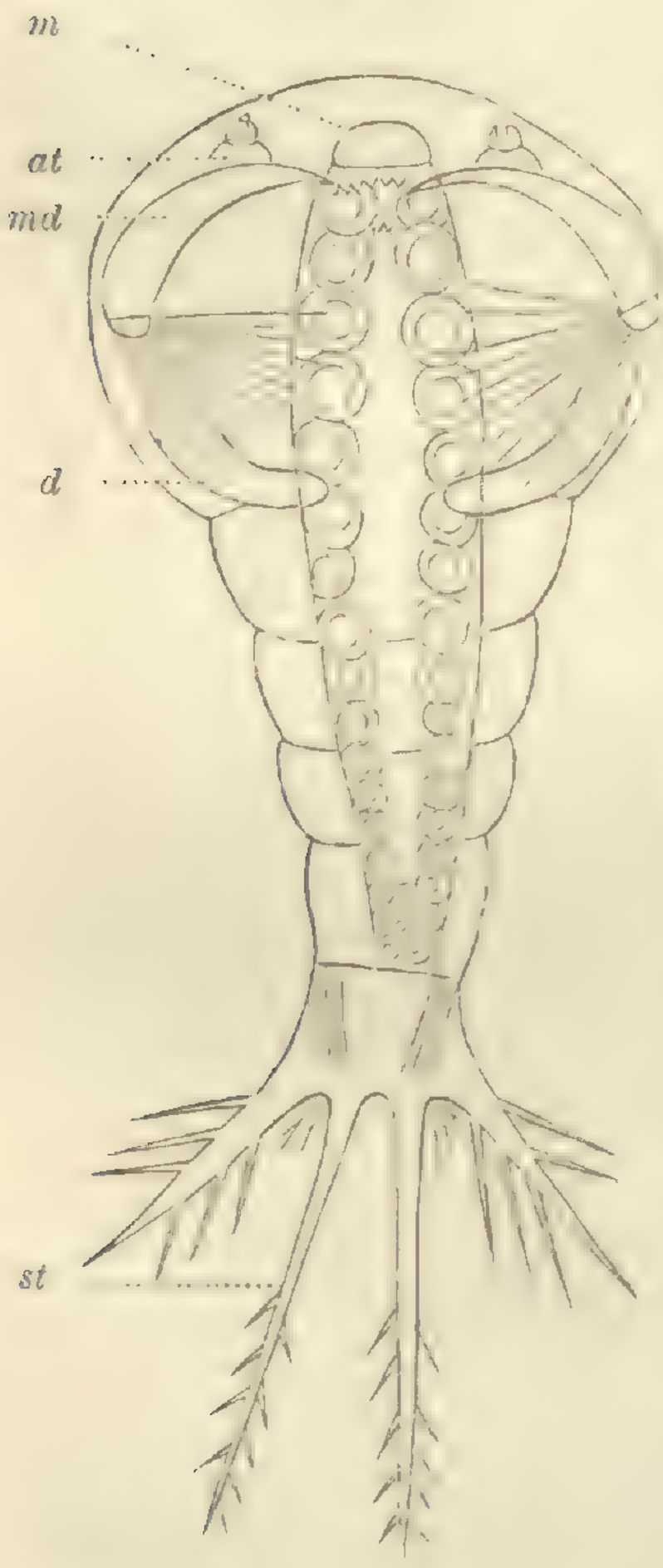
Development of Egg-parasite Platygaster.

(*st*). Fig. 17 (*m*, mouth ; *at*, rudimentary antennæ ; *md*, mandibles ; *d*, tongue-like appendages ; *st*, anal stylets ; the subject of this figure is of a different species from the insect previously figured, which, however, it closely resembles) shows the first larva stage after leaving the egg. This strange form, the author remarks, would scarcely be thought an insect, were not its origin and farther development known, but rather a parasitic Copepodous crustacean, whence he calls this the *Cyclops-like stage*. In this condition it clings to the inside of its host by means of its hook-like jaws (*md*), moving about like a Cestodes embryo with its

well known six hooks. The tail moves up and down, and is of but little assistance in its efforts to change its place. Singularly enough, the nervous, vascular, and respiratory systems (tracheæ) are wanting, and the alimentary canal is a blind sac, remaining in an indifferent, or unorganized state. How long it remains in this stage could not be ascertained.

The second larval stage (Fig. 18; *œ*, œsophagus; *ng*, supraœsophageal ganglion; *n*, nervous cord; *ga*, and *g*, genital organs; *ms*, bands of muscles) is attained by means of a moult, as usual in the metamorphoses of insects. With the change of skin the larva entirely changes its form. So-called hypodermic cells are developed. The singular tail is dropped, the segments of the body disappear, and the body grows oval, while within begins a series of remarkable changes, like the ordinary development of the embryo of most other insects within the egg. The cells of the hypodermis multiply greatly, and lie one above the other in numerous layers. They give rise to a special primitive organ closely resembling the "primitive band" of all insect embryos. The alimentary canal is made anew, and the nervous and vascular systems now appear, but the tracheæ are not yet formed. It remains in this state for a much longer period than in the previous stage.

Fig. 17.



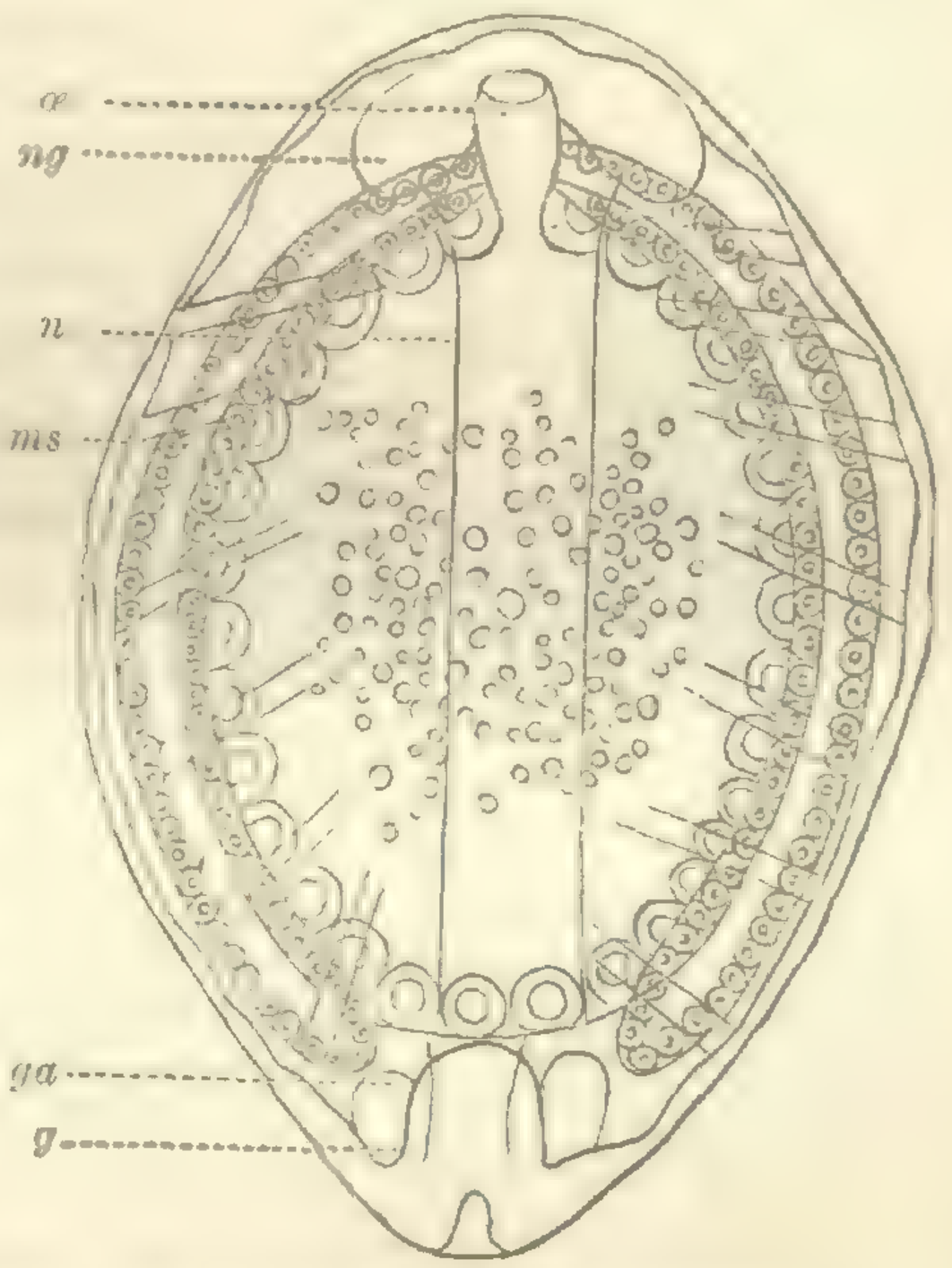
First larva of Platygaster.

The third larval form only a few live to reach. This is of the usual long, oval form of the larvæ of ichneumons, and the body has thirteen segments exclusive of the head. The muscular system has greatly developed and the larva is much more lively in its motions than before. The new organs that develop are the air tubes and fat bodies. The "imaginal discs" or rudimentary portions destined to develop and form the skin of the adult, or imago, arise in the pupa state, which resembles that of other ichneumons. These discs are only engaged, in Platygaster, in building up the rudi-

mentary appendages, while in the flies (Muscidæ and Corethra) they build up the whole body, according to the remarkable discovery of Weismann.

The origin of the sting is clearly ascertained. Ganin shows that it consists of three pairs of tubercles, situated respectively on the 7th, 8th, and 9th segments of the abdomen* (Fig. 19, *tg*). The labium is not developed from a pair of tubercles, as is usual, but at once appears as an unpaired, or single, organ. The pupa state lasts for five or six days, and when the imago appears it eats its way out through a small round opening in the end of the skin of its host, the Cecidomyia larva.

Fig. 18.



Second larva of Platygaster.

Not less interesting is the history of the development of a species of Polynema, another egg-parasite, which lays its eggs (one, seldom two) in the eggs of a small dragon fly, *Agrion virgo*, which oviposits in the parenchyma of the leaves of water-lilies (Nymphæa). The eggs develop as in Platygaster. The earliest stage of the embryo is very remarkable. It leaves the egg when very small and immovable, and with scarcely a trace of organization, being a mere flask-shaped sac of cells.† It remains in this state five or six days.

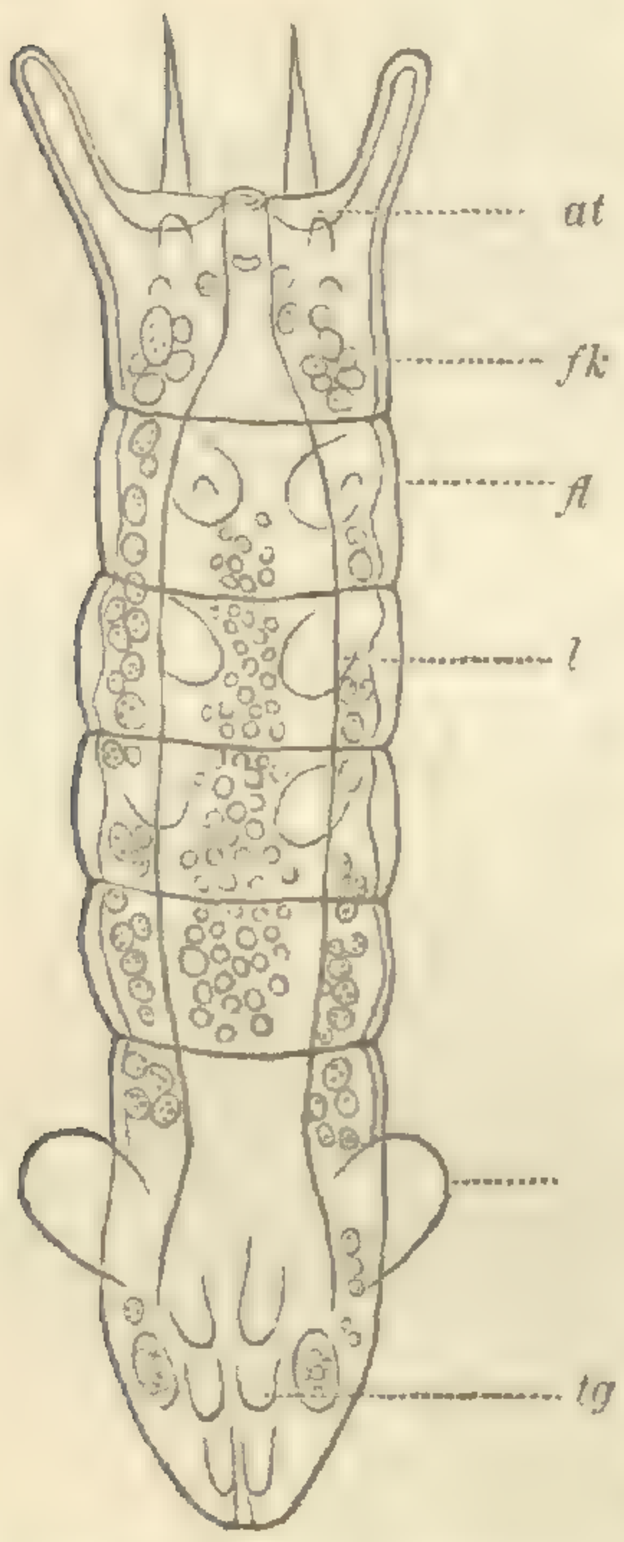
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* The reviewer, in his "Guide to the Study of Insects," p. 14, and previously, in the Proceedings of the Boston Society of Natural History, vol. xi. p. 393, 1868, has shown that the ovipositor of Bombus arises from three pairs of tubercles like those figured by Ganin, but the two anterior pairs are represented as both arising from the same (penultimate) segment of the abdomen. It is not improbable that at an earlier period each pair arises from a separate segment, as in Platygaster. Later studies have convinced the reviewer that these organs are homologous with the abdominal jointed stylets of many insects, and consequently with the legs and appendages of the mouth; and even with the "spring" of Poduræ.

†This reminds us (though Ganin does not mention it) of the development of the embryo of Julus, the Thousand legs, which, according to Newport, hatches the 25th day after the egg is laid. At this period the embryo is partially organized, having faint traces of segments, and it is still enveloped in its embryonal membranes and retains its connection with the shell. In this condition it remains for seventeen days, when it throws off its embryonal membrane, and becomes detached from the shell.

In the second stage, or Histriobdella-like form, the larva is, in its general appearance, like the low worm to which Ganin compares it. It may be described as bearing a general resemblance to the third and fully developed larval form (Fig. 19, *tg*, three pairs of abdominal tubercles destined to form the sting; *l*, rudiments of the legs; *fk*, portion of the fatty body; *at*, rudiments of the antennæ; *fl*, imaginal discs, or rudiments of the wings). No tracheæ are developed in the larva, nor do any exist in the imago (Ganin thinks, that as these insects are somewhat aquatic, the adult insects flying over the surface of the water, the wings may act as respiratory organs, like gills.) It lives six to seven days before pupating, and remains from ten to twelve days in the pupa state.

Fig. 19.



First larva of Polynema.

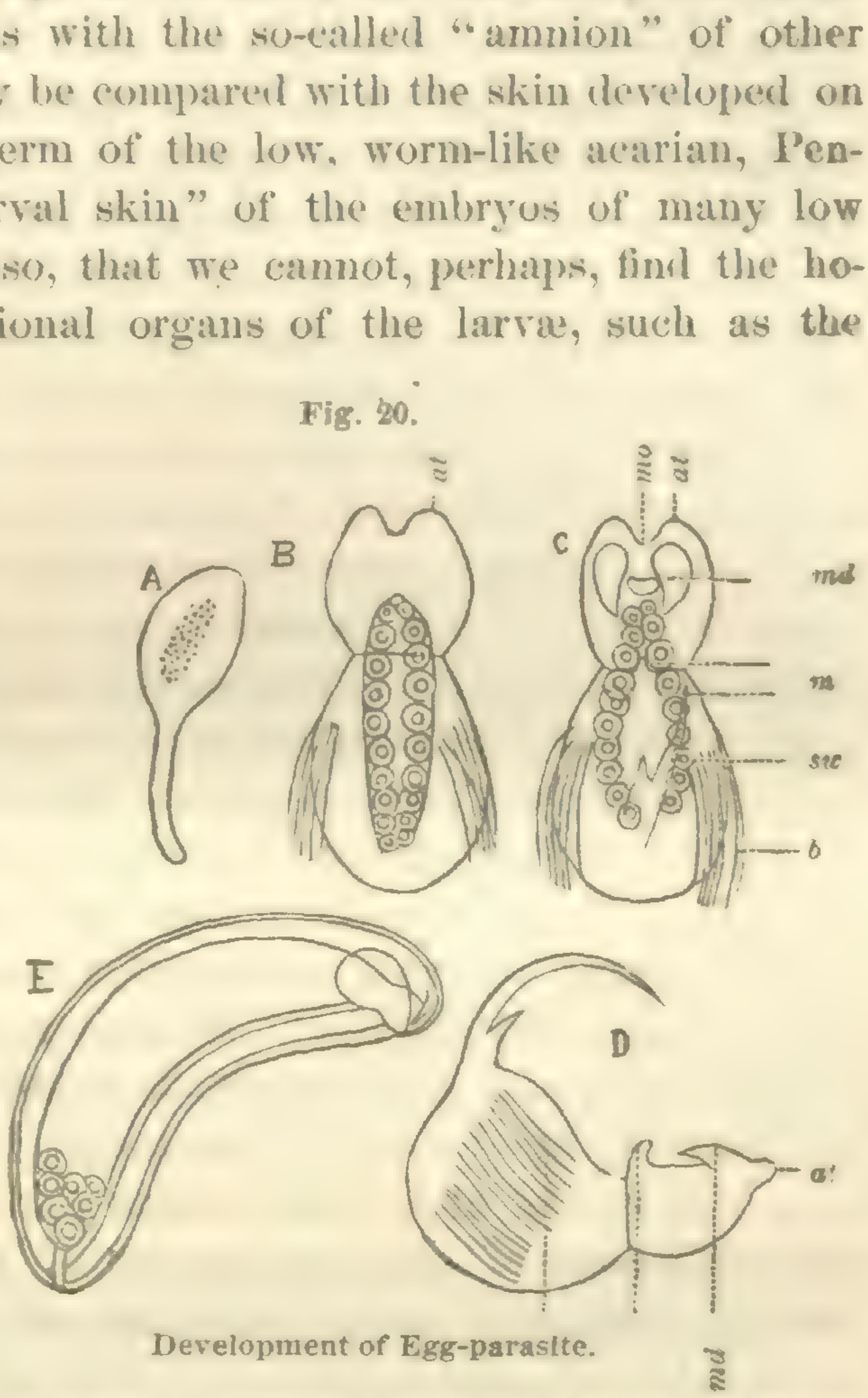
The development of Ophioneurus, another egg-parasite, agrees with that of Platygaster and Polynema. This egg-parasite passes its early life in the eggs of *Pieris brassicæ*, and two or three live to reach the imago state, though about six eggs are deposited by the female. The eggs are oval, and not stalked. The larva is at first of the form indicated by Fig. 20 *E*, and when fully grown becomes of a broad oval form, the body not being divided into segments. It differs from the genera already mentioned, in remaining within its egg membrane, and not assuming their strange forms. From the non-segmented, sac-like larva, it passes directly into the pupa state.

The last egg-parasite noticed by Ganin, is Teleas, whose development resembles that of Platygaster. It is a parasite in the eggs of Gerris, the Water Boatman. Fig. 20 *A* represents the egg; *B*, *C*, and *D*, the first stage of the larva, the abdomen (or posterior division of the body) being furnished with a series of bristles on each side. (*B* represents the ventral, *C* the dorsal, and *D* the profile view; *at*, antennæ; *md*, hook-like mandibles: *mo*, mouth; *b*, bristles; *m*, intestine; *se*, the tail; *ul*, under lip, or labium). In the second larval stage, which is oval in form, and non-segmented, the primitive band is formed.

In concluding the account of his remarkable discoveries, Ganin

draws attention to the great differences in the formation of the egg and the germ of these parasites from what occurs in other insects. The egg has no nutritive cells; the formation of the primitive band, usually the first indication of the germ, is retarded till the second larval stage is attained; and the embryonal membrane is not homologous with the so-called "amnion" of other insects, but may possibly be compared with the skin developed on the upper side of the germ of the low, worm-like acarian, Pentastomum, and the "larval skin" of the embryos of many low Crustacea. He says, also, that we cannot, perhaps, find the homologues of the provisional organs of the larvæ, such as the singularly shaped antennæ, the claw-like mandibles, the tongue- or ear-like appendages, in other Arthropoda (insects and Crustacea); but that they may be found in the parasitic Lernean crustaceans, and in the leeches, such as Histriobdella. He is also struck by the similarity in the development of these egg-parasites to that of a kind of leech (Nephelis), the embryo of which is provided with ciliæ, recalling the larva of Teleas (Fig. *B*, *C*,), while in the true leeches (Hirudo) the primitive band is not developed until after they have passed through a provisional larval stage.

Fig. 20.



Development of Egg-parasite.

This complicated metamorphosis of the egg-parasites, Ganin also compares to the so-called "hyper-metamorphosis" of certain insects (Meloe, Sitaris, and the Stylopidæ) made known by Siebold, Newport and Fabre, and he considers it to be of the same nature.

He also, in closing, compares such early larval forms as those given in Figs. 17 and 19 to the free swimming Copepoda. Finally, he says a few words on the theory of evolution, and remarks

"there is no doubt that, if a solution of the questions arising concerning the genealogical relations of different animals among themselves is possible, comparative embryology will afford the first and truest principles." He modestly suggests that the facts presented in his paper will widen our views on the genetic relations of the insects to other animals, and refers to the opinion first expressed by Fritz Müller (Für Darwin, p. 91), and endorsed by Hæckel in his "Generelle Morphologie," that we must seek for the ancestors of insects and Arachnida in the Zoëa form of Crustacea. He cautiously remarks, however, that "the embryos and larvæ observed by me in the egg-parasites, open up a new and wide field for a whole series of such considerations; but I will suppress them, since I am firmly convinced that a theory which I build up to-day, can easily be destroyed with some few facts which I learn to-morrow. Since comparative embryology as a science does not yet exist, so do I think that all genetic theories are too premature. and without a strong scientific foundation."

The reviewer is perhaps less cautious, but he cannot refrain from making some reflections suggested by the remarkable discoveries of Ganin. In the first place, these facts bear strongly on Cope and Hyatt's theory of evolution by "acceleration and retardation." In the history of these early larval stages we see a remarkable acceleration, or hurrying up, of the embryo. A simple sac of unorganized cells, with a half-made intestine, so to speak, is hatched, and made to do the duty of an ordinary, quite highly organized larva. Even the formation of the "primitive band," usually the first indication of the organization of the germ, is postponed to a comparatively late period in larval life. The different anatomical systems, the heart, with its vessels, the nervous system, and the respiratory system (tracheæ), appear at longer or shorter intervals, while in one genus, the tracheæ are not developed at all. Thus some portions of the animal are accelerated in their development more than others, while others are retarded, and in others still certain organs are not developed at all. Meanwhile all live in a fluid medium, with much the same habits, and surrounded with quite similar physical conditions.

The highest degree of acceleration is seen in the reproductive organs of the Cecidomyian larva of Miastor, which produces a summer brood of young, alive, and which live free in the body of the child-parent; and in the pupa of Chironomus, which has been

recently shown by Von Grimm, a fellow countryman of Ganin, to produce young in the spring, while the adult fly lays eggs in the autumn in the usual manner. This is in fact a true virgin reproduction, and directly comparable to the alternation of generations observed in the jelly fishes, in Salpa, and certain intestinal worms. We can now, in the light of the researches of Ganin, Siebold, Leuckart, and others, trace more closely than ever the connection between simple growth and metamorphosis, and metamorphosis and parthenogenesis, and perceive that they are but the terms of a single series. By the acceleration of a single set of organs (the reproductive), no more wonderful than the acceleration and retardation of the other systems of organs, so clearly pointed out in the embryos of Platygaster and its allies, we see how parthenogenesis under certain conditions may result. The barren Platygaster larva, the fertile Cecidomyia larva, the fertile Aphis larva, the fertile Chironomus pupa, the fertile hydroid polyp, and the fertile adult queen bee, are simply animals in different degrees of organization, and with reproductive systems differing not in quality, but in the greater or less rapidity of their development as compared with the rest of the body.

Another interesting point is, that while the larvæ vary so remarkably in form, the adult ichneumon flies are remarkably similar to one another. Do the differences in their larval history seem to point back to certain still more divergent ancestral forms?

These remarkable hyper-metamorphoses remind us of the metamorphosis of the embryo of Echinoderms into the Pluteus- and Bipinnaria-forms of the star-fish, sea-urchins, and Holothuriæ; of the Actinotrocha-form larva of the Sipunculoid worms; of the Cercaria-form larva of Distoma; of the Pilidium-form larva of Nemertes; and the larval forms of the leeches;* as well as the acarian Pentastomum, and certain other aberrant mites, such as Myobia, and in a less degree certain other more highly organized mites, such as Atax, and Hydrachna, and the ticks, which may almost be said to pass through a hyper-metamorphosis.

While Fritz Müller and Dohrn have considered the insects as having descended from the Crustacea (some primitive zoëa-form),

* Leuckart, in his great work, "Die Menschlichen Parasiten," p. 700, after the analogy of Hirudo, which develops a primitive streak late in larval life, ventures to consider the first indications of the germ of Nemertes in its larval, Pilidium-form as a primitive streak. He also suggests that the development of the later larval forms of the Echinoderms is the same in kind.

and Dohrn has adduced the supposed zoëa-form larva of these egg-parasites as a proof, we cannot but think in a subject so purely speculative as the ancestry of animals, that the facts brought out by Ganin tend to confirm the reviewer's theory, expressed in the last number of this journal, that the ancestry of all the insects (including the Arachnids and Myriapods) should be traced directly to the worms. The development of the degraded, aberrant arachnidan Pentastomum accords, in some important respects, with that of the intestinal worms. The Leptus-form larva of Julus, with its strange embryological development, in some respects so like that of some worms, points in that direction, as certainly as does the embryological development of the egg-parasite Ophioneurus. The Nauplius form of the embryo or larva of all Crustacea, also points back to the worms as their ancestors, the divergence having perhaps originated in the Rotatoria. In these similar modes of development between the worms and the Crustacea on the one hand, and the worms and insects on the other, have we not a strong genetic bond uniting these three great classes into one grand subkingdom; and can we not in imagination perceive the successive steps by which the Creator, acting through the secondary laws of evolution, has built up the great articulate division of the animal kingdom?—**A. S. P.**

NATURAL HISTORY MISCELLANY.

BOTANY.

Transpiration of Aqueous Vapor by the Leaves of Plants.—Professor McNab of Cirencester College, England, has recently published an important series of experiments on this subject. The plant experimented on was in all cases the common cherry-laurel (*Prunus laurocerasus*), and the fluid to determine the rapidity of ascent, lithium citrate, a very small quantity of which can be detected by means of the spectroscope. Dr. McNab divided the results under the following heads:—1. Quantity of water in the leaves. The mean of several experiments gave 63.4 per cent. 2. Quantity of water which can be removed by calcium chloride, or

sulphuric acid, *in vacuo*. This was found to be from 5.08 to 6.09 per cent. 3. Amount of transpirable fluid in the stem and leaves, 7.58 per cent. The remainder, from 56 to 57 per cent., was therefore determined to be fluid in relation to the cell-sap of the plants. 4. Rapidity of transpiration in sunlight, diffused light, and darkness. The results given are:—in sunlight, 3.03 per cent. in an hour; in diffused daylight, 0.59 per cent.; in darkness, 0.45 per cent. 5. Amount of fluid transpired in a saturated, and in a dry atmosphere in the sun, and in diffused daylight. In sunshine, the experiments gave 25.96 per cent. in an hour, in a saturated atmosphere; 20.52 per cent. in a dry atmosphere; in the shade the results were reversed, nothing whatever in a saturated, 1.69 per cent. in a dry atmosphere. These results strikingly confirm the earlier experiments of Dehérain, that evaporation from leaves is due to light and not to heat, and that it proceeds equally in a perfectly saturated atmosphere. 6. Quantity of water taken up by leaves when immersed in it. The mean of several experiments gave 4.37 per cent. in one and one-half hours. 7. Quantity of aqueous vapor absorbed by leaves in a secluded atmosphere. This was found to be nil, again confirming the statement of M.M. Prillieux and Duchartre that plants absorb no moisture whatever in the state of vapor through their leaves. 8. Differences in the amount of fluid transpired by the upper and under side of leaves in the sun and in diffused daylight. From the upper surface in sun 1.74 per cent. in an hour, from the under surface 12.33 per cent.; from the upper surface in diffused light 2.82 per cent. in forty-eight hours, from the under surface 16.08 per cent.; from both sides when coated with collodion, 0.86 per cent. in sun, 2.56 per cent. in diffused light. 9. Relation of fluid taken up, to that transpired, and that retained, by the plant. Increase of weight of branch in saturated atmosphere, diffused daylight, in forty-eight hours, 7.34 per cent., in ordinary atmosphere, 7.14 per cent., in darkness, 3.01 per cent. 10. Rapidity of ascent of fluids. From 4 7–12 inches in ten minutes to 8 7–12 inches in ten minutes. 11. Influences of gases on transpiration. Transpiration of fluid in oxygen in one hour in sun, 12.77 per cent., in atmospheric air, 7.5 per cent., in carbonic acid, 4.01 per cent., in nitrogen, 1.97 per cent. The bad weather, and the lateness of the season, terminated the experiments before several points of interest could be fully determined.—**A. W. B.**

Male Flowers on the Ear of Indian Corn.—In the April number of the American Naturalist, we expressed a desire to see specimens with a part of the ear male, that being so very much rarer than the case of the male panicle bearing female flowers and fruit, which, indeed, is common enough. Our correspondent, Dr. Henry Shimer, of Mt. Carmel, Ill., has sent us a specimen, accompanied by a long communication, touching upon hypothetical matters which we do not care now to discuss. We will only remark that the instance is not the one we had in view in asking. We wanted to see male flowers on the ear, that is, male flowers in the place of female ones, or else hermaphrodite flowers. But Dr. Shimer's instance is not of that sort. It is a case of a male panicle produced from the apex of a female spike, which, as he remarks, is too common to excite much attention.

Flowering of the Victoria Regia in the Open Air.—Joseph Mager, Esq., has succeeded in flowering the Victoria Lily in his pond in England. The pond is perfectly open, but the water is heated by hot water pipes coming from a boiler near the pond, carefully concealed. The seeds of the Victoria were planted in May last, and the first flower was produced Sept. 10th. Afterwards seven other flowers opened. The plant has eight leaves, of which the largest is five feet, two inches, in diameter. Mr. Mager has also succeeded in flowering a large number of other tropical lilies in his pond. The "London Field" for Nov. 26th, gives an engraving of the pond, and an account of the treasures it contains.

Isoetes in the Detroit River.—Though the Isoetes has been found in the Niagara river, and in the Oswego river near the Falls, and also at Sault St. Marie, near Lake Superior, the Lake botanists had failed to find it in our vicinity. This last season, however, after many fruitless searches, I discovered it (September 11th, 1870) at Windsor, Ontario. The specimens I at once found to be a well-marked form of *I. echinospora* Durien. In a subsequent search (September 18th), I found the same species, but of a distinct form, at Sandwich, Ontario, a point farther down our river. At both points, which are about three miles apart, and opposite the city of Detroit, the plants were taken from the river; and I attribute their growing on that side to the soil being more gravelly there than on the north side.

All of the specimens are quite small, the largest hardly exceeding three inches in height. In my Windsor plant the presence of stomata is at once apparent; the spinules on the macrospores are short, thick, and in connected ridges; the microspores being abundant and characteristic of the species. In the Sandwich plant the stomata, though present, are more difficult to find, being very few and indistinct; and the macrospores, though of equal size with those of the former plant (about 0'.23 in diameter) differ in being provided with spinules which are long, slender, and, occasionally, slightly forked. No microspores were observed. The presence of stomata in both these distinct forms of this species, which is a most variable one, is worthy of note.—Henry Gillman, *Detroit, Michigan.*

ZOOLOGY.

A New Genus of Brachiopods.—Among some small shells (supposed to be the young of *Waldheimia cranium*), recently received from the Northeast Atlantic, through Mr. Jeffreys, were three specimens of an undescribed genus of the subfamily *Terebratulinæ*. The shell resembles *Magasella*, being smooth and with an incomplete foramen. The loop nearly resembles that of *Ismenia sanguinea* Chemn., but has no secondary attachment to the hæmal valve, and the latter is destitute of a septum. I propose, for the genus, the name of *Frenula*, from the bridle-shaped loop; and, for the species, that of *Frenula Jeffreysii*. More extended descriptions are in preparation.—W. H. Dall.

Embryology of Limulus.—A reviewer in the Quarterly Journal of Microscopical Science (Jan. 1871, p. 89), seems to think it very little to our credit that the embryology of Limulus should have remained so long unknown, "seeing that they are favored by its presence in abundance on their coasts." This is hardly a charitable view to take of the subject, and shows that the writer of the notice has not the most remote idea of the difficulty attending researches on the sea coast. It is impossible to make connected observations, without extending them over a long series of years, and no one who is not thoroughly familiar with the habits of any marine animal at all seasons of the year, can hope to accomplish anything more than the most fragmentary work. The time of spawning of many of our most common inhabitants of the coast, is often very short,

and several seasons are frequently wasted in finding out this point alone. The difficulties are greatly increased when the workers live at some distance from the coast, and instead of the slurs the writer seems to cast upon the work which has been so well done as far as it is intended to go (see paper to be issued in Memoirs Boston Soc. Nat. Hist. 1871), he might have spent some of his ingenuity in looking over the long list of marine animals, known to live on the coast of Great Britain, of which the development is unknown (many of which are fully as important as Limulus), and do what he could to fill the gaps. We might suggest to the reviewer the Spatangoids, the Ctenophoræ, the eggs of which can be more readily supplied to him than those of Limulus, from the English side of the Atlantic, and to come to more accessible material, any one of the many families of marine fishes of which we as yet know nothing, neither in England nor elsewhere.

Readers of the Journal who are informed as to the progress of science will be astonished to hear of "HAECKEL's * law of individual development epitomizing palæontological development!" and to learn that A. Dohrn and E. Van Beneden are the great pioneers in the "speculations on the phylogeny of Arthropoda." As the writer seems to have but a partial knowledge of what has been done in Germany and Russia, we would refer him to Siebold's Zeitschrift for further information.—* *

THE PIGEON HAWK.—In the September number of your journal, Vol. iv, page 439, Mr. Winfred Stearns, of Amherst, comments upon Mr. Samuel's statement that he never saw the nest of the Pigeon Hawk, and knows of but one instance in which it has ever been found in New England. Mr. Stearns thinks Mr. Samuel could not have inquired much into the matter, as he, Mr. Stearns, has found no less than three nests in that very town of Amherst. Unfortunately for Mr. Stearns's statement, yet fortunately as enabling one to test the correctness of his alleged fact, he states that these nests *were all in hollow trees*. This is a condition in which the nest of a Pigeon Hawk is never found, and one in which no other hawk than the Sparrow Hawk is ever found, demon-

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* "Hæckel's law of individual development epitomizing palæontological development" is, thanks to Professor Agassiz's teachings, as familiar to students in this country as household words. His statement of the law appears as early as 1857, a chapter of the Essay on Classification being devoted to this subject. Agassiz also alluded to such a law so early as the publication of the "Poissons Fossiles," and Milne-Edwards referred to it in 1844 in the "Annales des Sciences Naturelles."—EDS.

strating at once that the hawks referred to by Mr. Stearns were the latter birds, which are not uncommon in that part of the State. I deem it of sufficient importance that an error in bird history so serious as Mr. Stearns has made should be set right, and not be permitted to pass unchallenged or accepted as fact.

I may be permitted to add that I have "inquired into the matter" for the past forty years, and I have yet to know of the first well authenticated instance of the nest and eggs of the Pigeon Hawk having ever been found in any part of Massachusetts. That it may breed in some mountainous and wild regions is, of course, possible, and my inability to trace it is only negative testimony. The horizon of one man is at the best very limited, and many ornithological facts occur that are not dreamed of in his philosophy. If any one else has "inquired into the matter" more successfully, I shall be very glad to be informed thereof.—T. M. Brewer.

Parthenogenesis in the Pupa State of Insects.—In Vol. XV., No. 8, of the "Memoirs of the Academy of St. Petersburg," M. O. von Grimm, describes a curious instance of Parthenogenesis in a species of the dipterous genus Chironomus. Like the well-known case of Miastor, discovered by Prof. Wagner, this is an example of reproduction by an insect in one of its preparatory, and therefore sexless stages, called *Pædogenesis*, by Von Baer. The formation of the egg-like reproductive bodies commences in the larvæ: but the eggs are not extruded until the insect has passed into the pupa state. It appears that in the spring the larvæ, produced in the ordinary way from eggs, grow rapidly, and after the third change of skin, attain their full size, and show distinct traces of the pupa within them. The eggs are produced direct from the pupa in this condition. In the autumn the course of development during the preparatory changes is precisely the same; the pupa, however, changes into the imago, which deposits the eggs, probably after copulation, in the ordinary manner. The mode of development of the eggs and ovaries, and that of the embryo in the egg, are described by the author at considerable length, and illustrated by good figures. The eggs are developed in the same way, both in the spring and in the autumn, although in the one case they will be deposited by the pupa, and in the other by the imago; and as they present no difference in their structure, the

author regards them all as eggs, and rejects the distinction into *ova* and *pseudova*. He seems inclined to adopt the notion that the supposed cases of Parthenogenesis may be due to self-fecundation.—*The Academy*.

GEOLOGY.

Cave Mammals in Pennsylvania.—Prof. Cope, at a recent meeting of the American Philosophical Society, announced the discovery by Charles M. Wheatley, of Phœnixville, Penn., of a cave in the auroral limestone of Chester Co., containing remains of Postpliocene Mammalia. The species so far recovered, are a tapir of large size, a small horse, a very large ruminant, and a mastodon (*Trilophodon Ohioticus*); also some very fine remains of a *Megalonyx*, and the remains of a large Mylodon, and the bones and teeth of a cave bear of large size; it is very distinct from the Cave Bear of Europe, or the living bears of the Northern Hemisphere; it is the *Ursus pristinus* (*Arctodus* of Leidy). Remains of serpents, turtles and insects also occur. Prof. Cope stated that Mr. Wheatley was continuing the excavations, and that he would make a further communication of results at a future time.

Remains of the Mammoth in Europe.—In addition to the celebrated skeleton of the Mammoth from Siberia which was found in such a remarkable state of preservation, the Museum at St. Petersburg contains a gallery entirely devoted to the remains of the *Elephas primigenius*, including probably many nearly entire skeletons. The most perfect skeleton out of St. Petersburg is probably one in the Museum at Brussels, found some time since and recently put together by M. Dupont, the present keeper of the Museum. An almost entire skull with tusks, was found some years since at Ilford in the Valley of the Thames, and is now in the British Museum. From the comparative height and slenderness of the skeleton of the mammoth as compared with that of the existing elephant, it would appear to have been a more active and lighter-built animal. The excavation of the fortifications around Antwerp, has led to the discovery not only of elephants' and mastodons' remains, but of a most wonderful series of cetacean bones. These are now arranged in a fine gallery in the Brussels Museum, which now bids fair to be one of the most attractive of continental institutions.—A. W. B.

Fossil Meteorite. — A new meteorite has just been discovered in the Miocene deposits of Greenland, and brought to England. It has been offered, we understand, to the Trustees of the British Museum for the sum of 240*l*. This is the first instance on record of a truly fossil meteorite having been met with. — *The Academy.*

ANTHROPOLOGY.

Did Man Exist in the Tertiary Age? — The evidence adduced by M. Bourgeois of the discovery of flint flakes and scrapers in the Miocene strata of Thenay, along with remains of the hornless rhinoceros and mastodon, proves, according to M. Hamy, that man was an inhabitant of Miocene Europe. It is, however, rejected by most of the French and English savants, because M. Burgeois has not shown that the implements in question may not have been derived ultimately from the surface of the ground, where they are very abundant. While M. Hamy acknowledges this to be the case, he does not see its full bearing on the value of the testimony. The implements are probably of a Quaternary, or even of post-quaternary age, and certainly cannot be considered decisive of the sojourn of man in Europe during the Miocene epoch, although the climate at the time was almost tropical, and the conditions of life easy. Nor can the evidence of the grooved bones of Halithere, found by M. Delaunay at Puancè in Maine-et-Loire, be accepted, because it cannot be proved that the grooves may not have been caused by some other agency than that of man. The proof of the existence of man in Europe during the Pliocene epoch derived from the striæ in the fossil bones found at Saint Prest, and in the valley of the Arno, accepted by M. Hamy, is equally unsatisfactory. The flint "arrow-head" and other rude fragments said to have been obtained at the former place from the same horizon as the bones of *Elephas meridionalis*, by M. Burgeois, the stout champion of Miocene man, do not afford the precise and exact testimony which is demanded for the establishment of the case.

The presence, indeed, of man in Europe in the Miocene and Pliocene epoch is as yet non-proven, and we must be content to await future discoveries. The results of the labors of archæologists and geologists throughout Europe during the last ten years has not placed the advent of man further back than the river

gravels of the Somme, and the epoch of the caves, both of which are post-glacial or post-pliocene, or quaternary, in other words, posterior to the great submergence and refrigeration of Northern Europe, through which many of the Pliocene mammalia were destroyed.—W. Boyd Dawkins, *in Nature*.

Mounds near Princeton, Illinois.—In January, 1870, through the kindness of P. D. Winship, Esq., I visited a place about three and a half miles south-east of Princeton, Illinois, where there are several small mounds, one or two of which Mr. Winship and others had previously opened. These mounds are very low, and are situated along an old terrace, which is perhaps sixty or seventy feet above the bed of a small stream. In one of these mounds human skeletons were found in a sitting posture, but the bones so readily crumbled that only portions could be preserved. They

Fig. 21.



Indian pottery, outside.

Fig. 22.



Indian pottery, inside.

showed, however, that in this mound there were buried at least one man and one woman. Two small stone implements, somewhat like Indian axes in shape, were found with the skeletons. These axe-shaped tools appear to be greenstone, and are similar to those found in ordinary Indian burial places.

About forty or fifty feet from the low mound from which the skeletons and axe-like implements were taken, a slight excavation was made, from which Mr. Winship and those with him took the piece of pottery figured in the accompanying wood-cut (Figs. 21.

22). This piece of pottery is evidently made of clay and sand. It is comparatively smooth on the inside, but more or less regularly wrinkled or ridged on the outside, the ridges undoubtedly being intended for ornamentation. On the inside of the piece of pottery there are two holes, which appear as if punched with a round instrument while the pottery was yet in a plastic state; the round instrument was not forced clear through the substance, but so nearly through that the material was raised into a protuberance on the outside, just where each hole would have been had the instrument been forced through. One of these protuberances appears as if worn off, and thus an opening has been made from one side to the other; the opening on the outside, however, is very small, as seen by the figure.* Two arrowheads, one of very fine jasper, and the other of coarse jasper, were found with the pottery.

About fifty rods farther down the stream, and on a much lower terrace, Mr. Winship called my attention to what he called a "race-course." It was apparently an old race-course, circular, and with a diameter of two hundred and fifty or three hundred feet; and the "track" is quite plain, being indicated by a well marked depression. That this is no modern affair is shown by the stump of a large oak which is standing right in the middle of the track, and which of course shows us that the tree of which it is a part grew from an acorn which germinated there since the track ceased to be used. — SANBORN TENNEY, *Williams College*.

NOTES.

PROFESSOR AGASSIZ recently addressed the Massachusetts Legislative Committee on Public Education, on the present needs and future prospects of the Museum of Comparative Zoology. He stated that the annual income amounts to a little over $10.000. This was insufficient to pay the salaries of the corps of twenty-six assistants, and individuals had generously aided the institution by gifts of from $1500, to $6000. The total amounts of these contributions, including grants, was $473,000. Its immediate neces-

* "Indian" pottery is often ornamented with circular impressions on the outside, probably made by a small hollow bone or reed, but this is the first instance that has come under my notice of the impression being made on the inside. — F. W. P.

sity, though no criterion for the future, is $50,000, for the arrangement of specimens alone; $25,000 will be needed for other purposes.

The state of Massachusetts has been generous to Professor Agassiz, as Director of what we may safely say, is, on the whole the best conducted, and in many respects most liberal museum in the world. The time is ripe for the immediate development of a museum, that shall in all its appointments be a model for all others, and we trust the liberal minded citizens of a state which owes so much to science for its wealth and the development of its intellect, will not let this golden opportunity pass.

Millions have been voted for developing the material resources of the state. Shall not a museum, which has already done so much in elevating the standard of scientific learning in our country, have its thousands? From motives of simple economy in money, and as one of the preventives against ignorance, and crime, the result of inherited ignorance, we would as editors of a scientific journal heartily urge liberal legislation to foster science and education. It is by the endowment of the higher institutions of learning, and our museums and laboratories, that popular education will be hereafter best advanced in our country.

Capt. C. H. Hall has his vessel on the stocks at Washington in preparation for her work among the ice, and is carefully selecting the proper persons to assist in his expedition. The scientific assistants have not yet been definitely settled upon.

We have had inquiries about "a work on Ferns, by Miss Paine," recently, or soon to be, published. Can any of our readers give us information about it?

The Indian Government have resolved to institute a general archæological survey of the whole of India. Maj. Gen. Cunningham has been appointed Surveyor-General. He is, according to Trübner's American and Oriental Literary Record, perhaps the only one thoroughly competent for the post.

A large number of the animals at the *Jardin des Plantes* and *Jardin d' Acclimation* have been sold and slaughtered for food.

A quarto work on the Texas cattle disease prepared by the Agricultural Department, is just out, that is, printed, not published.

"The History of Zoology," by Victor Carus, is already in great part printed.

The mining volume of the reports on the survey of the 40th parallel, by Messrs. Clarence King and I. T. Gardner, is in press and will be the most thorough and valuable work on the mines of precious metals ever published in America. The report of the ornithologist, Mr. Robert Ridgeway, is already completed in manuscript, and will contain a valuable series of most minute and careful observations on the habits, distribution and variations of the birds of the Rocky Mountain Region. These reports when finished will be a record of by far the most thorough geodetic survey ever carried through on this continent. Mr. King is now busy on the geology, etc., at New Haven, having returned from a series of mountain measurements which have engaged his attention during the summer.

The scientists who have accompanied the San Domingo Commission, are Prof. Wm. P. Blake, principal mineralogist and geologist, and two assistants, one from Yale and one from Harvard; Dr. Parry, botanist, with an assistant from the Cambridge Scientific School; Prof. Newcombe of Cornell University, general naturalist; Prof. Ward, University of Rochester, assistant geologist; Hon. George Geddes, ex-President of New York State Agricultural Society, and State Engineer, in the agricultural interest.

The California Academy of Science appeals to the public for aid in erecting a building for its museum and library. The liberal minded citizens of San Francisco may remember that while aiding in the advance of science in their own community, scientists elsewhere will largely benefit from a generous endowment of this society, which has already done so much in developing a knowledge of the natural and physical history of the Pacific slope of our continent.

The lovers of Botany in Camden, N. J., have instituted "a Botanical Circle," and publish in the local press interesting accounts of their meetings, which are held monthly. Mr. F. Bourquin has detected two rare mosses. *Diphyscium foliosum* and *Burbaumia aphylla*, at Camden. The latter has also been found at Camden by **Miss C. A. Boice.**

Capt. Hall is quietly organizing his Polar expedition, and has abundant sympathy from the President and others in his work.

Gen. Sherman has been appointed one of the Regents of the Smithsonian Institution in place of Gen. Delafield, resigned.

ANSWERS TO CORRESPONDENTS.

L. A. M. — The parasitic fungus on the common brake is *Xyloma aquilinum* Fries. The fragrant fern is *Aspidium fragrans* Swartz. We could not tell you what the bright green jelly-like moss is, without a specimen; a dried specimen is better than none. — J. L. R.

O. — The Bruchus reared from the *Olneya* is *Bruchus nigrinus* of Leconte, and according to Dr. Horn, who named the specimen, is an unpublished species.

G. W. H., Philadelphia. — Dr. Abbott and all other ornithologists of the present day use the names which the systematists of the present time consider the proper ones. There have been many changes in nomenclature since the days of Latham and Wilson, whom you quote, and to know the names of birds only by the names given by them, is like knowing how to spell words in the English language only as Chaucer spelled them. "Frank Forrester" would hardly be quoted by any ornithologist as an authority on matters of scientific nomenclature. At the present time the only standard work on the Birds of North America is that of Baird, Cassin and Lawrence. This work was reissued by the Naturalists' Agency in 1870. See advertisement in this number. This book will also give you in full what you wish to know about the Geese.

J. H. P., Bedford. — The Birds you send are: 1. Lesser Redpoll Linnet, *Ægiothus linaria*; 2. Tree Sparrow, *Spizella monticola*.

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THE SPRING FLOWERS OF COLORADO.

BY E. L. GREENE.

It is the tenth of April, and although the skies are clear, and the sun's rays warm enough for early June, yet the Colorado landscape shows no indications of spring. The mountain range which fills the western horizon, is still clad in all the dazzling white of wintry snows, and remains a picture of beauty and sublimity quite indescribable. The plains are brown and bare, as they were during most of the winter. Here and there, tufts of the evergreen Soap-weed (*Yucca angustifolia*), or matted masses of Prickly Pear, show their perennial verdure, and furnish the only conspicuous signs of plant life. No April showers have fallen to revive the grasses, and the herds of long-horned Texas cattle graze contentedly upon the sere remains of last year's growth. Yet at this early date, there are wild flowers, modest, and lovely April flowers, for the eye that knows where to look for them.

Extending all along the eastern base of the Rocky Mountains, is a series of high and picturesque table-lands, and below and among them, numerous grassy hills and knolls, all destitute of trees, often rocky, and apparently as barren as are the plains around. On sunny slopes, and in sheltered nooks among these foot-hills, we find our earliest flowers. By the first week in April, there appears on the very summits of these grassy knolls a real beauty, which, as it yet lacks an English name, may bear its Latin one, Townsendia (*T. sericea*). The plant belongs to the family

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of Compositæ, an order which has not the charm of furnishing many early flowers, but which displays its beauties in late summer or in autumn. Even our Townsendia forms its flower buds and its foliage in the fall. The plant is almost destitute of a stem, and the narrow silky leaves form a dense tuft two or three inches broad, just upon the surface of the ground. Nestling closely among the pretty leaves are five or six rather large daisy-like flowers. The rays are either white or rose-color, and the center of each head is yellow, as is commonly the case in the compound flowers. There grows with this another species of Townsendia (*T. Fendleri*), smaller and more delicate, with more numerous heads, but it flowers nearly a month later. These very pretty plants are well worthy of a place in our gardens, though they would perhaps be difficult to rear in any other than their native localities. By the fifteenth of the month *Viola Nuttallii* appears on the sunny hillsides, a fine yellow violet, with its petals prettily painted outside with reddish brown. With it *Mertensia obtusifolia* hangs out its pendant clusters of light blue.

Passing beyond the foot-hills and entering some mountain gulch or cañon, we find the rocky slopes all yellow in some places with the flowers of the Rocky Mountain Barberry. Though a congener of the barberry of the Eastern States and Canada, it is a trailing evergreen shrub, and the flowers are succeeded by handsome blue berries like frost grapes. This is *Berberis aquifolium* of the authors. Higher up among the rocks are the large pale purple flowers of *Anemone patens*, one of the finest of Rocky Mountain plants, but it is quite common as far eastward as Wisconsin, on bleak, gravelly hills. With it in the mountains of Colorado, grows a modest little cruciferous plant with white flowers (*Thlaspi Fendleri*); also a peculiar species of crowfoot (*Ranunculus glaberninus*), all of which are among the first flowers to appear.

By the twentieth of April, the zealous flower hunter will be amply rewarded for his toil, if he ventures to the top of some one of the table mountains. The task will indeed not be an easy one, for many tiresome stages must be made, up steep declivities, and among sharp and rugged rocks, and over what from the base may seem almost insurmountable, the high and almost unbroken wall of perpendicular rock, which invariably encircles the summits of these table mountains. High among these sublime formations, which stand pictured against the sky, like giant castle works, wild

birds of bolder wing construct their homes securely, and from many a dark recess the melancholy owl pours forth her plaintive wailings upon the ear of night. Yet these mighty barriers are not altogether impassable. Among the irregularities of their outline are places where little streams bordered with shrubs and bushes come singing down among the rocks, from the table land. Even broad and easy passage ways may be sought out by the eye before commencing the ascent.

These table lands, when reached, are usually found to present an uneven surface of bare rock, or, in places, of shallow soil. There are even extensive meadows on some of them with occasionally a pond of water. In sheltered situations opening toward the south where the spring sun first drove away the snow, there are already some real treasures for the botanist's portfolio. In every crevice and hollow, where there is a little soil, we find a very handsome cruciferous plant which has yet no name by which to be known, save the Latinized Greek one, *Physaria didymocarpa*. Its pretty rosettes of broad whitish leaves, which lay all winter close to the frosty rock, have now sent up a number of spreading stems with golden yellow flowers. A small variety of *Thermopsis fabacea*, with fragrant lupine-like blossoms, will be found where the soil is deeper, but the larger and more common form of this plant flowers a month later, on the plains below.

The most interesting tenant of these heights is the *Echinocactus Simpsonii*. As its name would indicate, it belongs to the cactus tribe. It is remarkable among the cactaceous plants of this latitude for its early flowering. Not less than a dozen species or varieties of these plants, grow upon the adjacent plains, but none of them are in flower before the first of June. This one may be found in perfection before the last of April. It is globose in form and very thickly armed with whitish spines, so that, when out of flower, the plants seem like mere balls of bristles scattered about among the rocks. The flowers are five or six in number, of a bright purple, forming a circle around the centre, or rather, apex of the plant. It is an object of very singular beauty, alone well worth the trouble and fatigue of an hour's climbing.

As the first of May draws nigh, the general aspect of the country becomes more springlike. The grasses are beginning to grow, and the number of flowers begins to increase so that to enumerate them would be tedious. However, we must not fail to notice a

very beautiful, low liliaceous plant with grassy foliage and crocus-like flowers, which now begins to whiten the hill-sides nearest the plains. Its name is *Calochortus venustus*, and it deserves its name, which, equally for the species and the genus, refers to its beauty.

PRAIRIE FIRES.

BY DR. C. A. WHITE.

Every dweller in the great interior region of North America, is more or less familiar with prairie fires, or rather, they have often at nightfall seen their lurid light in the distant horizon, or by day their huge volumes of smoke rising and blending with the clouds, and many are even familiar with the consuming march of the flames themselves. Strangers visiting these regions, between October and May, are often alarmed at the first sight of these illuminations, being impressed with the belief that they emanate from burning buildings.

Usually, these fires are harmless, but there is always danger that they will cause destruction of property, and even of life, and the settler in sparsely inhabited districts watches with anxiety until the almost inevitable annual scourge has swept all the uncultivated prairie in his neighborhood. The greater part of the combustible material which feeds these fires is grass, the remainder being the dried remains of those annual plants so well described by Mr. J. A. Allen, in the Naturalist for December, 1870. These together cover the ground every season, for the fires of one year do not at all impair or prevent their abundant growth the next. Stringent laws are enacted in all the prairie states, against the setting of fires to the prairies, yet each year's growth of grass upon at least the larger ones, is somehow almost invariably burnt. The progress of the fire is usually slow, and is often arrested by a few furrows plowed around the field for that purpose, by small rills or even by a slightly beaten road. But when the wind is high upon the great prairies, the case is very different. Then nothing can withstand the fury of the fire, and it often runs an unchecked course of more than a hundred miles, sometimes leaping rivers of more than a

dozen rods in width, since their valley sides are often grassy down to the water's edge. In such cases, woe to the traveller who may be unprepared for, or may lack nerve to meet the emergency. If he has a box of matches and ordinary coolness of judgment he is in no personal danger, for he has only to stop and set another fire, extinguish that part of it upon the windward side before it has increased beyond his control, and pass into the space that has been burnt free from grass by his own fire, where he is safe from the advancing flames that have given him the alarm. Some danger, however, always remains that his animals may take alarm from his own fire, and become unmanageable, but usually their instinctive dread, and a sense of dependence upon their masters, which horses constantly feel and manifest upon those lonely journeys, render them usually quite tractable under such circumstances.

While prosecuting the Geological survey of Iowa, we were often exposed to danger from fires when having occasion to cross the broad prairie region of the western part of the state. One October day after the first frosts of the season had killed the herbage, and the subsequent warm days had rendered the prairies almost like one vast tinder-box, the approach of night found us a few miles from a stream, the valley of which was distinctly in view as well as the broad prairie stretching beyond it. Mosquitoes are abundant in the valleys at this time of the year, and being apparently conscious that their end is approaching, they seem determined to get the greatest amount of blood in the shortest possible time from every living thing that comes in their way. We, therefore, stopped as usual, upon elevated ground, to camp where the breeze would prevent their visit. Procuring water for the camp, and watering our horses at a rill near by, we pitched our tent where we could overlook the surrounding country, and mowed the grass from a space of a few square yards upon which to build our camp fire of the few sticks we had brought from our last camping ground. Our supper over, and the horses picketed upon the grass that was still fresh by the rill, we lay down to sleep. The wind had been high all day, and did not abate upon the approach of night as it usually does. As it began to grow dark, I had observed in the distant horizon the light of a prairie fire. It was directly to the windward, and the face of the country in that direction was known to be such that nothing would be likely to arrest its progress towards us, except the stream before mentioned, and this I feared was too narrow

for that purpose in so high a wind. An hour was passed nervously watching the progress of the light and listening to the moaning of the wind, as it roughly swept the newly frost-killed grass. At last I could distinctly see the fire making its way down to the stream upon the further valley side; then for a time its light seemed to be gone, and I hoped its progress had been stayed by the water of the stream, but in a few moments more it had gained the top of the hither valley side. No time was now to be lost, so quickly arousing my companions, and bidding them follow me with their blankets, I seized a brand from the camp-fire and running a few rods to the leeward, a moment sufficed us to start a new fire from our camp, its progress towards it (for it will sometimes work its way slowly against the wind) being arrested by the beating of our blankets. One man then leading the horses into the burnt space, we followed, dragging tent, bedding, harness and camp-chest; then seizing the wagon, which was fortunately upon inclining ground, we rolled it safely in by the light of the fire we had kindled and also of that which was fast approaching us. Scarcely had we secured the last article and passed within the charmed circle, when the dense flames, leaping high in the air and rolling like surf upon the sea-shore, gathered around us, and enveloped us with their hot and suffocating smoke. We all, horses and men, stood there motionless; conscious of our safety it is true, but with an instinctive feeling of terror at the danger we had escaped. We were upon a hollow island in a sea of fire. A moment more, and it was a peninsula, for the advancing fire-flood parted around us; and then we were left in the darkness, intensified by the blackness of the charred earth, while the flames swept on over the distant prairie, like a troop of flying fiends.

Gathering our scattered equipage together, we lay down again for the night, with no regret except that our faithful horses could not have their accustomed grazing. Next morning found us in the midst of a dreary blackened waste, not "without the smell of fire upon our garments," but we were free from similar danger until we should reach a region of unburnt prairie.

SOMETHING ABOUT SEEDS.*

BY W. W. BAILEY.

By simply calling attention to the many beauties of these little organs, I hope to induce the youthful student to follow further in that pleasant path which I shall merely indicate.

A few months since I was reading with a tear in one eye for the misfortunes of the French, and a twinkle of merriment in the other, at the adventures of their ubiquitous war minister, when my breath disturbed the seed of an Asclepias (*A. incarnata*), by accident reposing on my table, and it floated on a voyage of discovery to a distant corner of my room. "Monsieur Gambetta!" I exclaimed, "Here is your original aëronaut! No balloon or parachute of man's invention can compare with the tufted silk which floats this little voyager! Fearlessly he trusts himself to the breezes, now for a moment touching on some interposing obstacle, then lightly sailing off again to bear his freight of life to the position chosen for its home."

And now the flossy seedkin has come into our lines, and shall not be released until he passes a satisfactory examination. Where are you travelling, little stranger, and what is the cause of your hurry? Can you not tell us something of your balloon itself, and of your purpose in trusting to the winds? After an ineffectual effort to soar beyond my reach, the imprisoned seed reveals his secret, and in so far as I can interpret his peculiar language, his story is as follows:—

The seed of Asclepias, or milkweed, is thin, flat, and of a brownish tint. The embryo is devoid of that store of albumen which many plants provide for the early sustenance of their young. It, with its fellows, is imbricated upon a papery placenta, its plumy tufts reposing in gill-like processes of the same until the perfection of the fruit, when they become disengaged by the lightest touch, and waft the attached seed to its destined resting-place. Nothing can be more soft and satiny than is the so-called coma of Asclepias. Under the microscope the hairs are found to be exceedingly smooth and regular in outline, and undistinguished

* A paper read before the Franklin Society, of Providence, R. I.

by the spiral twisting which characterizes many similar fibres. The evident design of the plumes, as in other cases where seeds are provided with such appendages, is to assist in the wide-spread distribution of the species. Many seeds probably fall quite near the parent plant, but chance breezes carry others often to a very great distance.

Some one is already wondering, doubtless, why I have not taken the more familiar dandelion for illustration. It is simply because, as I have said, the Asclepias happened to be upon my table. As every one knows, the dandelion (Taraxacum), the groundsel (Senecio), the thistle (Cirsium and Onopordon), and many other genera of Compositæ, the willows (Salicaceæ), some of the buttercups (Ranunculaceæ), the evening primrose family (Onagraceæ), together with members of many other orders, are similarly endowed with silky tufts to assist the seed in its migrations. The execution may differ in diverse species, but the plan remains the same. This is the commonest, yet other methods are adopted to obtain the same end, as we notice in the key-like samara of the maple and the winged seeds of the trumpet creeper (*Tecoma radicans*), of the pines and the elms. All these are charming objects viewed by the unassisted eye, or more closely examined by means of the microscope.

I cannot dismiss this portion of my subject without dwelling for a few moments upon the means provided for the scattering of seeds. Some plants, like the balsam (Impatiens) and the geranium, by a sudden contraction of portions of the capsule, expel the contents with a jerk, which often throws them to a considerable distance. Others are provided with little hooks, claws, fine hairs, or some other mechanical means of attaching themselves to moving objects and availing themselves of their involuntary aid. There is no American botanist, probably, but has expostulated mildly with the chain-like pods of Desmodium, which will persist in adhering to one's clothing, and the removal of which is no small task. The barbed achenium of *Bidens frondosa* is another pest to man, as are the burs of *Lappa major*, or burdock, to sheep and cattle, but we must bear in mind that in the case of these plants, we are merely mediums of conveyance, and have temporarily resigned our proud position at the head of nature.

Animals and birds often distribute seeds which have passed through the system undigested; currents of water in the ocean

bear them from one island or continent to another, while commerce, often unintentionally, scatters them over distant lands. In this latter way, many of the most pernicious weeds have spread from Europe into Australia, America and India, where they make themselves perfectly at home, and evince frequently even more vitality than the native plants. To take one or two instances of this peculiar method of spreading, the *Rudbeckia hirta* is said to have come into New England with hay seed from the West, and is evidently increasing, while in New Brunswick I have heard it claimed that the white-weed (*Leucanthemum vulgare*) has spread with other Yankee notions from the neighboring states. It has certainly proved a successful invader and has taken possession of half the cultivated country.

I cannot refrain from inserting here a note from Sir J. E. Tennent's "Ceylon" in relation to the curious seeds of *Spinifex squarosus*, the "water-pink" as it is sometimes called by Europeans.

"The seeds of this plant are contained in a circular head, composed of a series of spine-like divisions, which radiate from the stalk in all directions, making the diameter of the whole about eight or nine inches. When the seeds are mature, and ready for dispersion, these heads become detached from the plant, and are carried by the wind with great velocity along the sands, over the surface of which they are impelled by their elastic spines. One of these balls may be followed by the eye for miles as it hurries along the level shore, dropping its seeds as it rolls, which speedily germinate and strike root where they fall. The globular heads are so buoyant as to float lightly on the water, and the uppermost spines acting as sails, they are thus carried across narrow estuaries to continue the process of embanking on newly formed sand-bars. Such an organization irresistibly suggests the wonderful means ordained by Providence to spread this valuable plant along the barren beach to which no seed-devouring bird ever resorts: and even the unobservant natives, struck by its singular utility in resisting the encroachments of the sea, have recorded their admiration by conferring on it the name of Maha-Rawana-raewula, 'the great beard of Rawana or Rama.'"

As to the duration of seeds there are many conflicting accounts. All are familiar with the old story of the grain found with Egyptian mummies, which vegetated after its disinterment and gave rise to a peculiar kind of wheat. This was a pleasant tale with which to point a moral, but it is now discredited by those most familiar with the facts. Still, it holds its place in many popular books, and shows the ease with which incorrect statements may

gain credence, and with what difficulty they are refuted when once proclaimed. That some seeds do live for a long time cannot be doubted, but no such extreme limit is authenticated as that cited for the mummy wheat. There are too many opportunities for error and even fraud, where a story is received at second hand from the Arabs. The largest of the accepted statements look a mite apocryphal. With most seeds the principle of life is evanescent, and it is with extreme difficulty that many can be transported from one climate or country to another. Even those that preserve their appearance unchanged and remain suitable for food, are often found to have lost their power of germination. It is claimed, and probably with truth, that when the thorn-apple (*Datura stramonium*) springs up in a place where it has not been seen before for many years, or even during the life-time of the observer, that the seeds have been lying dormant in the soil until some favorable condition has caused them to vegetate. So also when weeds, hitherto unknown in the vicinity, spring up along the embankments of a newly opened railway, or upon the ruins of extensive conflagrations. But these are only exceptions to the general rule, that to insure the vegetation of seed, it is necessary to plant it within a limited space of time, and that the preservation of it indefinitely is hazardous. The conditions necessary for the retention of vitality are not as yet certainly known, but it is thought that a particular amount of dryness, together with the exclusion of light and air, are essentials to success.

The total amount of seed produced by some plants is very remarkable. Linnæus says that a single stem of tobacco yields forty thousand seeds, and we all know how well provided with them are our commonest plants. It follows, then, that while, may be, a portion remain as I have said, dormant for a certain time, yet many are destroyed by unfavorable conditions, or as food for animals and man. We are thus reminded of the suggestive lines of Holmes:

> **"Look at the wasted seeds that Autumn scatters,**
> **The myriad germs that Nature shapes and shatters."**

I have already spoken of the dissemination of seeds and the means by which it is effected. We will now examine with the microscope the seeds themselves. Those of Stellaria are always pretty objects, as are likewise those of the clove pink (*Dianthus caryophyllus*) and other genera of Caryophyllaceæ. The seed of

Collomia linearis is a very remarkable object. It is, in its normal condition, dry and hard, but when moistened and placed beneath the microscope, we are astonished to find it covered with myriads of little threads, which project into the water, and keep it in constant motion. These are spiral fibres, which when dry, remain closely attached to the surface of the seed. The seed of Geranium appears as if enclosed in a net, that of Hyperieum is crested upon one side, and is aptly compared by Lindley to an ancient helmet, while the tiny black fruit of Polygala is covered with white hairs, and is provided with a curious appendage called a carunele. This seems to be composed of light cellular tissue, which, when magnified, owing to its beautiful whiteness and the distinct demarcation of its cells, resembles frost-work; or to the chemist, suggests more strikingly the appearance of a glass rod which has been heated, and suddenly cooled by immersion in water. Corydalis is furnished with an aril, or accessory appendage, as is also the Euonymus, and many other plants. The aril in Euonymus, is red, and is one cause of the extreme beauty of this plant in autumn, when its colored pods expand and reveal the deeper tinted coating of the seed within.

With the beautiful colors often assumed by seeds, all are of course acquainted who in childhood have arrayed the gayly tinted beans in military order. Nearly all the primary colors are brought into play to ornament the different seeds, while some, more regal in their fancies, are bedecked with bronze and gold. The mention of beans, suggests the use of seed to man, the Gramineæ and Leguminosæ furnishing a very large proportion of our food. Then, too, when we think that all our fruits have a direct relation to the seeds, we must feel how absolutely dependent we are upon these unborn plantlets for our sustenance and comfort.

Yet there are many seeds that are not edible, and others that are extremely noxious. The most deadly substance known, perhaps, is prepared from the seed of *Strychnos nux-romica*. From this fact alone, and the knowledge that even here destructive seeds surround us, we learn that the study we have been engaged in, is not a profitless occupation. It teaches us, not only the hidden beauties that encompass us, but how to discriminate between the hurtful and the beneficial fruits — the worthless and the advantageous.

THE LONDON FOG.

BY J. VILA BLAKE.

Apropos of the dense fog which recently enveloped the English metropolis, the news and some details of which have crept from the English press into our own, the following extract from a private letter describing this rather rare occurrence as seen (and felt also) by American eyes, will probably be read with interest, especially as we have here no similar phenomenon which can be compared with a genuine London fog:—

"One of the many things that I enjoyed in London was a London fog—only think of it! It was a great piece of good fortune; for, although at this season of the year it is always foggy, yet one of these very dense ones is not of very frequent occurrence. Really, it was a thing well worth the seeing, and for nothing, too, without a fee. It had been very foggy for about twenty-four hours, though not so much so but that we could get about well enough. At six, after tea, H. proposed that we should go to hear Trovatore; so we went, and such a sight I never saw as that stage. It was really ludicrous, trying to peer through the smoky mist to see what was going on. Scenes, dresses, sparkling jewelry, all were thrown away; nothing could be seen, and the atmosphere, in addition, was so *irritating to the eyes*, that although there was nothing in the opera to move one, the audience seemed to be perpetually in tears. On coming out we saw at once what had been going on in the two or three hours since leaving home. The fog lay thick and dense around us; the link-boys were out in all their glory, dashing wildly about among the bewildered crowds, with their 'Have a torch, sir?' 'Light you home, sir?' 'Better take me, sir!' Then darting frantically into the blackness they were lost, only to reappear again, thrusting their blazing firebrands so near your clothing that it really seemed frightful. Drivers were offered enormous sums by terrified people to take them home,—offers refused with frightful oaths; helpless women clung to railings for safety; now and then a solitary omnibus came along, each horse led by a link-boy with his flaming torch: men knocked against each other, and *we* clung tightly to each other's arms and strove to keep each other in sight. On crossing the street opposite Charing-Cross Hotel, which is there very wide and is the point of meeting of five different ways, we were only guided by the sound of the horses' hoofs, and even then it was very hard to judge of the direction of the sound. We walked in faith, com-

pletely, if never before. Milton speaks of the 'palpable obscure.' He must have had a London fog in his mind, when he described the flight of the cursed angel through the misty, murky air. Finally we reached home in safety, fully appreciating what we had been through. The next day the papers were full of it, and, strange to say, reported but few accidents. Some women actually spent the whole night in the streets, afraid to stir, and no policeman, or watch, could be bribed to guide them home. H. passed quite a number clinging to the rails of Charing-Cross Hotel, and an hour afterwards, on his return, they were still there, and there, the paper said, the morning found them."

That the foregoing description of this remarkable feature of the meteorology of London is not at all exaggerated, appears from the account of many of the more noteworthy fogs recorded in Howard's "Climate of London." That authority mentions fogs, in the forenoon, of such density that drivers could not see their horses' heads; and in the evening of such opacity that "the most brilliant gaslight could scarcely penetrate the gloom."

Describing a very thick fog occurring in November, 1828, and remarking upon its physiological effects, the author says:—

"It began to thicken very much about half-past twelve o'clock, from which time, till nearly two, the effect was most distressing, making the eyes smart, and almost suffocating those who were in the street, particularly asthmatic persons. . . . . In the great thoroughfares, the hallooing of coachmen and drivers to avoid each other, seemingly issuing from the opaque mass in which they were enveloped, was calculated to awaken all the caution of riders, as well as of pedestrians who had to cross the streets."

These vaporous visitations are commonly very limited in extent. Often while the city is in more than midnight obscurity, and men and horses are groping their invisible way, step by step, only four or five miles from town the sky is unclouded and the sun shining brilliantly. The authority before referred to, records:—

"The fog of Wednesday (Dec. 31, 1817) seems to have been confined to the metropolis and the immediate vicinity. No further northward than the back of Euston Square, the weather was clear and even bright. A gentleman, who came to London from Enfield, saw no fog till he approached London. Southward of London, it extended as far as Clapham, and it was rather worse in some of the environs than in the metropolis itself. Upon an average, ten feet was the distance at which objects became invisible, out of doors. Within doors it was impossible to read without a candle."

But while this fog was thus limited at London, there was a sim-

ilar one the same day in Dublin which was probably a part of the same meteorological phenomenon, as appears from the following paragraph quoted from a Dublin journal of Jan. 1, 1818:—

"The oldest person living has no recollection of a fog so thick as the one which enveloped this city last evening, between the hours of six and nine. It was more dense in some streets than in others, and where this was the case it was impossible to pass with convenience without the aid of opened lanterns."

The occurrence of these fogs in frosty weather, is often the occasion of rare and exquisite displays of wintry beauties on shrubs, trees and buildings. Howard writes:—

"1814. January 4th. The mists, which have again prevailed for several days, and which have rendered travelling dangerous, are probably referable to stratus clouds. The air has been, in effect, loaded with particles of freezing water, such as in a higher region would have produced snow. These attached themselves to all objects, crystallizing in the most regular and beautiful manner. A blade of grass was thus converted into a pretty thick stalagmite; some of the shrubs, covered with spreading tufts of crystals, looked as if they were in blossom; while others, more firmly incrusted, might have passed for gigantic specimens of white coral. The leaves of evergreens had a transparent varnish of ice with an elegant white fringe. Lofty trees, viewed against the blue sky in the sunshine, appeared in striking magnificence; the whole face of nature, in short, was exquisitely dressed out in frost-work."

As an example of a similar beautiful phenomenon in a distant latitude and very different climate, I extract the following from Knox's "Overland through Asia," just published:—

"Our road for seventy versts lay along the bank of the Angara. A thick fog filled the valley and seemed to hug close to the river. In the morning, every part of our sleigh, except at the points of friction, was white with frost. Each little fibre projecting from our cover of canvas and matting became a miniature stalactite, and the head of every nail, bolt, and screw, buried itself beneath a mass like oxydized silver. Everything had seized upon and congealed some of the moisture floating in the atmosphere. Our horses were of the color, or no color, of rabbits in January; it was only by brushing away the frost that the natural tint of their hair could be discovered, and sometimes there was a great deal of frost adhering to them.

During my stay at Irkutsk I noticed the prevalence of this fog or frost cloud. It usually formed during the night, and was thickest near the river. In the morning it enveloped the whole city.

but when the sun was an hour or two in the heavens the mist began to melt away. It remained longest over the river, and I was occasionally in a thick cloud on the bank of the Angara when the atmosphere a hundred yards away was perfectly clear. The moisture congealed on every stationary object. Houses and fences were cased in ice, its thickness varying with the condition of the weather. Trees and bushes became masses of crystals, and glistened in the sunlight as if formed of diamonds. I could never wholly rid myself of the impression that some of the trees were fountains caught and frozen when in full action. The frost played curious tricks of artistic skill, and its delineations were sometimes marvels of beauty. Any one who has visited St. Petersburg in winter remembers the effect of a fog from the Gulf of Finland after a period of severe cold. The red granite columns of St. Isaac's church are apparently transformed into spotless marble by the congelation of moisture on their surface. In the same manner I have seen a gray wall at Irkutsk changed in a night and morning to a dazzling whiteness. The crystalline formation of the frost had all the varieties of the kaleidoscope without its colors."

Lest some Yankee, whose study of Latin has not robbed him of his birth-right utilitarianism, should ask of the London fog, *cui bono?*, I will quote in conclusion, a pleasing little speculation of Howard, which may serve as an answer in some sort. Thomas Hughes remarks that he considers the power and glory of England to be due in no small degree to the prominence and virtues of the family of "Brown." Our meteorologist seeks to explain one way in which those same "Browns" are developed, and traces the connection between that illustrious family and a London fog (and other forms of moisture) thus:—

"Since man includes in his composition the elements of the inferior natures, and among these the *vegetable*, it is probable that the very growth of our bodies may so depend on moisture, that it could not go on in air of a certain degree of dryness. It is at least plain, that mankind is of a larger growth in rainy countries (whether these be warm or cold) than in those that are subject for a great part of the year to the dry extreme. In like manner, and from like causes, in part, we see that the inhabitants of crowded cities, and manufacturing towns, arrive at a less growth than those in even worse circumstances, as to diet and clothing, in the country; the latter being so much more exposed, in childhood and during adolescence, to the weather."

THE GAME FALCONS OF NEW ENGLAND.

BY WILLIAM WOOD, M.D.

In the April number of the NATURALIST, for 1870, I published an article on Falconry. I now propose to describe, in this and some future numbers, all the falcons found in New England, that were formerly used, or can be trained to capture game, with an account of their habits, manner of nesting, and their eggs. While there are nine of the subgenus Falco found within the limits of North America, only three are found in New England, if I except the gerfalcon, which, if found at all, must be wholly accidental. In this genus, we find birds of smaller size and strength, yet possessing all the courage and swiftness of the eagles. These were the birds used in falconry, and called noble because of the high prerogative of those who followed this amusement. In these, the bill is short, sharp, and curved from the base; the nostrils are circular with a central tubercle. They are easily distinguished from all other hawks by a prominent tooth in the upper mandible, shaped like the letter V, and a notch in the lower one to receive it. This genus is considered by naturalists as "the typical, or most highly or completely organized of rapacious birds."

I will first describe the *Falco peregrinus* Wilson. This is very commonly called the Peregrine falcon, and is inferior to none of its genus in beauty, courage and rapacity. There seems to be some diversity of opinion as to the identity of this and the European species. Bonaparte, DeKay and others, consider them distinct, while Nuttall, Pennant, Audubon and others, believe them identical. Audubon remarks that "once when nearing the coast of England, being then about one hundred and fifty miles distant from it, in the month of July, I obtained a pair of these birds which had come on board of our vessel and had been shot down. I examined them with care, and found no difference between them and those which I shot in America." This is the bird that was so highly prized and mostly used in England for falconry, and among the many hundreds owned by the Grand Khan, once Emperor of Tartary and China, the Peregrine falcon was considered second to none, except the gerfalcon. They are much more common now

than formerly. Audubon remarks "that within his remembrance it was a very scarce species in America, and if he shot one or two in the course of a winter, he considered himself fortunate; whereas, of late years, he has shot as many in a day, and perhaps a dozen in the winter." This bird is sometimes called the Great-footed hawk, on account of the large size of its feet, which are enormous considering the size of the bird. Those not aware of this fact would think it a deformity. On the seashore it is known by the name of the Duck hawk, from its habit of capturing and feeding upon ducks, and the stories relating to its exploits, as narrated by the hunters, are too marvellous to be entitled to credit. It is said that this bird will follow after the gunners, knowing that the report of their guns will start the ducks, and thus afford an opportunity for capturing them, and if not successful, will sometimes seize the game shot by the sportsmen before they can reach it, and fly off with it; but as "it is a poor rule that does not work both ways," the hunter as often secures water-fowls captured by the hawks, before they can carry them away or devour them.

Until quite recently, it has been supposed that the Rocky Mountains were the extreme western limit of this falcon, and that its congener, the *Falco nigriceps*, was its representative in the western portion of this continent, but more recent investigations have given this bird a much larger range. In a letter from Professor S. F. Baird, of Dec. 24th, 1870, he says, "the duck hawk, by our latest researches, is found from Labrador around the entire northern coast to Behring's Straits, and Alaska, of precisely the same general nature as the bird of eastern United States. The western *Falco nigriceps* is, I am now satisfied, simply a smaller race of the duck hawk, and occurs from Puget Sound southward to Chili."

This falcon is bold and powerful, and not excelled by any bird in rapidity of flight. One belonging to Henry II. of France, which flew after a little bustard at Fontainebleau was captured at Malta the next morning and recognized by the ring which it wore; consequently it must have flown one thousand three hundred and fifty miles. One sent to the Duke of Lerma returned in sixteen hours from Andalusia to the Island of Teneriffe, a distance of seven hundred and fifty miles. In the British Zoology, there is an account of one that escaped from its master, in the shire of Angus, a county on the east side of Scotland, with two heavy bells at-

tached to each foot, on the 24th of September, 1772, and was killed on the morning of the 26th near Mostyn, Flintshire.

They live to a great age. In 1793, one was caught at the Cape of Good Hope, and brought to England with a golden collar about its neck, with the date 1610, and an inscription indicating that it belonged to James I. of England. This falcon must have been at least one hundred and eighty-three years old, yet it still appeared lively, but its eyes were dim, and the feathers about the collar were changed to white.

It seldom is seen sailing like most other hawks, but either ascends with a broad spiral circle till it gains a suitable height to select its prey, or perches upon a tree that overlooks some swampy ground where snipe and rail abound, and darts down upon its game with such swiftness that destruction is inevitable. If the bird is too heavy to fly with, it is forced to the ground, otherwise it is carried to the woods and devoured at leisure. In the vicinity of their breeding places they are a terror to the poultry as well as a dread to the farmer, for there they usually hunt in pairs, one following directly after the other, and if the first one misses the game, the other is sure to pick it up; there is no escaping the two. This is the universal testimony of all the farmers living in the vicinity of the cliffs where they breed. One of my collectors went over one hundred miles to get a nest of their eggs, from only hearing a farmer in the vicinity of a cliff describe their manner of hunting: knowing from this circumstance alone, that it must be the duck hawk.

It is stated "that it preys chiefly upon sea-ducks, and therefore is, for the most part, met with on the coast, — is rarely found inland, and its migrations and wanderings are influenced by the flight of its favorite game." This was not the experience of Wilson and Ord along the coast of New Jersey. "To behold this hero, the terror of the wild fowl and the wonder of the sportsman, was the chief object of our wishes. Day after day did we traverse the salt marshes, and explore the ponds and estuaries, which the web-footed tribes frequent in immense multitudes, in the hope of obtaining the imperial depredator; even all the gunners of the district were summoned to our aid, with the assurance of a great reward if they procured him, but without success." Some time after this, Mr. Wilson received a specimen from Egg Harbor. Most of the observations made on this continent relative to the

duck hawk and its habits, have been made along the coast of Labrador and Newfoundland, where the shores and islands abound with rugged cliffs, affording them the very best place to be found anywhere on our Atlantic coast for nidification. This, in connection with an abundance of sea fowls, makes it the favorite resort of this bird; yet, it is nevertheless a fact, that all along our mountainous ranges, whether inland or not, wherever precipitous cliffs are found, they do live and breed, probably resorting to the seashore in the winter, as game is more abundant there. It is said that they are not uncommon in Kansas, and are found in Iowa. I do not find the duck hawk included in Mr. J. A. Allen's list of the birds of western Iowa, yet Mr. L. E. Rickseeker writes me that "he has a fine specimen of the eggs, collected in Iowa, March 21st, 1868."

Manner of nesting. — Ord says, that the duck hawk breeds on trees in the gloomy cedar swamps which are almost inaccessible to the foot of man. This is probably only his belief, for I am unable to learn from his writings that he ever saw a nest, and furthermore, he acknowledges that Wilson and himself faithfully, yet unsuccessfully searched the cedar swamps of New Jersey where they were supposed to breed. Neither Audubon, nor Nuttall ever saw a nest within the limits of the United States, and the former had some doubts as to its rearing young within the above named limits, yet says, "I think they breed in the United States, having shot a specimen in the month of August, near the falls of Niagara."

About the year of 1850, I was aware that a pair of these hawks nested on Talcott Mountain, about ten miles west of Hartford, from the fact that they frequented this place in the spring, summer, and fall months, and I had also seen an adult and young that were shot there in June. Not being aware at that time, that the nest had ever been found within the limits of the United States, I determined, if possible, to settle the question of their nesting, and the manner of their nesting, in Connecticut. For this purpose, I visited the mountain several times, and offered a liberal reward to those living in the vicinity for finding the nest, but it was not until 1861 that my efforts were crowned with success. Four young were taken from the nest alive, and the parent bird shot. This, as I stated in a series of articles which I was then publishing on the "Rapacious Birds of Connecticut," was about the first of June, but on getting the exact date from the captor, I find it was

May 25th that they were taken from a cliff on Talcott mountain, about twenty feet from the summit. It was with inexpressible delight that I viewed these birds, for I then supposed that I was the first to settle the mooted question, and in the article above referred to, I stated that this settles beyond dispute three points; first, that they breed on cliffs; second, that they breed in Connecticut; and third, that they nest very early. These young birds were evidently from four to six weeks old when captured, and allowing three weeks for incubation, it must bring the time of nesting the latter part of March. This was the first nest of the duck hawk ever taken in New England so far as is known to naturalists. The young were kept alive, and two of them were given to Professor S. F. Baird in the fall of 1862, when on a visit to E. W. Hill, and were kept alive at the Smithsonian Institution until the spring of 1863. A few years after this, my attention was called to a note in Dr. Brewer's North American Oölogy, part 1st, page 9, in which it appears that Prof. S. S. Haldeman had found the nest and captured the young on a high and almost vertical cliff on the banks of the Susquehanna; the account of which was published in the "Proceedings of the Academy of Natural Sciences," vol. I, page 54, 1841. Prof. Haldeman says, in that article, "it is asserted in the works on American ornithology that the *Falco peregrinus* builds its nest on trees, and not in the clefts of rock as in Europe. So far as my observations have gone this remark is incorrect, inasmuch as they build in the cliffs which border the Susquehanna. This species remains in Pennsylvania ten or twelve months in the year."

It is now universally admitted that duck hawks nest on cliffs and never on trees, and that they select places difficult to get at and often inaccessible, which is, no doubt, the reason that the eggs have been so seldom found. Says Audubon, in speaking of the nests found on the high and rocky shores of Labrador and Newfoundland, "they were placed on the shelves of rocks, a few feet from the top, and were flat and rudely constructed of sticks and moss." The nest on Talcott Mountain was of the same construction. The nests found by Mr Bennett in Massachusetts and Vermont were entirely destitute of sticks and moss. Mr. B. in describing to me the several nests which he has been fortunate enough to find, says, "they are built a little below the summit of the ledge, on a projection of rocks, which in one instance was not more than one foot in width, without sticks, grass, moss, or the

least vestige of a nest except a slight hollow in the earth, there being barely soil enough to keep the eggs from rolling out. In one instance where there was a little grass on the projection, it was all removed, and nothing but the bare earth left for the nest."

Mr. J. A. Allen, in his "Notes on some of the Rarer Birds of Mass.," gives Mr. Bennett the credit of being the first to find the eggs (April 19, 1864), so far as is known to naturalists, within the limits of the United States. I have received letters from two different sources, claiming to have found the eggs in Pennsylvania and Maryland some years prior to that date. If so, oölogists would not have been any the wiser had it not been for Mr. Bennett's persevering labors. So far as I am able to find any published account of it, Mr. B. is entitled to priority.

It would seem that the duck hawk is not a very pugnacious bird, as other birds are often found nesting quite near it. Says Audubon, "in several instances we found these falcons breeding on the same ledge with Cormorants (*Phalacrocorax carbo*)." Says Mr. G. A. Boardman, "the cliffs on which the duck hawk breeds are very high, and often when above you cannot tell where to go over, as you cannot see the nest from above or below unless the bird flies off. It is so with the ravens. They breed within a few rods of one another in one place." They become very much attached to their nests, and will occupy them as long as they live if not repeatedly robbed of their eggs and disturbed. If one of the pair is shot the surviving one will secure a mate and return to the same nest. In the north of Scotland they breed on the precipitous cliffs of that mountainous region, and some of the eyries have been known traditionally, as far back as the annals of the district extend. Mr. Bennett informs me that a farmer residing in Vermont, under a precipitous cliff, told him that a pair of eagles (duck hawks), had occupied the same nest on the ledge ever since he owned the farm, thirty-seven years, and how much longer he could not tell. Mr. Bennett, with great effort, secured for me from that nest a set of four of the handsomest and most uniformly marked eggs of the duck hawk that I have ever seen. From the same source I learn that this falcon defends it eyrie several weeks prior to occupying it, with as much and even more tenacity than during incubation. This peculiarity is not exclusively confined to this bird, for I have observed the same in some others of our rapacious birds while building their nests. They nest very early and are much

more cleanly in their habits than most birds of prey. Audubon says, "their season of breeding is so very early that it might be said to be in the winter." This needs a little explanation. At the time this was written the only eggs of the duck hawk known to oölogists on this continent were found north of the limits of the United States, where the season is so much later than in our latitude, that snow is frequently on the ground when the eggs are collected. One of my collectors in that locality writes, "I got a nest last spring as early as the first of April, when the snow was a foot deep." This certainly would appear like winter to one accustomed to see the frost out of the ground and the roads settled, as it often is here at that time. The usual time of nesting is from the last of March to the middle of April; sometimes earlier, and sometimes later, but no more irregular as to time than most of our rapacious birds. They will nest two and possibly three times during the season if the eggs are taken as often, as appears from the observations of Mr. Bennett.

If the arbitrary law of James I. of England, relative to robbing the peregrine falcon's nest ("the taking of the eggs, even on a person's own ground, was punished with imprisonment for a year and a day, together with a fine at the king's pleasure"), had been in force in the United States, until quite recently, there could not have been a much less number of their eggs found in our oölogical cabinets that were obtained within our own territory.

The common number of eggs found in a nest is three or four. Audubon once found five. The size and markings vary considerably according to the observations of different writers upon the subject. The first set obtained by Mr. Bennett were quite different in size and markings. Audubon remarks, "the eggs vary considerably in size and markings, which I think is owing to a difference of age in the females; the eggs of the young bird being smaller." This certainly cannot account for the unusual difference in the set obtained by Mr. Bennett, for they were all taken out of the nest at one time, and must have been laid by one bird. Mr. G. A. Boardman writes that "the duck hawk's eggs I find vary much in size and color, the last nest I got from the cliffs at Grand Menan were very oddly marked; one looks very much like the fish hawk's, only differing in size; in another, half the egg is white, with brown blotches on each end." I think the set of Mr. Bennett and that of Mr. Boardman are exceptional cases, as before

me are thirteen eggs of the duck hawk obtained in very different localities, viz: Massachusetts, Vermont, Labrador and Alaska, which are quite irregularly marked, yet as uniform in size and markings as any of the blotched eggs of our rapacious birds. In my collection are fifty-seven eggs of the Red-shouldered hawk (*Buteo lineatus*), and the variations both in size and markings are fully as great and rather more so than those of the duck hawks referred to above. The measurement of one egg from each set will be sufficient (as those belonging to the same set in my own collection are very uniform in size) to show that the difference in size is not very great, although they were collected in widely separate localities.

Massachusetts,—Size of egg, long diameter.						2.15	in.; short diameter.			1.80	in.
Vermont,	"	"	"	"	"	2.08	"	"	"	1.75	"
Labrador,	"	"	"	"	"	2.10	"	"	"	1.68	"
Alaska,	"	"	"	"	"	2.10	"	"	"	1.70	"

The eggs are oblong—larger at one end than the other. The egg from Labrador is quite pointed; those from Massachusetts and Alaska are less so, while those from Vermont are but slightly smaller at one end than the other. The ground color is light reddish brown, mottled with darker shades of the same color in irregular blotches, most abundant at one end, usually the larger end, but occasionally the markings are more delicate and quite evenly distributed. There is now and then an egg in which the ground color is dirty white.

Length of bird, 16–20 inches; alar extent, 36–42 inches; compact and firmly built; neck short, feet remarkably large, upper mandible with a tooth-like process, and a corresponding notch in lower. Adult, head and hind neck dark brown, upper parts bluish gray with darker bands, lower part yellowish white with breast and sides transversely barred with black, cheeks with a patch of black; tail brownish black with eight transverse bars of pale cinereous; legs and toes yellow, bill light blue, eyes hazel. Younger specimens, entire upper parts brownish black, space on cheek black, with long longitudinal stripes of brownish black on the under parts, instead of transverse as in the adult: legs bluish lead color.

A HEARTH OF THE POLISHED STONE AGE.*

On the summit of a steep hill between the valley of the Bas Roches and that of the Dheune, overlooking the immense plain of the Saône, and commanding a view of the Jura, the Alps, and the mountains of the Maconnais and the Morvan, and surrounded by numerous other camps. is the camp of Chassey, which occupies an area of about eight hundred yards in length by a breadth varying from about one hundred to two hundred yards. So commanding and important a spot was not only taken possession of by the Romans for a *castellum*, and by the Gauls for an *oppidum*, but was also occupied in prehistoric times. Several collections of antiquities belonging to different periods have been formed upon the spot, but it was reserved for M. Perrault to make the interesting discovery which he has recorded in so simple yet so complete a manner in the pages now before us. A terrace, sheltered by rocks from the north and east winds and facing the morning sun, seemed to him well adapted for early habitations, while a depression in the ground in front proved, on examination, to contain the remains of a large hearth, or it might be termed kitchen, and here he instituted excavations.

Beneath a few inches of soil he found a bed rather more than two feet in thickness, made up of ashes, bones, and pottery, and containing numerous instruments of various kinds. The whole reposed on a platform of rough slabs of stone, blackened like the soil beneath them by the action of fire. Not a trace of metal was discovered, and in describing the objects found, M. Perrault divides them into (1) instruments of stone, (2) those of bone, and (3) pottery.

Exclusive of fragments, some one hundred and fifty stone instruments were found, consisting for the most part of hatchets, arrowheads, flakes, borers, scrapers, hammers, mealing stones and polishing stones. No less than eight perfect stone hatchets were found, as well as fourteen broken, and of those that were

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* We copy from *Nature* of Jan. 19th the following interesting summary of a recent work by Ernest Perrault, entitled "Note sur un Foyer de l'Age de la Pierre polie decouvert au Camp de Chassey en Septembre, 1869." 1870. 4to. pp. 32, and 8 plates. **London: Williams and Norgate.**

uninjured two were still mounted in stag's horn sockets, similar to those with which the discoveries in the Swiss Lake dwellings have made us so well acquainted.

Only two are of flint, and one of fibrolite, the others being of chloromelanite, serpentine basalt, and diorite. They seem to have been formed from pebbles brought down by the Saône, and it is interesting to observe that the same process of manufacture was in use in this part of Burgundy as in Switzerland, the splitting of the pebbles into the required form having been partly effected by sawing. That some of the spare hours of those who frequented the hearth were employed in preparing their hatchets is proved by the large number of grinding or polishing stones, of which, counting fragments, upwards of sixty were present. M. Perrault regards one of the smallest of the cutting instruments, a little triangular celt, as a religious emblem, but it seems more probable that it was used as a hand-tool, like a chisel, of one of which the sharpened end was also found.

The arrowheads of flint, twenty-three in number, present a variety of forms, leaf-shaped, triangular, lozenge-shaped and tanged, the latter both with and without barbs. Their general aspect is such as might have been expected from the locality, most of the forms occurring also in Switzerland. There are, however, one or two shaped like small hatchets, with a broad, sharp base, formed by the original edge of the flake from which they were made, and rounded, or truncated at the other end. It is stated that this sharp edge was intended for insertion in the wood, but more probably it was the other end that was thus secured, and the arrows were, so to speak, chisel-pointed, like the flint-tipped arrows which survived in use, probably for fowling purposes, after metals became known to the ancient Egyptians. Similar arrowheads, if such they be, have been found in considerable numbers in Sweden, and a few in Denmark, as well as in some other parts of France. It seems by no means impossible that some of the sharp-based instruments from the Yorkshire Wolds may have served a similar purpose.

The mealing stones consist of a large block, usually of hard sandstone or porphyry, and a smaller stone as muller, and are of the same character as those still in use in Central Africa. They must have been gradually eaten together with the flour they produced, and no doubt tended to promote that wearing away of

the crown of the teeth, so common in ancient times. None of the grain has been found, but probably most of the cereals known to the old Swiss Lake dwellers were also known at Chassey.

The objects in bone and horn are almost identical with those from the earlier Swiss Lake dwellings, and consist of the sockets already mentioned, awls, chisels, etc. The pottery, which is extremely fragmentary, is much of the same character as the Swiss. It has been ornamented both by punctured dots and by a sort of pillar moulding, as well as by incised lines. In one instance there seems to have been an attempt to represent the outline of a boar by lines scratched in the clay when still moist. In another, the ornament consists of bands of triangles alternately cross-hatched and plain, a style more in accordance with the bronze age than with that of stone. Most of the pottery seems to have been adapted for suspension. The number of small ears or handles found exceeded two hundred. A few spindle-whorls and beads were also found, but the most curious objects are the spoons, exactly similar in form to those of wood in common use in our kitchens at the present day, but formed of clay. It is true that several wooden ladles and at least one earthenware spoon were found in the settlement of Robenhausen, but one can hardly repress a feeling of surprise at finding the spoon so fully and completely developed among a people apparently unacquainted with the use of metal, though it is true that they appear to have had the materials for porridge at their command.

In concluding this short notice of a valuable contribution to prehistoric archæology, a regret must be expressed that the animal remains discovered in the refuse heap have not, apparently, as yet been submitted to proper scientific examination, so as to determine the species, and which of them were domesticated, though some human remains from neighboring tumuli and interments are reported on by Dr. Pruner-Bey. The animals whose bones occurred are described as the ox (possibly domesticated), pig, stag, sheep, goat, and horse, which is rare. The bones are not always broken, and the vertebræ occasionally occurred in juxtaposition, as if meat at times had been extremely abundant. There is no mention of any remains or traces of dogs, and this condition of the bones seems to afford an argument in favor of their absence, which, if established, would be a remarkable fact. Some teeth of reindeer are mentioned as having been found on the plateau, and

it would be of great interest to ascertain their relation to the other remains. Let us trust that ere long there may again be a season in France when a thought may fairly be bestowed on other camps and other earthworks than those on which attention is now so unfortunately concentrated.

BRISTLE-TAILS AND SPRING-TAILS.

BY A. S. PACKARD, JR., M.D.

The Thysanura, as the Poduras and their allies, the Lepismas, are called, have been generally neglected by entomologists, and but few naturalists have paid special attention to them.* Of all those microscopists who have examined Podura scales as test objects, we wonder how many really know what a Podura is?

In preparing the following account I have been under constant indebtedness to the admirable and exhaustive papers of Sir John Lubbock, in the London Linnæan Transactions (vols. 23, 26 and 27). Entomologists will be glad to learn that he is shortly going to press with a volume on the Poduras, which, in distinction from the Lepismas, to which he restricts the term Thysanura, he calls Collembola, in allusion to the sucker-like tubercle situated on the under side of the body, which no other insects are known to possess.

The group of Bristle-tails, as we would dub the Lepismas in distinction from the Spring-tails, we will first consider. They are abundant in the Middle States under stones and leaves in forests, and northward are common in damp houses, while one beau-

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* Nicolet, in the "Annales de la Societe Entomologique de France" (tome v, 1847), has given us the most comprehensive essay on the group, though Latreille had previously published an important essay, "De l'Organization Exterieure des Thysanoures" in the "Nouvelles Annales du Museum d'Histoire Naturelle Paris, 1832," which I have not seen. Gervais has also given a useful account of them in the third volume of "Apteres" of Roret's Suite a Buffon, published in 1844.

The Abbe Bourlet, Templeton, Westwood, and Haliday have published important papers on the Thysanura; and Meinert, a Danish naturalist, and Olfers, a German anatomist, have published important papers on the anatomy of the group. In this country Say and Fitch have described less than a dozen species, and the writer has described a new species of Campodea, while Humbert has described in a French scientific journal a species of Japyx (*J. Saussurii*) from Mexico.

tiful species that we have never noticed elsewhere, is our "cricket on the hearth," abounding in the chinks and crannies of the range of our house, and coming out like cockroaches, at night, shunning the light. Like the cockroaches, which they vaguely resemble in form, this species loves hot and dry localities, in distinction from the others which seek moisture as well as darkness. By some they are called "silver witches," and as they dart off, when disturbed, like a streak of light, their bodies being coated in a suit of shining mail, which the arrangement of the scales resembles, they have really a weird and ghostly look.

The *Lepisma saccharina* of Linnæus, if, as is probable, that is the name of our common species, is not uncommon in old damp houses, where it has the habits of the cockroach, eating cloths, tapestry, silken trimmings of furniture, and doing occasional damage to libraries by devouring the paste, and eating holes in the leaves and covers of books.

In general form Lepisma may be compared to the larva of Perla, a net-veined Neuropterous insect, and also to the narrow-bodied species of cockroaches, minus the wings. The body is long and narrow, covered with rather coarse scales, and ends in three many-jointed anal stylets, or bristles, which closely resemble the many-jointed antennæ, which are remarkably long and slender. The thermophilous species already alluded to may be described as perhaps the type of the genus, the *L. saccharina* being simpler in its structure. The body is narrow and flattened; the basal joints of the legs being broad, flat and almost triangular, like the same joints in the cockroaches. The legs consist of six joints, the tarsal joints being large and two in number, and bearing a pair of terminal curved claws. The three thoracic segments are of nearly equal size, and the eight abdominal segments are also of similar size. The tracheæ are well developed, and may be readily seen in the legs. The end of the rather long and weak abdomen is propped up by two or three pairs of bristles, which are simple, not jointed, but moving freely at their insertion; they thus take the place of legs, and remind one of the abdominal legs of the Myriapods; and we shall see in certain other genera (Machilis and Campodea) of the Bristle-tails that there are actually two-jointed bristles arranged in pairs along the abdomen. They may probably be directly compared with the abdominal legs of Myriapods. Further study, however, of the homologies of these peculiar appendages,

and especially a knowledge of the embryological development of Lepisma and Machilis, is needed before this interesting point can be definitely settled. The three many-jointed anal stylets may, however, be directly compared with the similar appendages of Perla and Ephemera. The mode of insertion of the antennæ of this family is much like that of the Myriapods, the front of the head being flattened, and concealing the base of the antennæ, as in the Centipedes and Pauropus. Indeed the head of any Thysanurous insect seen from above, bears a general resemblance in some of its features to that of the Centipede and its allies. So in a less degree does the head of the larvæ of certain Neuroptera and Coleoptera. The eyes are compound, the single facets forming a sort of heap. The clypeus and labrum, or upper lip, is, in all the Thysanura, carried far down on the under side of the head, the clypeus being almost obsolete in the Poduridæ, this being one of the most essential characters of that family. Indeed, it is somewhat singular that these and other important characteristics of this group have been almost entirely passed over by authors, who have consequently separated these insects from other groups on what appear to the writer as comparatively slight and inconsiderable characters. The mouth-parts of the Lepismatidæ (especially the thermophilous Lepisma, which we now describe) are most readily compared with those of the larva of Perla.

Fig. 23.



The rather large, stout mandibles are concealed at their tips, under the upper lip, which moves freely up and down when the creature opens its mouth. The mandible is about one third as broad as long, armed with three sharp teeth on the outer edge, and with a broad cutting edge within, and still further within, a lot of straggling spinules. In all these particulars, the mandible of Lepisma is comparable with that of certain Coleoptera and Neuroptera. So also are the maxillæ and labium, though we are not aware that any one has indicated how close the homology is. The accompanying figure (23) of the maxilla of a beetle may serve as an example of the maxilla of the Coleoptera, Orthoptera, and Neuroptera. In these insects it consists invariably of three lobes, the outer being the palpus, the middle lobe the galea, and the innermost the lacinia; the latter undergoing the greatest modifications, forming a comb composed of spines and hairs varying greatly in relative size and length. How much the

palpi vary in these groups of insects is well known. The galea sometimes forms a palpus-like appendage. Now these three lobes may be easily distinguished in the maxilla of Lepisma. The palpus instead of being directed forward, as in the insects mentioned above (in the pupa of Ephemera the maxilla is much like that of Lepisma), is inserted nearer the base than usual and thrown off at right angles to the maxilla, so that it is stretched out like a leg, and in moving about the insect uses its maxillæ partly as supports for its head. They are very long and large, and five or six-jointed. The galea, or middle division, forms a simple lobe, while the lacinia has two large chitinous teeth on the inner edge, and internally four or five hairs arising from a thin edge.

The labium is much as in that of Perla, being broad and short, with a distinct median suture, indicating its former separation in embryonic life into a pair of appendages. The labial palpi are three-jointed; the joints being broad, and in life directed backwards instead of forwards, as in the higher insects.

There are four American species of the genus Lepisma in the Museum of the Peabody Academy, which contains, so far as we are aware, the only collection, small as it is, of Thysanura in the country. Besides the common *L. saccharina?* (Pl. 1, fig. 1) there are three undescribed species; one the heat-loving form, perhaps an imported species, found in a kitchen in Salem, and apparently allied to the *L. thermophila* Lucas, of houses in Brest, France; and two allied forms, one from Key West, and another from Polvon, Western Nicaragua, collected by Mr. McNiel. These three last species are beautifully ornamented with finely spinulated hairs arranged in tufts on the head: while the sides of the body, and edges of the basal joints of the legs are fringed with them.

The most complicated genus, and which stands at the head of the family, is Machilis (Pl. 1. figs. 8, 9), of which there are specimens in the Museum of the Peabody Academy, from Albany, N. Y., Virginia, and Oregon, indicating two species. They affect dry places, living under leaves and stones. They all have rounded, highly arched bodies, and large compound eyes, the pair being united together. The maxillary palpi are greatly developed: but the chief characteristics are the two-jointed stylets arranged in nine pairs along each side of the abdomen, reminding us of the abdominal legs of Myriapods. The body ends in three long bristles, as in Lepisma. The interesting genus Nicoletia stands at the bot-

tom of the group. It has the long, linear, scaleless body of Campodea, in the family below, but the head and its appendages are like Lepisma, the maxillary palpi being five-jointed, and the labial palpi four-jointed. The eyes are simple, arranged in a row of seven on each side of the head. The abdomen ends in three long and many-jointed stylets, and there are the usual "false branchial feet" along each side of the abdomen. There are two European species which occur in green houses. No species have yet been found in America.

The next family of Thysanura is the Campodeæ, comprising the two genera, Campodea, and Japyx. These insects are much smaller than the Lepismidæ, and in some respects are intermediate between that family and the Podurida (including the Smynthuridæ).

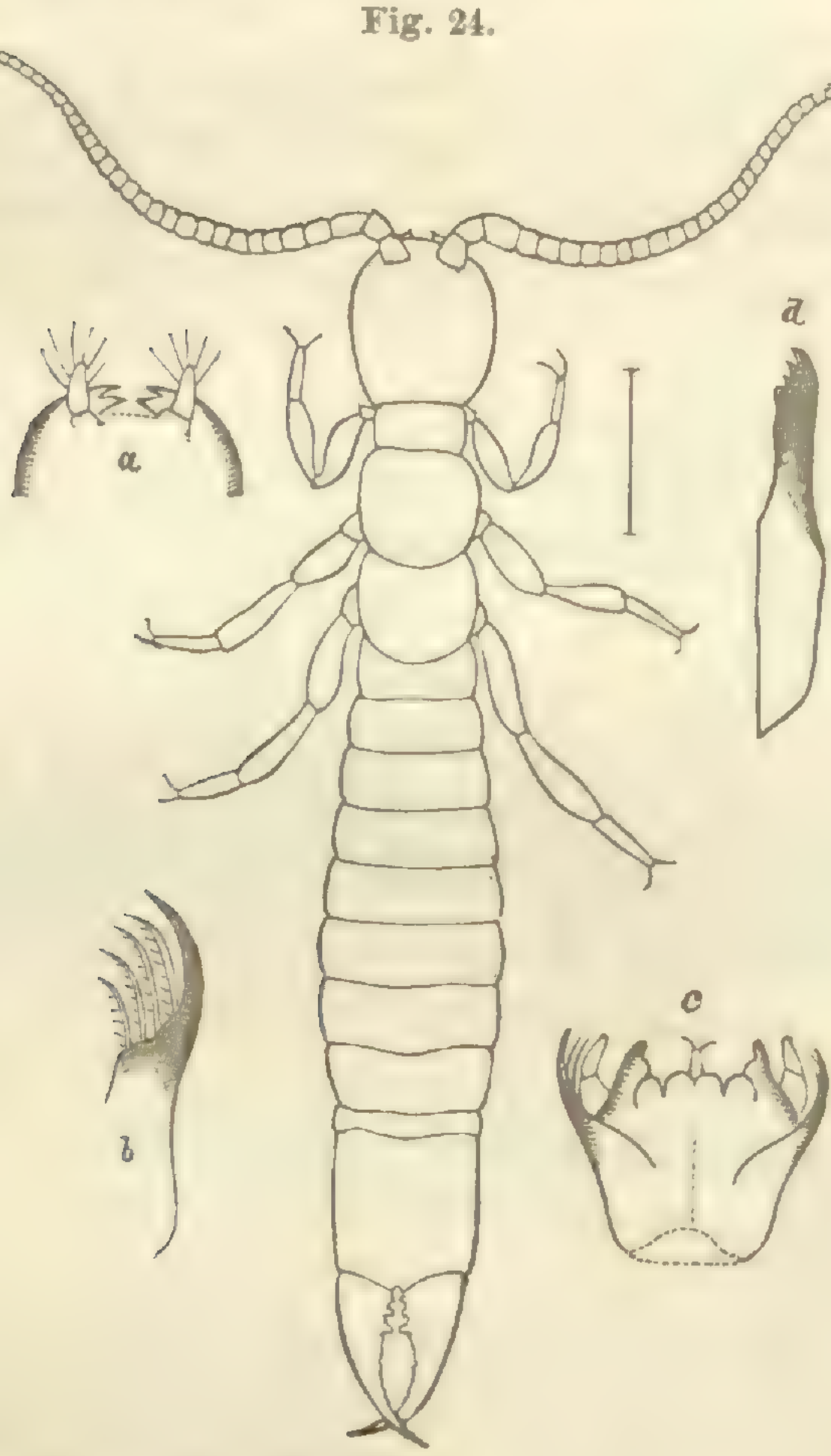
In this family the body is long and slender, and the segments much alike in size. There is a pair of spiracles on each thoracic ring. The mandibles are long and slender, ending in three or four teeth, and, with the other appendages of the mouth, are concealed within the head, "only the tips of the palpi (and of the maxillæ when these are opened) projecting a very little beyond the rounded entire margin of the epistoma," according to Haliday. The maxillæ are comb-shaped, due to the four slender, minutely ciliated spines placed within the outer tooth. The labium in Japyx is four-lobed and bears a small two-jointed palpus. The legs are five-jointed, the tarsi consisting of a single joint, ending in two large claws. The abdomen consists of ten segments, and in Campodea along each side is a series of minute, two-jointed appendages such as have been described in Machilis. These are wanting in Japyx. None of the species in this family have the body covered with scales.

The more complicated genus of the two is Japyx (Fig. 24, *Japyx solifugus* Hal.; *a*, the mouth from beneath, with the maxillæ open: *b*, maxilla; *d*, mandible; *c*, outline of front of head seen from beneath, with the labial palpi in position), which, as remarked by the late Mr. Haliday (who has published an elaborate essay on this genus in the Linnæan Transactions, vol. 24, 1864), resembles Forficula in the large forceps attached to its tail.

Campodea (*C. staphylinus* Westw., Fig. 25, enlarged; *a*, mandible; *b*, maxilla), otherwise closely related, has more rudimentary mouth-parts, and the abdomen ends in two many-jointed bristles.

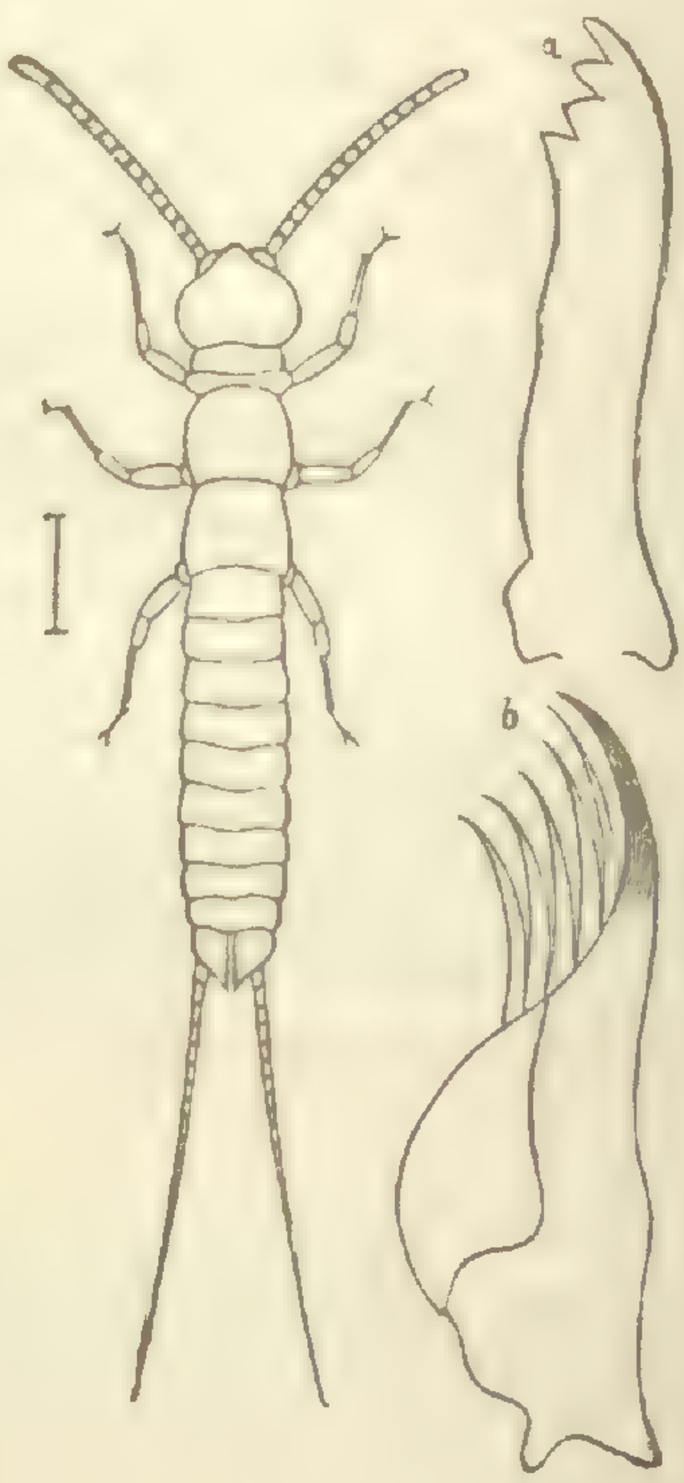
Our only American species of Campodea (*C. Americana* Pack.) lives under stones in damp places. It is yellowish, about a sixth of an inch in length, is very agile in its movements, and would easily be mistaken for a very young Lithobius. Haliday has remarked that this family bears much resemblance to the Neuropterous larva of Perla, as previously remarked by Gervais; and the many points of resemblance of this family and the Lepismidæ to the larval forms of those Neuroptera that are active in the pupa

Fig. 24.



Japyx.

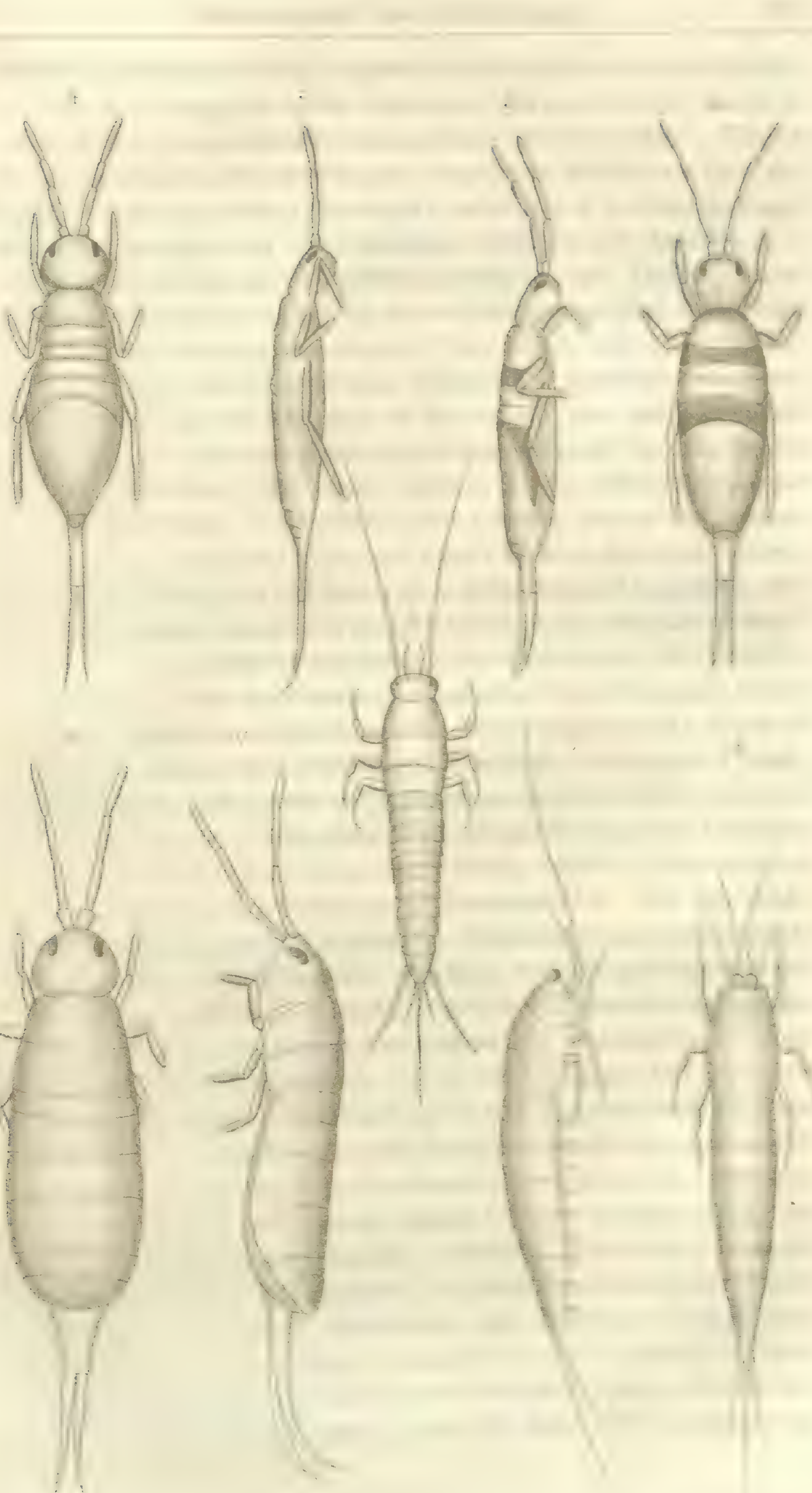
Fig. 25.



Campodea.

state (the Pseudo-neuroptera of Erichson and other authors) are very striking. Campodea resembles the earliest larval form of Chloëon, as figured by Sir John Lubbock, even to the single-jointed tarsus; and why these two Thysanurous families should be removed from the Neuroptera we are unable, at present, to understand, as to our mind they do not diverge from the Neuropterous type any more than the Mallophaga, or biting lice, do from the type of Hemiptera.

Haliday, remarking on the opinion of Linnæus and Schrank, who



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referred Campodea to the old genus Podura, says with much truth. "it may be perhaps no unfair inference to draw, that the insect in question is in some measure intermediate between both." This is seen especially in the mouth-parts which are withdrawn into the head, and become very rudimentary, affording a gradual passage into the mouth-parts of the Poduridæ, which we now describe.

The next group, the Podurelles of Nicolet, and Collembola of Lubbock, are considered by the latter, who has studied them with far more care than any one else, as "less closely allied" to the Lepismidæ "than has hitherto been supposed." He says "the presence of tracheæ, the structure of the mouth, and the abdominal appendage, all indicate a wide distinction between the Lepismidæ and the Poduridæ. We must, indeed, in my opinion, separate them entirely from one another; and I would venture to propose for the group comprised in the old genus Podura, the term Collembola, as indicating the existence of a projection, or mammilla, enabling the creature to attach or glue itself to the body on which it stands." Then without expressing his views as to the position and affinities of the Lepismidæ, he remarks "as the upshot of all this, then, while the Collembola are clearly more nearly allied to the Insecta than to the Crustacea or Arachnida, we cannot, I think, regard them as Orthoptera or Neuroptera, or even as true insects. That is to say, the Coleoptera, Orthoptera, Neuroptera, Lepidoptera, etc., are in my opinion, more nearly allied to one another than they are to the Poduridæ or Smynthuridæ. On the other hand, we certainly cannot regard the Collembola as a group equivalent in value to the Insecta. If, then, we attempt to map out the Articulata, we must, I think, regard the Crustacea and Insecta as continents, the Myriapoda and Collembola as islands — of less importance, but still detached. Or, if we represent the divisions of the Articulata like the branching of a tree, we must picture the Collembola as a separate branch, though a small one, and much more closely connected with the Insecta, than with the Crustacea or the Arachnida." Lamarck regarded them as more nearly allied to the Crustacea than Insecta. Gervais, also, in the "Histoire Naturelles des Insectes: Apteres," indicates a considerable diversity existing between the Lepismidæ and Poduridæ, though they are placed next to each other. Somewhat similar views have been expressed by so high an authority as Professor Dana, who, in the "American Journal of Science" (vol. 37, Jan., 1864), proposed a

classification of insects (based on the principle of cephalization), and divided the Hexapodous insects into three groups: the first (Ptero-prosthenics, or Ctenopters) comprising the Hymenoptera, Diptera, Aphaniptera (Fleas), Lepidoptera, Homoptera, Trichoptera and Neuroptera; the second group (Ptero-metasthenics, or Elytropters) comprising the Coleoptera, Hemiptera and Orthoptera; while the Thysanura compose the third group. Lubbock has given us a convenient historical view of the opinions of different authors regarding the classification of these insects, which we find useful. Nicolet, the naturalist who, previous to Lubbock, has given us the most correct and complete account of the Thysanura, regarded them as an order, equivalent to the Coleoptera or Diptera, for example. In this he followed Latreille, who established the order in 1796. The Abbe Bourlet adopted the same view. On the other hand Burmeister placed the Thysanura as a separate tribe between the Mallophaga (Bird Lice) and Orthoptera, and Gerstaecker placed them among the Orthoptera. Fabricius and Blainville put them with the Neuroptera, and the writer, in his "Guide to the Study of Insects," and previously in 1863, ignorant of the views of the two last named authors, considered the Thysanura as degraded Neuroptera, and noticed their resemblance to the larvæ of Perla, Ephemera, and other Neuroptera, such as Rhaphidia and Panorpa, regarding them as standing "in the same relation to the rest of the Neuroptera [in the Linnæan sense], as the flea does to the rest of the Diptera, or the lice and Thrips to the higher Hemiptera."

After having studied the Thysanura enough to recognize the great difficulty of deciding as to their affinities and rank, the writer does not yet feel prepared to go so far as Dana and Lubbock, for reasons that will be suggested in the following brief account of the more general points in their structure, reserving for another occasion a final expression of his views as to their classification.

The Poduridæ, so well known by name, as affording the scales used by microscopists as test objects, are common under stones and wet chips, or in damp places, cellars, and about manure heaps. They need moisture, and consequently shade. They abound most in spring and autumn, laying their eggs at both seasons, though most commonly in the spring. During a mild December, such as just experienced, they may be found in abundance. Nearly a dozen species were found on the grounds of the Museum of the

Peabody Academy, affording ample material for study until nearly Christmas time, and again, late in February. About a hundred species are found in Europe, and nearly a quarter of that number I have, with the aid of my friend Mr. C. A. Walker, observed in this country, though paying little attention to them previous to last autumn.

The body of the Poduras is rather short and thick, most so in Smynthurus (Fig. 26), and becoming long and slender in Tomocerus and Isotoma. The segments are inclined to be of unequal size, the prothoracic ring sometimes becoming almost obsolete, and some of the abdominal rings are much smaller than others; while in Anura and Lipura, the lowest forms of the group, the segments are all much alike in size.

The head is, in form, much like that of certain larvæ of Neuroptera. The basal half of the head is marked off from the eye-bearing piece (epicranium) by a V-shaped suture (Fig. 28, head of Degeeria), and the insertion of the antennæ is removed far down the front, near the mouth, the clypeus being very short: this piece, so large and prominent in the higher insects, is not distinctly separated by suture from the surrounding parts of the head, thus affording one of the best distinctive characters of the Poduridæ. The eyes are situated on top of the head just behind the antennæ, and are simple, consisting of a group of from five to eight or ten united into a mass in Smynthurus, but separated in the Poduridæ (Fig. 41, *e*, eye of Anura). The antennæ are usually four-jointed, and vary in length in the different genera. The mouth-parts are very difficult to make out, but by soaking the insect in potash for twenty-four hours, thus rendering the body transparent, they can be satisfactorily observed. They are constructed on the same general type as the mouth-parts of the Neuroptera, Orthoptera, and Coleoptera, and except in being degraded, and with certain parts obsolete, they do not essentially differ. On observing the living Podura, the mouth seems a simple ring, with a minute labrum and groups of hairs and spinules, which the observer, partly by guess-work, can identify as jaws, and maxillæ, and labium. But in studying the parts rendered transparent, we can identify the different appendages. Fig. 29 shows the common *Tomocerus plumbeus* greatly enlarged, and as the mouth-parts of the whole group of Poduras are remarkably constant, a description of one genus will suffice for all. The labrum, or upper lip, is sepa-

rated by a deep suture from the clypeus, and is trapezoidal in form. The mandibles and maxillæ are long and slender, and buried in the head, with the tips capable of being extended out from the ring surrounding the mouth for a very short distance. The mandibles (*md*, Fig. 30) are like those of the Neuroptera, Orthoptera and Coleoptera, in their general form, the tip ending in from three to six teeth (three on one mandible and six on the other), while below (Fig. 41, *md*) is a rough, denticulated molar surface, where the food seized by the terminal teeth is triturated and prepared to be swallowed. Just behind the mandibles are the maxillæ, which are trilobate at the end, as in the three orders of insects above named. The outer lobe, or palpus, is a minute membranous tubercle ending in a hair (Fig. 31, *mp*), while the middle lobe, or galea. is nearly obsolete, though I think I have seen it in Smynthurus where it forms a lobe on the outside of the lacinia. The lacinia. or inner lobe (Fig. 31, *lc*; 32, the same enlarged), in Tomocerus consists of two bundles of spinules, one broad like a ruffle, and the other slender, pencil-like, ending in an inner row of spines, like the spinules on the lacinia of the Japyx and Campodea, and, more remotely, the laciniæ of the three orders of insects above referred to. There is also a horny, prominent, three-toothed portion (Fig. 31, *g*). These homologies have never been made before, but they seem natural, and suggested by a careful examination and comparison with the above-mentioned mandibulate insects.

The spring consists of a pair of three-jointed appendages, with the basal joint soldered together early in embryonic life, while the two other joints are free, forming a fork. It is longest in Smynthurus and Degeeria, and shortest in Achorutes (Fig. 36, *b*), where it forms a simple, forked tubercle; and is obsolete in Lipura, its place being indicated by an oval scar. The third joint varies in form, being hairy, serrate and knife-like in form, as in Tomocerus (Fig. 30, *a*), or minute, with a supplementary tooth, as in Achorutes (Fig. 36, *c*). This spring is in part homologous with the ovipositor of the higher insects, which originally consists of three pairs of tubercles, each pair arising apparently from the seventh, eighth, and ninth (the latter the penultimate) segments of the abdomen in the Hymenoptera. The spring of the Podura seems to be the homologue of the third pair of these tubercles, and is inserted on the penultimate segment. This comparison I have been able to make from a study of the embryology of Isotoma.

Another organ, and one which, so far as I am aware, has been overlooked by previous observers, I am disposed to consider as an ovipositor. In the genus Achorutes, it may be found in the segment just behind the spring-bearing segment, and situated on the median line of the body. It consists (Fig. 36) of two squarish valves, from between which project a pair of minute tubercles, or blades, with four rounded teeth on the under side. This pair of infinitesimal saws, remind one of the blades of the saw-fly, and I am at a loss what their use can be unless to cut and pierce so as to scoop out a place in which to deposit an egg. It is homologous in situation with the middle pair of blades which compose the ovipositor of higher insects, and if it should prove to be used by the creature in laying its eggs, we should then have with the spring, an additional point of resemblance to the Neuroptera and higher insects, and instead of this spring being an important differential character, separating the Thysanura from other insects, it binds them still closer, though still differing greatly in representing only a part of the ovipositor of the higher insects.

But all the Poduras differ from other insects in possessing a remarkable organ situated on the basal segment of the abdomen. It is a small tubercle, with chitinous walls, forming two valves from between which is forced out a fleshy sucker, or, as in Smynthurus, a pair of long tubes, which are capable of being darted out on each side of the body, enabling the insect to attach itself to smooth surfaces, and rest in an inverted position.

The eggs are laid few in number, either singly or several together, on the under side of stones, chips, or, as in the case of *Isotoma Walkerii* Pack., under the bark of trees. They are round, transparent. The development of the embryo of Isotoma in general accords with that of the Phryganeidæ and suggests the near relationship of the Thysanura to the Neuroptera.

Sir John Lubbock has given us an admirable account of the internal anatomy of these little creatures, his elaborate and patient dissections filling a great gap in our knowledge of their internal structure. The space at our disposal only permits us to speak briefly of the respiratory system. Lubbock found a simple system of tracheæ in Smynthurus which opens by "two spiracles in the head, opposite the insertion of the antennæ," *i. e.*, on the back of the head. (Von Olfers says, they open on the prothorax.) Nicolet and Olfers claim to have found tracheæ in several lower

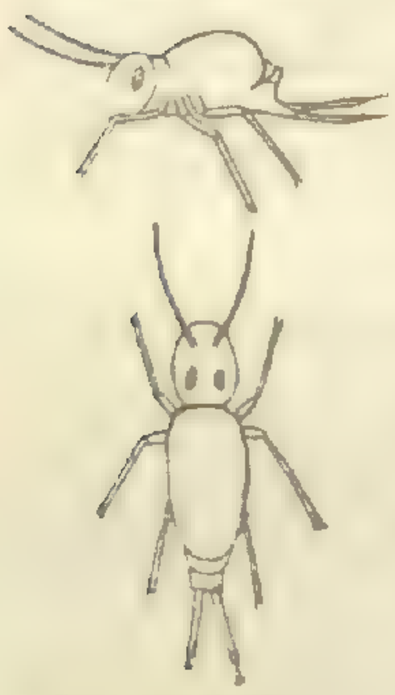
genera (Orchesella, Tomocerus, and Achorutes, and allied genera). but Lubbock was unable to detect them, and I may add that I have not found them either in living specimens, or those rendered transparent by potash, though careful search was made for them.

Having given a hasty sketch of the external aspect of the Poduras, I extract from Lubbock a synopsis of the families and genera for the convenience of the student, with the names of known American species, or indications of undescribed native forms.

SMYNTHURIDÆ.

Body globular or ovoid; thorax and abdomen forming one mass; head vertical or inclined; antennæ of four or eight segments. Eyes eight on each side, on the top of the head. Legs long and slender. Saltatory appendage with a supplementary segment.

Fig. 26.



Smynthurus.

Smynthurus Latreille. Antennæ four-jointed, bent at the insertion of the fourth, which is nearly as long as the other three, and appears to consist of many small segments. No conspicuous dorsal tubercles. (In this country Fitch has described five species: *S. arcalis*, *elegans*, *hortensis*, *Novaboracensis*, and *signifer*. Fig. 26 represents a species found in Maine.)

Dicyrtoma Bourlet. Antennæ eight-jointed, five before, three after the bend. Two dorsal tubercles on the abdomen.

Papirius Lubbock.* Antennæ four-jointed, without a well-marked elbow, and with a short terminal segment offering the appearance of being many-jointed.

PODURIDÆ.

This family comprises those species of the old genus Podura, in which the mouth has mandibles [also maxillæ and a labium], and the body is elongated, with a more or less developed saltatory appendage at the posterior extremity.

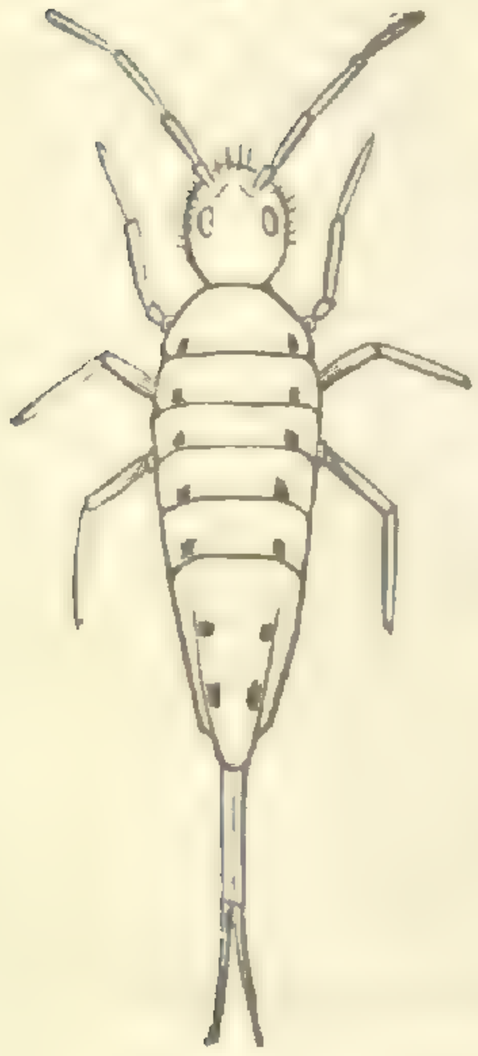
Orchesella Templeton. Segments of the body unequal in size.

*Lubbock considers that Papirius should be placed in a distinct family from Smynthurus, because it wants trachea. Their presence or absence scarcely seems to us to be a family character, as they are wanting in the Poduridæ, and are not essential to the life of these animals, while in other respects Papirius differs but slightly from Smynthurus.

more or less thickly clothed by clubbed hairs. Antennæ long, six-jointed. Eyes six in number on each side, arranged in the form of an S. (One or two beautiful species live about Salem.)

Degeeria Nicolet. Segments of the body unequal in size, more or less thickly clothed by clubbed hairs. Antennæ longer than the head and thorax, filiform, four-jointed. Eyes eight in number, on each side of the head. (Two species are figured on Pl. 1, figs. 2–5. Fig. 27 represents a species found in Salem, Mass., closely allied to the European *D. nivalis*. Fig. 28, head of a Degeeria, showing the parts of the head. Five species are already known in New England.)

Fig. 27.



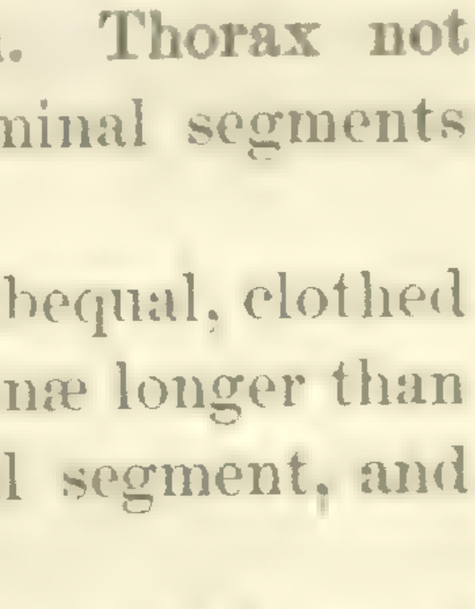
Degeeria.

Seira Lubbock. Body covered with scales. Antennæ four-jointed; terminal segment not ringed. Eyes on a dark patch. Thorax not projecting over the head. Abdominal segments unequal.

Templetonia Lubbock. Segments of the body subequal, clothed by clubbed hairs, and provided with scales. Antennæ longer than the head and thorax, five-jointed, with a small basal segment, and with the terminal portion ringed.

Isotoma Bourlet (*Desoria* Nicolet). Four anterior abdominal segments subequal, two posterior ones small; body clothed with simple hairs, and without scales. Antennæ four-jointed, longer than the head; segments subequal. Eyes seven in number on each side, arranged in the form of an S. (Three species are found in Massachusetts, one of which is figured on Pl. 1, figs. 6, 7.)

Fig. 28.



Head of Degeeria.

Tomocerus Nicolet. Abdominal segments unequal, with simple hairs and scales. Antennæ very long, four-jointed, the two terminal segments ringed. Eyes seven in number on each side. (The European *T. plumbea* Linn., *Podura plumbea* of authors, is one of our most common species. Fig. 29, greatly enlarged, copied from Templeton; fig. 30, side view, see also fig. 31, where the mouth-parts are greatly enlarged, the lettering being the same, *md*, mandibles; *mx*, maxillæ; *mp*, maxillary palpus; *lb*, labium; *lp*, labial palpus; *lc*, lacinia; *g*, portion ending in three teeth; *l*, lobe of labium; *sp*,

Fig. 30.

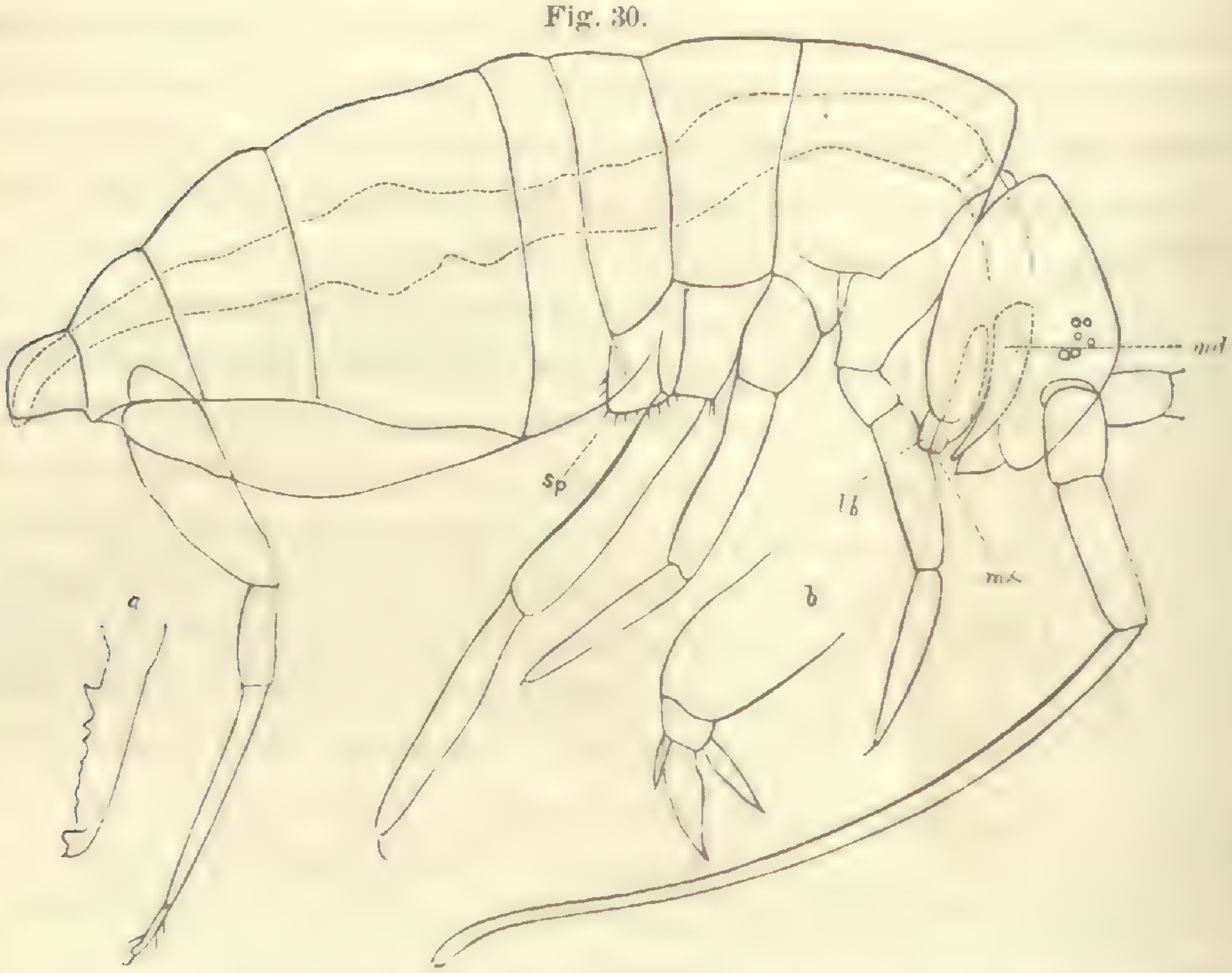


Fig. 33.

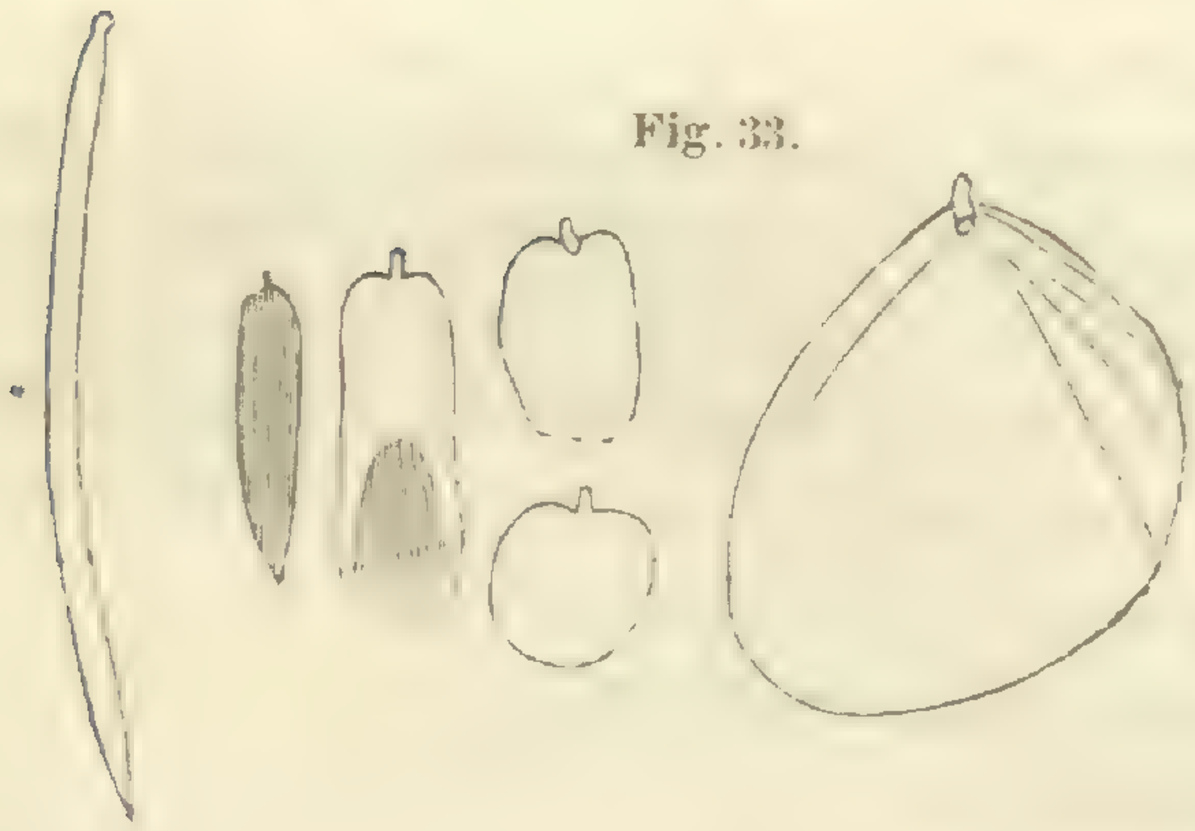


Fig. 29.

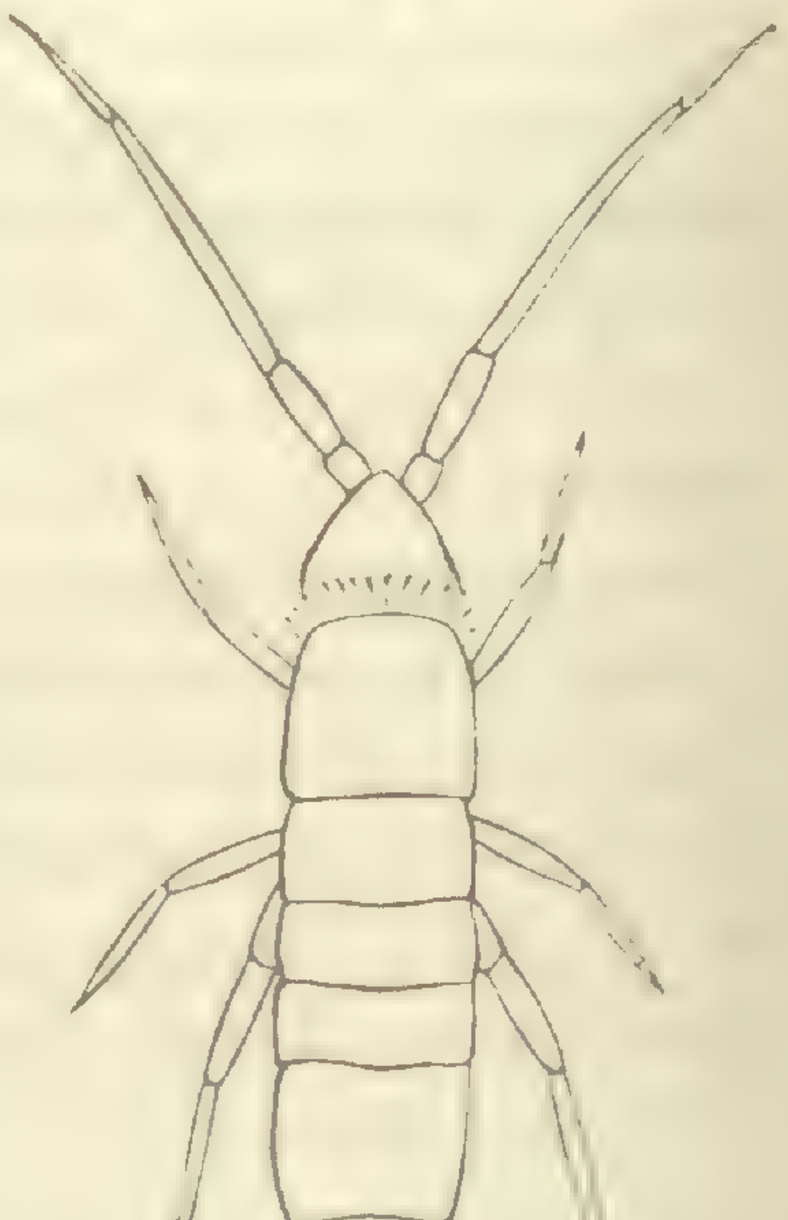


Fig. 31.

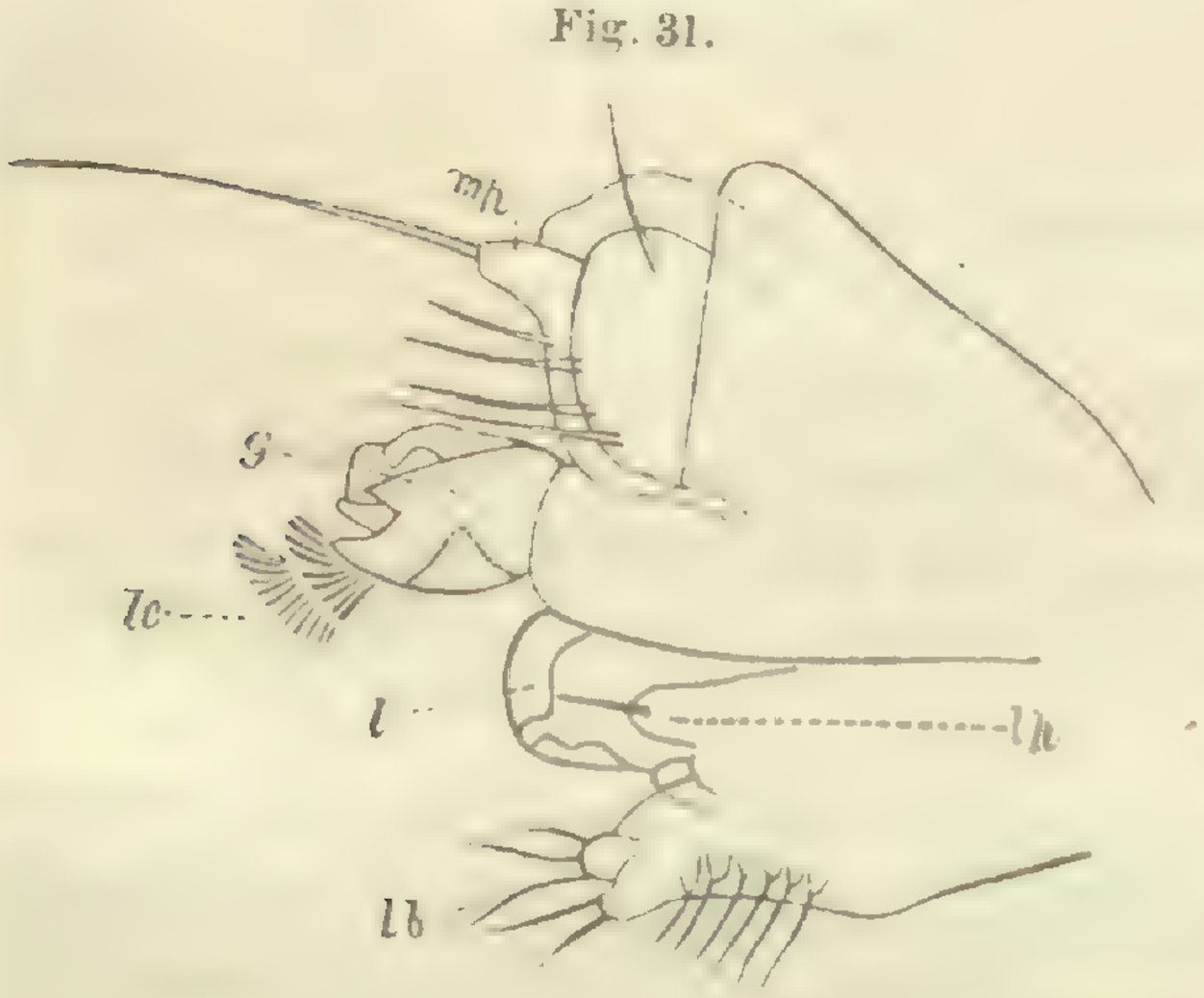
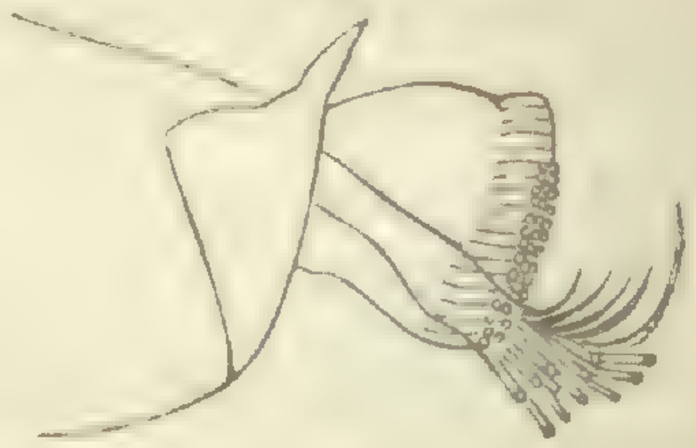


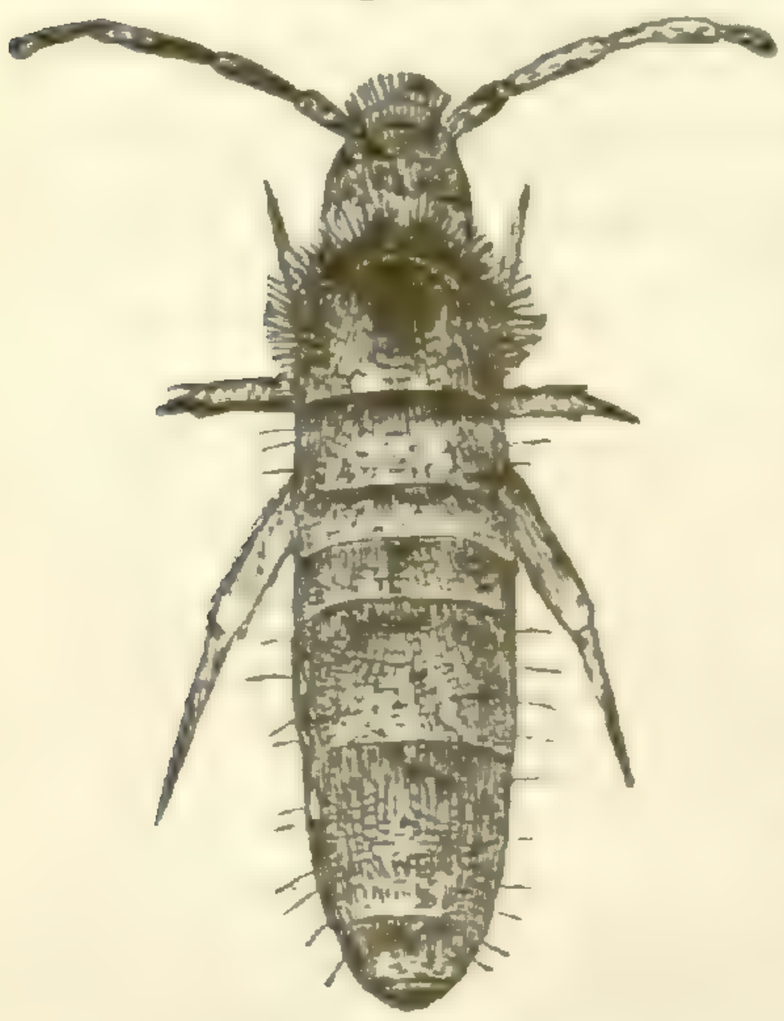
Fig. 32.



Tomocerus Plumbeus.

ventral sucking disc; the dotted lines passing through the body represent the course of the intestine; *b*, end of tibia, showing the tarsus, with the claw, and two accessory spines: *a*, third joint of the spring. Fig. 32, lacinia of maxilla greatly enlarged. Fig. 33, different forms of scales, showing the great variation in size and form, the narrow ones running into a linear form, becoming hairs. The markings are also seen to vary, showing their unreliable character as test objects, unless a single scale is kept for use.)

Fig. 34.



Lepidocyrtus albinos.

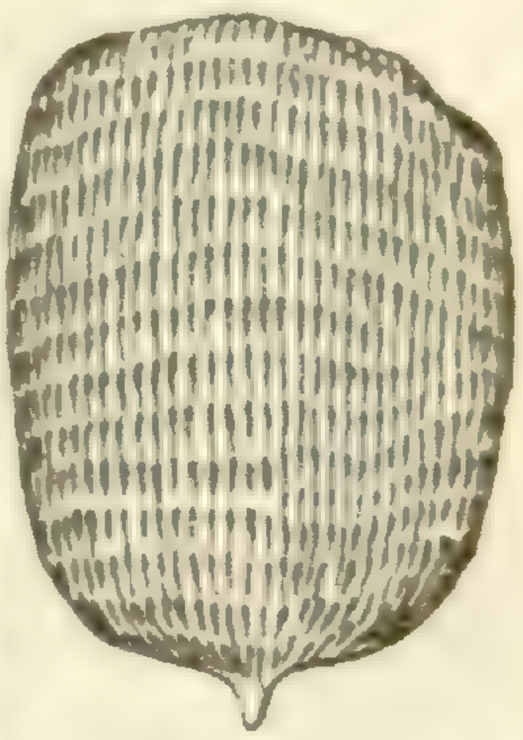
Lepidocyrtus Bourlet. Abdominal segments unequal, with simple hairs and scales. Antennæ long, four-jointed. Eyes eight in number on each side. (Fig. 34, *L. albinos*, an European species, from Hardwicke's "Science Gossip." Fig. 35, a scale. Two species in New England.)

Podura. Abdominal segments subequal. Hairs simple, no scales. Antennæ four-jointed, shorter than the head. Eyes eight in number on each side. Saltatory appendage of moderate length.

Achorutes Templeton. Abdominal segments subequal. Antennæ short, four-jointed. Eyes eight in number on each side. Saltatory appendage quite short.

Fig. 36 represents a species of this genus very abundant under the bark of trees, etc., in New England. It is blackish lead color; *a*, end of tibia bearing a tenant hair, with the tarsal joint and large claw; *b*, spring; *c*, the third joint of the spring, with the little spine at the base; fig. 37, the supposed ovipositor; *a*, the two blades spread apart; *b*, side view. The mouth-parts in this genus are much as in Tomocerus, the maxillæ ending in a lacinia and palpus.

Fig. 35.

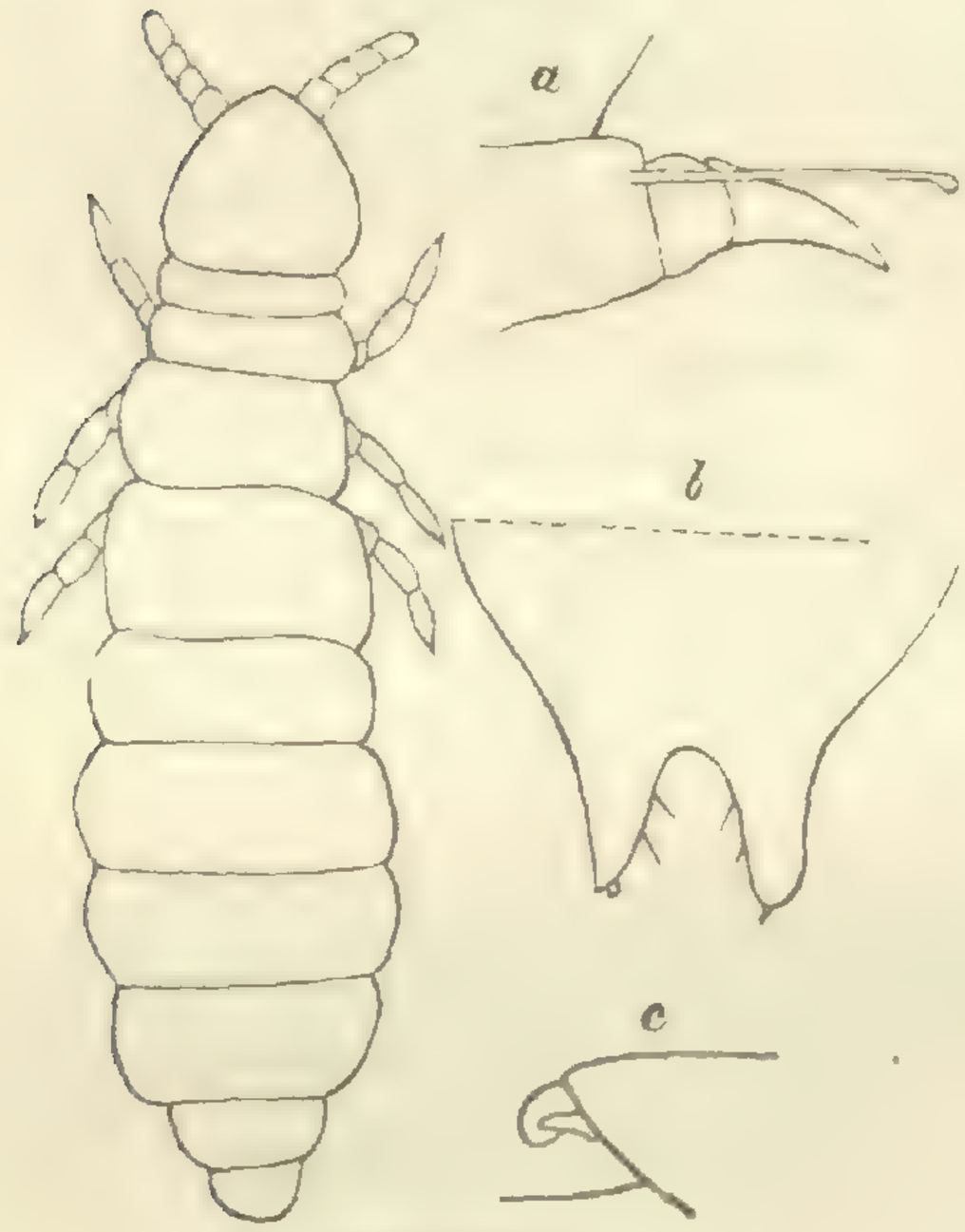


The two remaining genera, Lipura and Anura, are placed in the "family" Lipuridæ, which have no spring. Lubbock remarks that "this family contains as yet only two genera, Lipura (Burmeister), in which the mouth is composed of the same parts as those in the preceding genera, and Anura (Gervais), in which the mandibles

and maxillæ disappear." Our common white Lipura is the European *L. fimetaria* Linn. (fig. 38, copied from Lubbock). The site of the spring is indicated by an oval scar.

Fig. 39 represents a common species of Anura found under stones between tide marks at Nantucket. Compared with Achorutes, the body is rather longer and slenderer and more hairy, while the front of the head is much prolonged, almost forming a beak. The legs (fig. 40) end in a large, long, curved claw. On examin-

Fig. 36.



Achorutes.

Fig. 37.

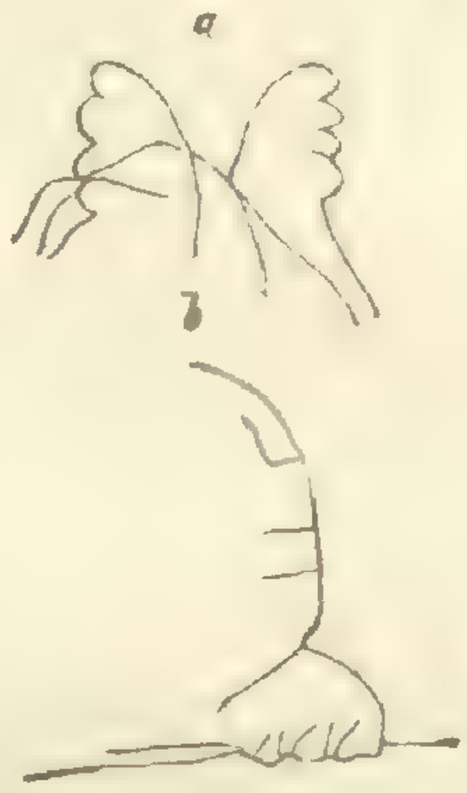


Fig. 38.



Lipura fimetaria.

ing specimens soaked in potash, I have found that the mouth-parts (fig. 41, *md*, mandibles; *mx*, maxillæ; *e*, eyes, and a singular accessory group of small cells, which have not been noticed heretofore as far as I am aware) are exactly like those of Achorutes and Lipura. The mandibles, like those of other Poduras, end in from three to six teeth, and have a broad, many-toothed molar surface below. The maxillæ end in a tridentate lacinia as usual, though the palpi and galea I have not yet studied.

For the reason that I can find no valid characters for separating these two genera as a family from the other Poduras, I am inclined to think that they form, by the absence of the spring, only a sub-division (perhaps a sub-family) of the Poduridæ.

The best way to collect Poduras is, on turning up the stick or stone on the under side of which they live, to place a vial over them, allowing them to leap into it; they may be incited to

leap by pushing a needle under the vial. They may also be collected by a bottle with a sponge saturated with ether or chloroform. They may be kept alive in vials for weeks by keeping moist slips of blotting paper in the vial. In this way I have kept specimens of Degeeria, Tomocerus and Orchesella, from the middle of December till late in January. During this time they occa-

Fig. 41.

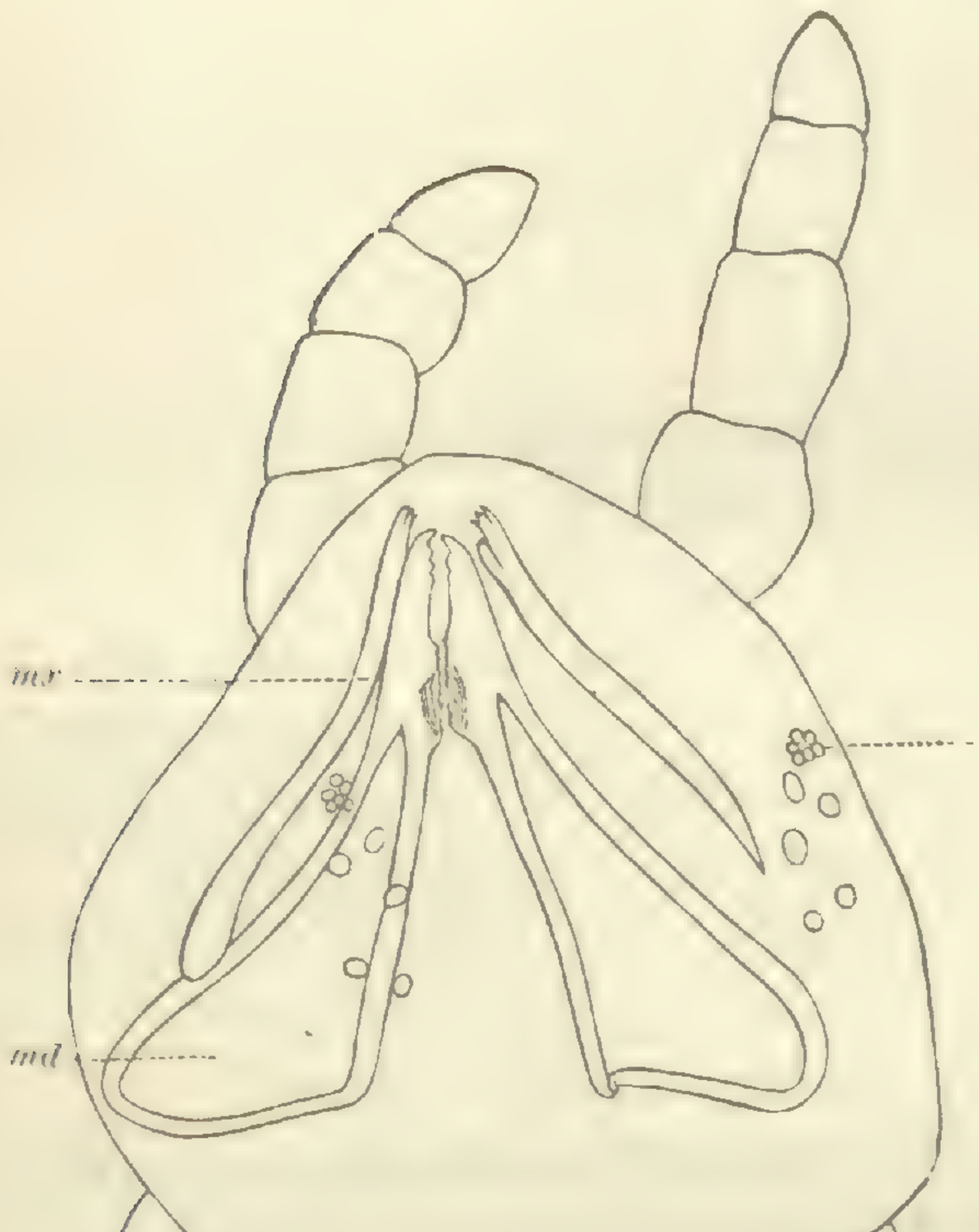


Fig. 39.

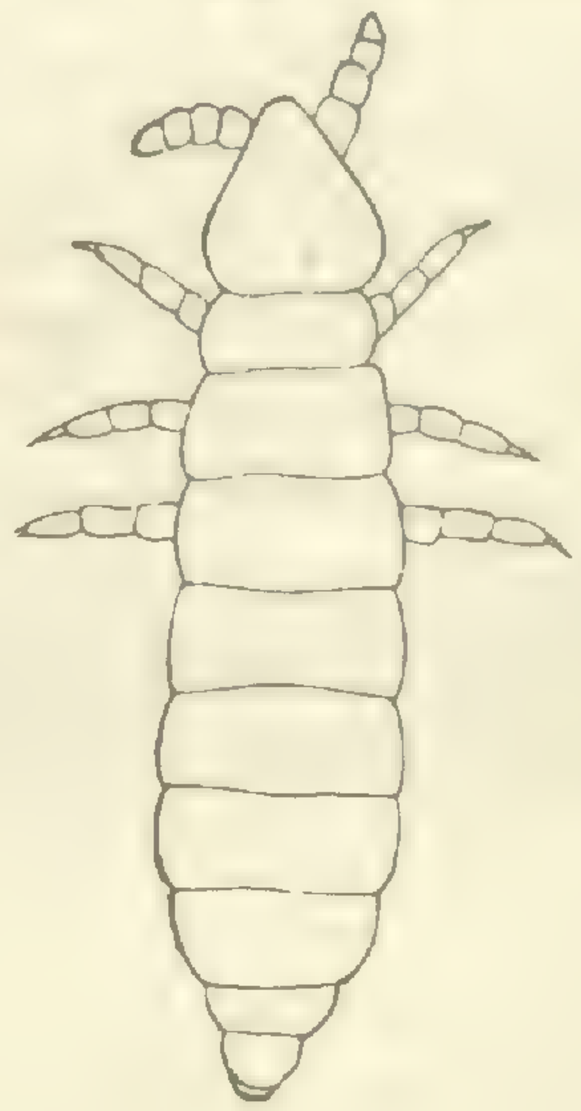


Fig. 40.



Anura.

sionally moulted, and *T. plumbea*, after shedding its skin eat it up within a few hours. Poduras feed ordinarily on vegetable matter, such as dead leaves and growing cryptogamic vegetation.

These little creatures can be easily preserved in a mixture of whiskey and glycerine, or pure whiskey, though without the glycerine the colors fade. The writer would be thankful for specimens both of Poduras and Lepismas, for study.

REVIEWS.

MUSCULAR HOMOLOGIES.*—It is now nearly a century (1774) since Vicq d' Azyr made the first detailed comparison between the anterior and posterior limbs; in doing which he was truly said to have "founded a new kind of comparative anatomy involving a study of the relations which exist between different parts of the body of the *same animal*." His special method of comparison was very defective and has been followed by few; but his general idea of the limbs as similar and *parallel* parts which repeat each other in a *serial* manner one behind the other, has been adopted by nearly all those who have since examined the subject; the exceptions being Gerdy, Foltz, Wyman, and three of the latter's pupils, Folsom, Coues, and the writer of this notice; all these have recognized a *symmetrical* relation between the anterior and posterior regions of the body and the limbs, which was first clearly and impartially discussed by "the most accomplished as well as the most distinguished anatomist of this country,"† three years before the present series of papers began to appear.

Dr. Coues's first paper is occupied with a very clear and intelligible discussion of the general ideas involved in the subject; clear. that is, to those who are already familiar with the "tools of thought" peculiar to this department of knowledge, which is sometimes, with a shade of derision, called "transcendental" anatomy; Dr. Coues accepts the adjective in so far as it expresses "the transcendent importance of investigations that can alone bring order out of a chaotic mass of observed facts, and make a philosophy of anatomy possible." There was some ground for the ridicule heaped upon Oken and Carus and St. Hilaire, who were the pioneers in this, till then unbroken, wilderness of homologies; no wonder the marvellous things which they for the first time beheld. so charmed and excited them that they became, as it were, intoxi-

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* Antero-posterior Symmetry, with especial reference to the Muscles of the Limbs. By Elliott Coues, A.M., M.D., Ph.D., Assistant Surgeon United States Army. The Medical Record, N. Y., June 1st, July 1st, July 15th, August 15th, September 1st, October 1st, October 15th, 1870.

† On Symmetry and Homology in Limbs. By Jeffries Wyman. Proc. Bost. Soc. Nat. Hist., June, 1867.

cated with new ideas, and painted what they saw in fantastic and impossible shapes; even in later times there is much that is apparently if not really fanciful in the views of the great English anatomist, whose archetype skeleton made each man a "potential Briareus as to limbs," and it is doubtless true that other cultivators of this field of anatomy have become so entangled in the complicated machinery of their own devising, as to see in the fruitful soil only stones to be cast out, stumps to be uprooted and streams of error to be turned from their channels; all of them facts, for which "so much the worse if they do not accord with my theory."

But the last ten years have brought new laborers into the harvest; crude anatomical speculations have been gradually corrected by the severe criteria of embryology, and such men as Gegenbauer in Germany, Cleland and Flower, Huxley and Humphrey, Mivart and Parker* in England, are carefully reviewing all previous works and sifting the grains of truth from the Okenian chaff. Indeed, the science of homologies now fills more or less space in every anatomical periodical, and here in America we are encouraged to this kind of research not only by the general bearing of the works of Agassiz, Dana, and Wyman, but in particular by the paper on "Symmetry and Homology," above named.

In his second paper, Dr. Coues considers the symmetrical homology of the bones of the limbs and adopts the determinations of Prof. Wyman with queries respecting the correspondence of the shoulder and pelvic girdles; a subject which now demands careful revision in the light of Parker's splendid monograph.† The most important of these determinations is one upon which, in fact, the whole matter rests, or which rather expresses the result of the entire investigation, viz.: that the little finger (*minimus*) is the symmetrical homologue of the great toe (hallux or protos), on the ground of their relative position upon the inner borders of hand and foot respectively, when the former is supinated and brought into its more normal position.

That this is the true morphological way of comparing the hand and the foot, and that the difference in the *numerical composition* of the thumb and little toe would be of very little morphological consequence, even were it constant in the vertebrates, was first, so

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*The late Prof. Goodsir devoted much time to morphological investigations.

†Structure and development of the Shoulder-girdle and Sternum. W. Kitchen Parker. Ray Society, 1868.

far as we know, insisted upon by the writer of this notice in a brief communication in 1866* which Dr. Coues appears not to have seen; we allude to it here from our sincere conviction that the recognition by anatomists of the morphological inconsequence of numerical composition as compared with relative normal position will not only aid the solution of many other problems in homology, but will especially enable us to remove what Professor Wyman, as late as 1867,† regards as "the greatest difficulty in the way" of those who adopt a symmetrical homology of the limbs.

The third paper opens as follows: "From what has preceded, it is evident that corresponding muscles are to be sought upon antitypically (or symmetrically) correlated aspects of the limbs, and determined mainly by relation;" but the difficulties found in the application of the principle to the bones are increased tenfold by the complexity of the muscular apparatus, and, at the outset, the author is forced to admit the present impossibility of making satisfactory determinations of the muscles acting upon the humerus and the femur; the *triceps humeralis*, however, and the *quadriceps femoralis* are seen to be homologous in the light of symmetry, even more clearly than they have been previously with the common idea of serial homology; Owen and Goodsir, being apparently the only anatomists who have denied this correspondence.

The outer and inner ham-string muscles give much trouble both on account of their number and their origin from the pelvis, and Dr. Coues finds himself obliged to dissent from previous determinations of their relation to the two flexor muscles of the fore-arm (*biceps* and *brachialis anticus*); his discussion of the homologies of these muscles and of the *popliteus*, and that respecting the *latissimus dorsi*, and the *supinator longus*, are admirable examples of pure morphological argument, and while the reviewer is not yet fully convinced of the correctness of the conclusions upon these and other mooted points, he is ready to acknowledge, that the general presentation of the muscular homologies is far more ably and fairly presented in this series of papers than in the memoir‡ to which their author so kindly refers; which, by the way, like most theses of anatomical beginners, attempted to cover too much ground, and really accomplished only one thing, the statement of the law of

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* On a Cat with Supernumerary Digits. Proc. Bost. Soc. Nat. Hist., May 16th, 1866.

† Op. cit. p. 276.

‡ On Morphology and Teleology. Mem. Bost. Soc. Nat. Hist., vol. I.

"long" and "short" muscles. Dr. Coues alludes in several places to the necessity of distinguishing between single muscles or muscular organs in different animals, and the muscular "morphological integers" which really ought to be determined before any final decision can be reached respecting symmetrical homologies in the muscular system. He recognizes the fallacy of conclusions drawn from the structure of that singular animal, man, who is in one place described "as the only true biped: no brute has such shoulder-pads, no brute such buttocks." He accepts the reviewer's suggestion* that the present *flexores* and *extensores carpi* are morphologically *extensores* and *flexores* respectively. He also adopts the opinion of Wyman and others, that the patella is a "Sesamoid" bone; but he unfortunately also adopts unquestioned the Owenian theories of the vertebrate skull, and the morphological position of the scapular arch, which are now to be regarded **as doubtful, if not altogether disproven.**

We have not space here for a detailed account of the author's determinations; the result of the investigation may be given in his own words: "few muscles have not been shown to have correlatives in the opposite limb; of some of these now seeming to have none, correlatives will probably be found: some of the correspondences here laid down are obscure or doubtful; some others are provisional, subject to further revision: most are demonstrably symmetrical, and have been demonstrated so to be."

We would call attention to the very apt and striking comparisons often made by the author: as, for instance, when the stunted caudal segments are styled "*larval*" vertebræ, and the cranial segments "*neural imagines.*"

But there are a few matters of general interest connected with these papers which ought not to pass unnoticed. First, they appear in a strictly medical journal, and this may pave the way for discussions which must aid both the practitioner and the morphologist; for the principles of symmetry have already been shown to underlie many of the phenomena of disease in men and animals; and there must be constantly occurring cases which will illustrate and confirm or correct the ideas drawn from pure anatomy. Second, the papers themselves evince a closeness of anatomical observation and a logical power, which promise well for the future of

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* Comparative Myology of the Chimpanzee. Bost. Jour. Nat. Hist. 1861. p. 393.

philosophical anatomy in America. And third, these papers are absolutely free from covert flings and sarcasms at opposing theories, and their author has done ample justice to the labors of those whose works he has employed; we must regret the lack of reference to other, and later papers upon limb-homologies, especially those in the "Journal of Anatomy and Physiology." But this was to some extent unavoidable with one who is serving in the army, and is at least atoned for in one way by the assiduity with which the author has made dissections of animals which he could procure. *

This hasty notice has done scant justice to Dr. Coues's work. Let us urge upon all, who are, or wish to be interested in the study of homology, to read this series of papers; we hope before long to publish elsewhere † a more complete review of these productions of our morphological brother; to include therewith a notice of the remarkable paper of Professor Wyman, who is in limb-homologies our common progenitor; to add some suggestions respecting terminology as to both the objects of our study, and the ideas involved therein; to indicate as far as possible, the various minor problems which will occupy us for the half century prior to the probable acceptance of these views by all anatomists; and finally, to append a list of all works and papers bearing upon the question of the homology of the anterior and posterior limbs of vertebrate animals.—B. G. Wilder.

Forms of Animal Life. ‡—In its plan, arrangement, and the great mass of details and its useful illustrations, this work on comparative anatomy, is the most convenient manual we now have in the English language. Were we going away from libraries. for a sojourn by the sea-side to pursue anatomical studies, we should take with us Gegenbaur's incomparable "Grunzüge der Vergleichenden Anatomie" (Principles of Comparative Anatomy), Huxley's "Introduction to the Classification of Animals," and his "Elementary Lessons in Physiology," but if deprived of these, and one book was to do the work of all, our choice would be Professor Rolleston's excellent compendium.

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* The Opossum and the Ornithorhyncus, among others, have received Dr. Coues's attention and were especially useful in this particular line of research.

† American Journal of Science and Arts.

‡ Forms of Animal Life. Being Outlines of Zoological Classification based upon Anatomical Investigation and illustrated by Descriptions of Specimens and of Figures. By George Rolleston. Oxford, 1870. 8vo. pp. clxviii, 268.

We miss a chapter giving directions to the beginner in the difficult art of dissection. A figure to accompany the explanation of the parts of the skeleton of a rat in order to illustrate the vertebrate skeleton, would also add to the value of the manual.

The classification is mostly taken from the anatomical system of the Germans. In a lineal arrangement, such as the author is obliged to adopt in a book, the Mollusca follow the Vertebrata, then succeed the third sub-kingdom, Arthropoda; the fourth, Vermes; the fifth, Echinodermata; the sixth, Coelenterata; and the seventh and last, Protozoa.

In looking over the chapter on Arthropoda (Insects and Crustacea) we find some things to criticise. The Cladocera are spoken of on p. cv. as a "family." By some naturalists of high standing, such as Claus and others, this group is considered as a suborder. On p. cix. where certain larvæ of insects are mentioned as having the digestive canal "aproctous," we might add that the larva of Stylops has the intestine ending in a blind sac. On p. 112 it is stated that the "telson, or terminal so-called segment of the crustacea does not appear to possess the characteristics of a true segment." In Limulus, the ninth segment of the abdomen, well marked in the embryo, forms the caudal spine, or telson. It is a small thing to criticise, but throughout the work all the specific names, with very rare exceptions, begin with a capital: thus marring the typography of the book.

Bee Culture.* — Mr. Adair has succeeded in collecting for his annual a number of articles by our leading apiarians comprising much valuable information, both to bee keepers and to students of animal psychology. A proof of this is seen in the first article by Vogel (which we reprinted on p. 17), which contains so much bearing on the theory of evolution, and the principles of breeding.

No art has profited more from the most abstruse researches of purely scientific men, than the art of bee keeping. Huber's hive, the prototype of all our modern hives, was constructed by that philosopher, solely that he might the better watch the habits of bees to gratify his wonderful desire for knowledge for its own sake. The discovery of Parthenogenesis by Siebold and Berlepsch was a purely scientific one, but of the greatest value in the art of

* Annals of Bee Culture for 1870. A Bee Keepers' Year Book. D. L. Adair, editor. Louisville, Ky., 1870. 8vo. pp. 64. 50 cents.

raising bees. Vogel's article shows how much the future of bee keeping depends on the application of physiological knowledge, obtained by the most difficult and abstruse experiments. So much is said by "practical" men of the futility of studying bugs, or cutting up dead or dried plants, or the cruelties of vivisection, or of "scientific toys," such as the microscope or spectroscope, that a reminder of what the world owes to the scientific recluse, is naturally suggested.

In some remarks on "Apicultural Progress" Mr. Elisha Gallup, contrasting the abundant bee literature of the present year with the dearth of bee books in 1846, says "we now have three monthly journals: the American Bee Journal, the Illustrated Bee Journal, the Bee Keepers' Journal, the Annals of Bee Culture [under review]; while there is "scarcely an agricultural paper of any note in the land, that has not its bee department, and all are edited with truthfulness and ability." Mr. Charles Dadant in a "Glance at European Bee Culture," after reviewing its progress in France, Italy and Switzerland, says: "As for Germany, it would take a book to record all the improvements, inventions and discoveries made in that country in the last fifteen years; suffice it to say, that in 1868, there appeared four hundred and twelve publications on bee culture in Germany. This would show that Germany is now the most advanced country in Europe in theoretical bee culture; but in practical bee culture, it is safe to say that Young America is ahead of all."

Regarding the enemies of the bee, other than insects, Professor A. J. Cook says:—

"Insectivorous birds also — chief of which in this case is the King-bird (*Tyrannus Carolinensis*) — are ever on the alert to take the home-returning bees. Nor do they capture only drones, for we have seen their stomachs full to repletion of the little workers. We ought not to kill these birds, for from their insectivorous habits, they are of invaluable aid to the farmer. If the apiary is in a grove, as it should be if possible, these bee-martins will be seen, on a tree or bush, to sit and perch, and do something else; for who has not seen them dart for the passing insect, with unerring aim? and certainly the bees coming home to a hive high from the ground would be more apt to become the victims of these rapacious gourmands.

"But some of our readers have been thinking of, and fearing toads ever since commencing to read this article. Now, as we claim a firm friendship for the toad, loving to watch him in our room and

garden, as he throws out his slender tongue with lightning quickness, taking in the thieving insects which rob us of our delicious fruits, we love to speak a word in his defence. From our observations, we deduce the following: Toads usually seize those bees which fall to the ground; so it is the freighted honey-gatherer, which aims amiss for the alighting board, and thus falls to the ground, that is entombed in the stomach of his Toadship. So from what we have already said, we believe, despite the opinion of some of our best apiculturists, that it is the bees in hives high from the ground which suffer from his Batrachian majesty."

On the subject of breeding in-and-in, Mr. E. Gallup tells us that in "three cases he has known bees to be bred in-and-in without any cross from other stocks, until they became mere dwarfs, and entirely ceased to swarm, or be of any profit to their owner."

At the meeting of the German bee keepers at Nuremburg, Dr. Pollman exhibited a collection of bees illustrative of their natural history. "It was composed of two boxes, containing workers, queens, and drones of the different kinds of bees, such as black, Italian, Greek, Egyptian, etc., and of different parts of the bodies of bees, hermaphrodites, insects hostile to bees, scales of wax of all sizes, broods, foul broods, combs, &c."

NATURAL HISTORY MISCELLANY.

BOTANY.

Climbing Fern.—The beautiful Climbing Fern (*Lygodium palmatum*) exists and flourishes in its wild state within the borders of "old Essex." The writer discovered this rare and attractive plant in 1869, while exploring "Lynn Woods" in the vicinity of the famous "Penny Bridge." The locality of its haunt is within the limits of Saugus, and not far from that romantic spot known as the Pirates' Glen. Specimens have been obtained having a stalk or "vine" nearly four feet in length. As the climbing fern is one of the most rare, graceful and attractive plants found in this country, it is a matter of satisfaction to know that we have it growing in our woodland valleys. This fern has been found, though rarely, in Florida, Kentucky and Massachusetts. In Virginia it is often seen, and it has been found in several localities

between that state and our own. Some very fair specimens have been obtained in Concord, not far from Thoreau's favorite Walden woods. At East Windsor Hill, Conn., at one time abundant supplies were obtained for decorative purposes, but so careless were the people who sought this dainty "vine" that the Legislature passed an act forbidding its heedless and wanton extermination. The name *Lygodium* is from the *Greek* signifying *flexile* or *flexible; palmatum* suggests the resemblance of the outlines of the fronds to an outspread hand. Success in transplanting the "Climbing Fern" depends much upon the care exercised to obtain good roots. Having these, little complaint will be made of the difficulty attending the culture of one of Nature's daintiest eccentricities.—GEO. E. EMERY.

PARASITIC FUNGI IN THE HUMAN EAR. — In the "Bulletin de la Société Imperialé des Naturalistes de Moscou" for 1870, No. 1, just received, is a paper by Dr. Karsten on the parasitic fungi found in the human ear, accompanied with beautiful illustrations. The author confirms the statements of Hallier and other previous observers, that when the spores of these parasitic fungi are sown elsewhere, the plants which result from them assume very different forms, according as the substance on which they are sown is rich or poor in material for nutrition; and that fungi described as distinct species, or even as belonging to different genera, are merely different genetic forms of the same plant.—A. W. B.

RED SNOW IN WASHINGTON TERRITORY. — In the summer of 1858, when employed on the survey of the boundary between the Territories of the United States and those of Great Britain (the 49th parallel of north latitude), I ascended the main range of the Cascade Mountains, a little south of the line and at an elevation of about 6500 feet. While looking for a camping place, one of my men, with an expression of horror, brought me a handful of *red snow* which he had picked up on a higher neighboring point, and asked what it was. His disgust can be imagined when after inquiring where he had obtained it, I eat it. Accompanying him back I found that the color was, so to speak, "sheeted" over a considerable space on the northern side of a point of rocks. As it lay in place, it was of a pink color, beautifully contrasting with the white bank on which it lay. Compressing it in the hand, it gave a bloody tint to the water which oozed from it. The taste

seemed somewhat earthy. I had no other means of examining it than a pocket lens, under which the coloring matter seemed to consist of tadpole shaped bodies, with rounded heads and attenuated tails, perhaps two lines in length. I afterwards met with the same phenomenon on the range dividing two branches of the head waters of the Similkameen mountains, a little east of the Cascades, and at the height of about 6000 feet. The coloration of the snow was unequal — somewhat in bands or clouds, or, as I have above expressed it, "sheeted," and it rarely penetrated above a few inches. I believe this is the first notice of the occurrence of the "red snow" within the territories of the United States. — GEORGE GIBBS.

FERTILIZATION OF FUMARIACEÆ. — Professor Hildebrand of Bonn contributes to Pringsheim's "Jahrbuch für wissenschaftliche Botanik" for 1870, a continuation of his observations on the mode of fertilization of different races of plants, referring especially to the order Fumariaceæ. He finds that in all plants belonging to this order the access of pollen to the stigma of the same flower is unavoidable, with the exception of Hypecoum, in which the stamens are distinct. In the genera with diadelphous stamens (Fumaria, Corydalis, Dicentra, etc.), the pollen falls immediately on to the stigma, which is in close proximity to the anthers, and is developed precisely at the same time. This does not, however, necessarily imply self-fertilization, as insects carry off the pollen to other flowers to fertilize them. By artificial impregnation Prof. Hildebrand obtained similar results to those published by Darwin in the case of other plants, that a pistil fertilized by pollen from its own stamens does not produce so many seeds as one fertilized by foreign pollen. Hypecoum is somewhat protandrous (stamens ripening before pistil). — A. W. B.

FERTILIZATION OF DICHOGAMOUS FLOWERS. — While Professor Hildebrand has been prosecuting his researches in Germany, Professor Delpino of Florence (now Botanical Professor in the Forest Institute at Vallombrosa) has been following up similar lines of inquiry in Italy, with equal success. In his recent papers, entitled *Ulteriori Osservazioni sulla Dicogamia nel Regno Vegetale* — of which the first part fills almost two hundred and fifty octavo pages, and the first fasciculus of the second part, forty pages more — he has illustrated the very diversified arrangements in many

natural orders with hermaphrodite blossoms, which secure cross-fertilization as effectively as if the flowers were of distinct sexes. This treatise is a treasury of observation upon this subject. We have also from the same author an Italian version of a lecture by Dr. E. Müller, on the application of the Darwinian theory to flowers and to the insects visiting the flowers, with extended notes — the whole of which is worthy of an English version. — Eds.

Lichens. — Since the article entitled "Lichens under the Microscope" was written, I have met with a notice in Krempelhuber (Geschichte der Lichenologie, vol. 1, p. 431) of three fossil lichens, one related to Ramalina, a second to Verrucaria, and a third to Opegrapha; the first two found in the "Keuper," or upper new Red Sandstone, and the third in chalk.

In regard to the number of the species, it ought perhaps to have been stated that Krempelhuber's enumeration includes all synonymes and doubtful species, in short everything to which a separate name has been attached. Nylander (Synopsis, 1859) gives the number of species at 1361, which is probably considerably below the real number. — H. W.

ZOOLOGY.

Notes on American Deer. — I wish to make an early correction through the Naturalist of an error in my observations as given in my paper entitled "American Cervus." On page 7 of that paper, I stated that the elk (*C. Canadensis*), like most other quadrupeds, has but one pelage a year. I can now state that it sheds its coat twice a year like all the other species of that genus, which I have had an opportunity of studying.

The shades of color, and the length of the hairs, of the summer coat and its successor, are so nearly alike, and the former is shed and replaced by the latter so gradually, that it is exceedingly difficult to detect the change even when the attention is called directly to it.

In anticipation of some more extended observations on this branch of natural history, allow me to notice a very marked physiological difference between the elk and the three smaller species of the same genus which I now have in my grounds (*C. Virginianus*, *C. macrotis* and *C. Columbianus* Rich). In the elk the

theca extends along the abdomen to within three inches of the umbilicus, and has no pendant prepuce, almost precisely as is observed in the Bos family. In the three smaller species named the theca is suspended from a point so near the scrotum that when the animal is standing it occupies a vertical position within half an inch of it, the posterior measurement of which is three to four inches, anterior measurement half that length. The lower half may be described as an exaggerated prepuce, which is entirely wanting in the elk. In this regard but little difference is observed in the three smaller species.

It would be interesting to know to which of these species the moose (*C. alces*) most conforms in this particular, and I hope that you, or some of your correspondents will be able to inform us. — J. D. Caton, *Ottawa, Ill., Nov.*, 1870.

Occurrence of Kirtland's Owl in Maine. — A characteristic specimen of the *Nyctale albifrons* Cassin, was shot at Norway, Me., September 14th, by Mr. Clarence M. Smith, and by him presented to the museum of Yale College. It has not been hitherto recorded from New England. So far as known to me, the specimen taken at Racine, Wis., by Dr. Hoy, is the only one previously recorded from the United States. Prof. Baird mentioned another specimen collected by Dr. A. Hall, near Montreal, and in a recent number of the "Canadian Naturalist" (vol. v. p. 103) a specimen is recorded as obtained near Quebec, by Rev. D. Anderson. The early date would indicate that the specimen taken at Norway was resident there, as it was before the southward migration had commenced. In a recent letter Prof. Baird expresses doubt whether the *albifrons* may not prove to be the young of *N. Acadica*. But if so, it is singular that the young of the latter has not oftener been observed in localities where it is common, as in many parts of New England. This question is well worthy of thorough investigation. — A. E. Verrill.

Spawning of the Capelin. — The Capelin (*Mallotus villosus*), an inhabitant of the northern seas of the Atlantic coast of America, is well known as a bait for cod-fish. It visits the shores during August and September, for the purpose of spawning, when it is so abundant as to darken the sea for miles. There are some peculiarities about the method of its spawning; the females, on approaching the beach, being attended by two males, who hold

the female between them, by means of the ridge of closely set, brush-like scales with which the males alone are provided, so that she is almost entirely concealed. In this state the three run together with great swiftness upon the sand, and in this act the spawn issues from the female, which is simultaneously fertilized. An immense business is carried on in the capture of the capelin as bait for the cod; the French fishermen alone obtaining from the fishing ground off Newfoundland, from sixty thousand to seventy thousand hogsheads annually for this purpose.

Ornithological Notes. — In J. A. Allen's "Notes on Some of the Rarer Birds of Massachusetts," in the Naturalist for January, 1870, he says of the Glossy Ibis (*Ibis Ordii*), "It was also taken, as I learn from Mr. Vickery, in New Hampshire, in October, 1858, by Dr. Palmer." I have the specimen in my collection now, an old bird, in full plumage, taken near Lake Winnipiseogee, in the town of Alton, N. H. I have also the Canada Jay (*Perisoreus Canadensis*), and Black-backed, Three-toed Woodpecker (*Picoides arcticus*), both taken in Strafford, N. H. The jay I shot in winter, and the woodpecker was taken late in the fall. I believe the Canada Jay is not mentioned by Mr. Allen as occurring in Massachusetts. It is not improbable that it may be an occasional winter visitant. The Pine Grosbeak (*Pinicola Canadensis*) has appeared in Ipswich during the winters of 1867–68, and 1868–69. I secured one in red plumage, but they were mostly young birds. — Charles Palmer, *Ipswich.*

Mimicry in Insects. — At a recent meeting of the Scientific Committee of the Horticultural Society, a remarkable paper was read by Mr. Andrew Murray, on the subject of Mimetism, especially as exhibited in the instances of the South American butterflies, which have already been discussed in our columns. Mr. Murray adduced a number of arguments which he considered told against the theory that the mimicry had been produced by Natural Selection, and attributed it to hybridization. — *Nature.*

Parasite on the Wasp. — Mr. F. Smith exhibited to the Entomological Society of London, *Phora florea*, a dipterous parasite in the nest of the wasp. We have figured and noticed in the Naturalist, vol. 2, p. 196, a similar parasite in the cells of the honey bee living in Europe. Similar flies should be looked for in this country by our enterprising bee keepers.

Ringneck Duck. — Mr. G. A. Boardman of Calais, Me., writes that he found several flocks of the Ringneck Duck, *Fulix collaris*, breeding on the river, near Calais, the past season, and that he secured the old and "chicks." He states that he knows of no other instance of this duck breeding in New England.

Mocking Bird in Maine. — I found a mocking bird, *Mimus polyglottus*, in the woods up the river this past season. This is the first time the bird has been found in Maine, to my knowledge, and I think it could not have been an escaped cage bird. — G. A. Boardman, *Calais, Maine.*

Red Squirrels not Red. — I received in November last a very pretty black specimen of the *Sciurus Hudsonius*, and also a pure white specimen of the same species. — G. A. Boardman, *Calais, Maine.*

GEOLOGY.

Devonian Rocks in the Amazonian Valley. — At the foot of the celebrated Serra do Ereré, rechristened Monte do Agassiz by Dr. Silva Continho, in the Province of Grao Pará, Brazil, is an extensive plain on the northern side, composed of coarse shaly sandstones of a reddish color, red, white, and black shales, and very hard cherty beds, all lying quite horizontally, but broken through by a perfect network of heavy trap dykes, which appear on the surface of the plain like ruined walls. The sandstone beds contain fossils of which I secured a large collection. They comprise one or more species of *Dalmanites* of which I have fragments kindly determined for me by Professor James Hall, *Chonetes?, Spirifer, Leptocœlia, Orthisina, Orthis?, Lingula, Discina, Tentaculitz, etc.* In a *relatorio* published in the "Diario do Grao-Pará" of Pará, January 5th, 1871, I referred this series of beds to the Devonian. A small collection of the above fossils was referred to Professor Hall, who writes me that "the forms and associations are of Devonian character, and the impression produced from the *tout ensemble* is that they are of the age of the Upper Helderberg group."

We have now the Devonian age of the Ereré beds, I think, definitely settled, and it is interesting that these are the only Brazilian rocks that we can satisfactorily refer to that age.

These Devonian rocks, lying quite horizontally, reach close up to the base of the Serra do Ereré, and run along it for some distance. The Serra is composed of heavy beds of coarse sandstone, with a slight admixture of feldspathic clay, and so exceedingly compact that a fracture passes through the grains of sand. This is the general character of the rock; some is not so compact, and there are one or two comparatively thin beds of hardened feldspathic clay. The rock is without fossils. The whole series dips towards the southeast approximately, the angle being in some cases as high as 15°–20.° I studied this locality for a month, and I came away with the only conclusion that seemed legitimate, viz.: that the Serra was older than the Devonian rocks of the plain to the north. It is not a table-topped Serra, and does not belong to the same system as the table-topped hills of Almeirim, Paraúquára and Santarem, which I believe to be Tertiary. The group of hills of Ereré and Paitúna, is entirely different from anything else I have seen on the Amazonas, and it seems quite unique.

I did not find the geological structure of the Amazonian valley as simple as I expected. Along the line of the main river it is very monotonous. So it is along the lower Mississippi, but the valley is bordered by older rocks, Eozoic, Silurian?, Devonian and Carboniferous. Nor are the clays, etc., so uniform in their distribution as I expected to find them. I have seen clays from the Devonian, Carboniferous and Tertiary so exactly alike that it would be impossible to distinguish them, in the hand specimen, from the recent clays.

I am preparing a report on my geological studies on the Amazonas, which I shall publish as soon as possible. — Ch. Fred. Hartt, *Jan.* 17*th*, 1871.

Origin of Diamonds. — Professor Morris has started a new theory as to the source whence diamonds are derived. Hitherto they have been looked upon as coming from igneous and metamorphic rocks, like garnets, rubies, and many other precious stones; a better knowledge of the geology of the diamond district of South Africa, leads us to conclude that these stones come from certain stratified beds containing, besides reptilian remains, numerous plants and much fossil wood. These beds are known as the "Karoo" or *Dicynodon* beds. Professor Morris calls to mind the remarkable fact (well known to botanists and mineralo-

gists) that in the stems of the bamboo small crystals of quartz are found, known by the name of *tabasheer;* he suggests, whether it may not be possible that the diamonds yielded by these old plant beds similarly owe their origin to vegetable growth. The idea is well worthy the attention alike of the chemist, the mineralogist and the botanist. — *The Academy.*

Discovery of Actual Glaciers on the Rocky Mountains.— Mr. Clarence King announces in the March number of the "American Journal of Science and Arts," the fact that while "extinct glaciers, equalling in all respects the former grandeur of the alpine system," were discovered by Prof. Whitney and his corps, there are still in existence glaciers on the northern side of Mt. Shasta in Northern California, "the largest about four and a half miles in length, and two to three miles wide." Glaciers have also been found by Mr. Emmons on Mt. Tachoma, or Rainier, and on Mt. Hood by Mr. Hague. On the former mountain (Rainier) :—

"The main White River glacier, the grandest of the whole, pours straight down from the rim of the crater in a northeasterly direction, and pushes its extremity farther out into the valley than any of the others. Its greatest width on the steep slope of the mountain must be four or five miles, narrowing towards its extremity to about a mile and a half; its length can be scarcely less than ten miles. The great eroding power of glacial ice is strikingly illustrated in this glacier, which seems to have cut down and carried away on the northeastern side of the mountain, fully a third of its mass. The thickness of rock cut away, as shown by the walls on either side, and the isolated peak at the head of the triangular spur, in which the bedding of the successive flows of lava forming the original mountain crust, is very regular and conformable, may be roughly estimated at somewhat over a mile. Of the thickness of the ice of the glacier, I have no data for making estimates, though it may probably be reckoned in thousands of feet."

Eozoon Canadense.—Some doubts having been thrown on the organic origin of this oldest known geological form of life by a correspondent in "Nature," Dr. Carpenter has been induced to recapitulate the arguments in favor of the organic theory; and has also brought from Principal Dawson of Montreal, in "Nature" for February 9th, an account of recent explorations and observations in the Laurentian rocks of Canada, which seems fully to establish the claims of *Eozoon* to the character of a veritable fossil.—A. W. B.

THE BOTTOM OF THE SEA OFF THE EASTERN UNITED STATES.—At the meeting of the Boston Society of Natural History, Nov. 16, the President introduced Count L. F. de Pourtales, who spoke on the constitution of the bottom of the ocean off the east coast of the United States, south of Cape Hatteras, as developed by the soundings and dredgings of the United States Coast Survey.

The chief constituent, he said, is silicious sand, from the coast line to about the one hundred fathom line, a limit which also coincides nearly with the inner edge of the gulf stream for a great portion of its course. Outside of this line the whitish, calcareous "Globigerina" mud prevails and extends probably under the greater part of the ocean. The silicious sand is replaced to the southward of the Vineyard Islands, and off the eastern end of Long Island, by a greenish or bluish mud, known by the navigators as the Block Island soundings. Similar mud is found off Sandy Hook in a range of depressions known as the mud-holes, which form a leading mark to find the port of New York in thick weather. In the neighborhood of New York a few rocky patches are found which require investigation. Near Cape Fear, also, rocky bottom is sparingly found, affording a foothold to some corals, gorgonias and sponges. Otherwise the sand is pretty uniform in constitution, varying only in the size of the grain.

A remarkable deposit of green-sand is found on the inner edge of the Gulf Stream, off the coast of Georgia and South Carolina. The bottom consists here chiefly of living and dead foraminiferæ, the chambers of the latter becoming filled with a silicate which injects even the finest ramifications of the canals of the shell. At first yellow, it gradually turns green, at the same time the shell proper decays and breaks off, leaving a cast, which by attrition and conglomeration with others often loses the characteristic form of a cast. Sometimes black pebbles are found, of which a section shows plainly the origin due to an agglomeration of casts of foraminiferæ.

The dredgings made by the Coast Survey in the Straits of Florida have revealed the existence of a large bank, or deep sea platform off the Florida Reef, consisting of a highly fossiliferous limestone still in process of formation from the numerous shells, echinoderms and corals, mostly new to science, which live on it, at a depth of from one hundred to three hundred fathoms. Between this platform and the reef, the bottom consists of the detritus of

the reef, more or less finely comminuted and not rich in animal life. In depths beyond the three hundred fathom line, but with considerable variation in its limits, we find again the Globigerina mud which also fills the greater part of the Gulf of Mexico in deep water.

The Coast Survey intends to prosecute these researches next year with increased means.

Fossil Whale in the Drift. — The bones of a whale closely allied to the White Whale (*Beluga leucas*) of the Gulf of St. Lawrence, have been discovered at Cornwall, Ontario County, Canada. It seems to be the same as the *B. Vermontana* of Thompson.— *Nature.*

MICROSCOPY.

Photo-Micrographs for the Stereoscope.* — Before the suggestion in Carpenter's last edition on the Microscope, that stereoscopic pictures might be obtained by photographing a microscopic object alternately with the two sides of an objective, I had been working on the subject with some degree of success. Dr. Carpenter, however, seems to mention the fact rather as a means of convenient illustration, or a scientific curiosity, than as the expedient of great practical utility that I conceive it to be.

Two or three methods seem to be applicable to the production of such pictures. Some objects, somewhat equal in width and depth, and visible under a lens of long focus, may be tilted by a simple, graduated, and carefully centred mechanical arrangement, first toward one side, and then equally toward the other, photographing each aspect by the same power and under essentially the same conditions: or, of certain objects under low and medium powers, a conception of solidity may be gained, by using photographs which are identical, except that, by a slight change of focus, they represent different planes of the object: or, the object and lens remaining unchanged, the lateral halves of the objective may be alternately stopped off, either directly, or by means of stops under the achromatic condenser, or by means of an achromatic condenser (of very small angular aperture) inclined first toward

*From remarks by Dr. R. H. Ward, at a meeting of the Troy (N. Y.) Scientific Association, Feb. 20th, 1871.

one side and then toward the other, so that each picture shall represent the view actually taken of the object by each side of the objective. The latter method of the three, is doubtless the one most generally applicable in practice.

Pictures formed in this manner, and mounted upon cards ready for use in the ordinary stereoscopes, would greatly excel in elegance and definiteness any present means of disseminating results in many branches of microscopical study. As a means both of popularizing the familiar facts of microscopy, and of interchanging among microscopists the knowledge of novel results of investigation, they would be invaluable. Few objects, for instance, would be more interesting to persons of general, if not scientific culture, than excellent stereoscopic views of the structure of plants, insects, and other familiar natural objects; and almost any microscopist would be glad to possess similar views representing the latest researches into the structure and relations of tissues, the micro-chemistry of poisons and adulterations, or the anatomy of typical species in any family of microscopic organisms. Such pictures might be usefully prepared by any public institution, and distributed to scientific institutions and societies; or, preferably, prepared by some scientific, not sensational, private source, and furnished to buyers, like Dancer's micro-photographs, through the ordinary channels of trade.

In order to photograph, without delay, any field of view which a working microscopist deems worthy of preservation, he should have a camera mounted on a plank which is blocked at one end for the feet of the stand used as a "working instrument." Then, whenever desired, the eye-piece is removed, the instrument levelled into a horizontal position and placed accurately on the plank, and the magnified image instantly thrown upon the focussing plate of the camera. Finding the usual band, passing around pulleys and over the fine-adjustment wheel, to be a slight annoyance in carrying out this plan with the stand I ordinarily use (a large stand of the "Jackson" model), I make the fine adjustment by a somewhat soft cylinder of India-rubber lying upon the wheel. This cylinder is rather more than three inches long, is an inch and a half in diameter, and weighs about four ounces. It is open through its centre, like a tube with thick walls and small bore, and is mounted upon one end of a straight, light, wooden rod, the other end of which is supported on or near the top of the camera.

It is prevented from rolling off from the fine-adjustment wheel by a horizontal wire, transverse to the axis of the apparatus, attached by a hinge-joint to a post at the side of the plank, and to a pin in the end of the wooden rod which just passes through the cylinder; and being retained not over the centre, but somewhat to one side of the wheel, loss of motion is simply impossible, and an extremely fine and manageable motion is secured. The unequalled facility and certainty with which this apparatus can be instantly laid upon the fine-adjustment wheel or turned back from it, is sufficiently evident.

Microscopy at the Army Medical Museum.—The Medical Society of the State of New York, one of the largest and most influential organizations of the kind in this country, at a recent meeting adopted a series of resolutions expressing its interest in and appreciation of the microscopical work of the United States Army Medical Museum at Washington. The Society approves, with some degree of enthusiasm, the methods of investigation, and of disseminating results, employed at the Museum, especially in regard to the study of healthy and diseased tissues; believing that the progress attained is of material use to the profession, and that it would be unattainable at present without the unusual facilities furnished by the Government.—R. H. W.

NOTES.

Mr. Boucard, the well known dealer in specimens of Natural History, and traveller, formerly living in Paris, but now resident in London, proposes the publication of a work on the Coleoptera of Mexico and Central America, including the adjacent portions of the United States, especially the Pacific region. He earnestly desires contributions of specimens, whether named or not, to be used in his investigations, and will return such as he is not permitted to keep, suitably identified, and will render an equivalent in other specimens, if desired, for such as are sent to him to be retained. Any specimens intended for him may be sent through the Smithsonian Institution, or direct to his establishment in London, 55 Great Russell street, Bloomsbury, W. C.

A rare opportunity of securing specimens of insects from Texas and Southern New Mexico, is now open to those interested. By reference to the advertising pages it will be seen that Mr. Belfrage is to make a long collecting journey through the above named region. We can recommend him as a faithful and excellent collector. His specimens arrive in excellent condition.

The excrements of bats from Egypt have recently become an article of trade as a sort of guano for manure.

It has been announced at the Royal Geographical Society that Livingstone has arrived at Ujiji on his return journey.—*Nature.*

ANSWERS TO CORRESPONDENTS.

E. S. M.—The plants are:—1. *Utricularia purpurea*; 2, probably *Claytonia Virginica* (poor specimen); 3, *Sagittaria calycina* var. *spongiosa*; 4. *Spirœa*; 5, *Hydrocotyle Americana*; 6, *Phaseolus trilobus*.

A. G. H.—The cocoon of *Platysamia Cecropia* was filled with the cocoons (containing the perfect insects) of an Ichneumon.

W. O., Montreal.—Professor J. Leidy, Philadelphia, Professor A. E. Verrill, New Haven, and Professor H. J. Clarke, Lexington, Ky., are the only persons in this country who are engaged on the subject of internal parasites, so far as we are informed. Dr. Weinland has been in Germany for many years.

BOOKS RECEIVED.

A Concise Analytical and Logical Development of the Atmospheric System, and of the Elements of Prognostication, by which the weather may be forecasted, adapted to the Practical Mind of the Country. By Thomas B. Butler, author of the "Philosophy of the Weather." Revised Edition. Andrew Selleck, Norwalk, Conn. 1870. 12mo, pp. 405. Cloth.

Bulletin of the Museum Comparative Zoology, Vol. II, No. 2. Preliminary Report on the Crustacea Dredged in the Gulf Stream in the Straits of Florida. By L. F. de Pourtales, Assist. U. S. Coast Survey. Part I, Brachyura. By Dr. Wm. Stimpson, 1870. 8vo pamph., pp. 52.

Annual Report of the Surgeon General United States Army. 1870. 8vo pamph., pp. 10.

The Earthquake of October 20, 1870. By Principal Dawson, LL. D., F.R.S., etc. pp. 8. 1870.

Report on the Progress of the State Geological Survey of Michigan. By Alexander Winchell, Director. Lansing, 1871. 8vo pamph., pp. 64.

Descriptions of Some New England Nudibranchiata. By A. E. Verrill. 8vo. pp. 4. Nov., 1870.

Report on the Geological Survey of the State of Iowa, to the 13th General Assembly, Jan., 1870, containing results of examinations made within the years 1866, 1867, 1868 and 1869. By Charles A. White, M.D. 2 vols. cloth. Imperial 8vo, pp. 734. Plates and maps. Des Moines, 1870.

Report of an Inquiry in regard to Schools of Technical Science in certain portions of the United States. By J. G. Hodgkins and A. T. Machattie. 8vo pamph., pp. 34. Toronto, 1870.

Third Annual Report of the Natural History Club of Philadelphia. 1871. 8vo pamph., pp. 24.

Fourth Annual Report of the Commissioner of Fisheries of the State of Maine for the year 1870. 8vo pamph., pp. 56. 2 plates.

Fifth Annual Report of the Commissioners of Inland Fisheries [of Massachusetts]. January. 1871. 8vo pamph., pp. 77.

On the Genesis of Species. By St. George Mivart, F.R..S 12mo, cloth, pp. 296, illustrated. London. Macmillan & Co. 1871. [$2.00.]

Honduras: Descriptive, Historical and Statistical. By E. G. Squier, M.A., F.S.A., etc. Issued by permission of the author, and under the authority of His Excellency Don Carlos Gutierez, Envoy Extraordinary and Minister Plenipotentiary of the Republic of Honduras in Great Britain. 12mo, cloth, pp. 278 and map. London. Trubner & Co. 1870.

Travels in Central America, including Accounts of Some Regions Unexplored since the Conquest. From the French of The Chevalier Arthur Morelet. By Mrs. M. F. Squier. Introduction and Notes by E. Geo. Squier. 12mo, cloth, pp. 430, illustrated. New York. Leypoldt. Holt & Williams. 1871.

Report of the Fruit Growers' Association of Ontario for the year 1870. [*Including 1st Annual Report on Noxious Insects.*] 8vo pamph., pp. 130. Toronto, 1871. [Gov. Doc.]

NATURAL HISTORY IN THE PUBLIC SCHOOLS.

THINKING that a strong effort should now be made for the encouragement of the study of Natural Science in the Public Schools of the country, the editors of the NATURALIST have (in connection with several most eminent educators) recently asked the Legislature of Massachusetts to grant a small appropriation for the purpose of supplying regularly the higher schools of the State with copies of the NATURALIST, believing that beneficial results, both to the teacher and scholar, would follow the perusal of its pages, and that by presenting the subject to the scholar in this form, a love for the study would be awakened, which it is impossible to secure simply from text books, that are in themselves repellant to the beginner.

The Legislature of Massachusetts referred the petition to its Committee on Education, and that Committee, with full appreciation of the importance of the subject, gave a hearing to those interested, on the ninth of March, when the following letters were read, and remarks were made by several gentlemen on the importance and probable satisfactory results of the plan.

We regret that no report was made of the remarks of Hon. Joseph White, Secretary of the Massachusetts State Board of Education. This gentleman endorsed the proposition as one well worthy of being tried by the State, and while believing that good results would follow, said that the plan was an experiment, but as it was an experiment in the right direction he thought it should be tried, and as Secretary of the Board of Education he was convinced that the copies could be distributed advantageously among the schools.

The decision of the Legislature has not yet been given.* but believing that the plan will meet with advocates in other States, as well as in Massachusetts, and hoping to see it tried elsewhere, we have concluded to print such portion as we have in writing of the testimony given before the Massachusetts Committee, for the perusal of those in other States who may be friendly to the cause.

Avoiding argument in this place, we will only remark, in anticipation of some replies, that the NATURALIST was not established as a pecuniary speculation, and is maintained by the fostering care of the Trustees of the Peabody Academy of Science, as one of the means of carrying out the wishes of the founder of the Academy, who, ever thoughtful of the benefit of mankind, distinctly enjoined upon his trustees the promotion of Science and Useful Knowledge, not only in his native county, but in "our Commonwealth and common country."

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*Since this was put in type the Committee on Education have reported favorably.

[*Letter from Professor Agassiz.*]

EDITORS OF THE AMERICAN NATURALIST:

CAMBRIDGE, March 6, 1871.

Dear Sirs:—The time seems to have come when to the received methods and approved topics of popular education such branches of physical and natural sciences should be added as have acquired real importance for the business of life during the last fifty years. There is only one difficulty in the way of this most desirable object. There are no teachers to be had—not enough to be found in the whole State of Massachusetts simply to provide the Normal Schools—whatever efforts might be made to introduce these studies at present, and the demand is likely to become more pressing every day. It would seem, therefore, to be the part of wisdom to consider what may be done to prepare the way. For years past I have been urging upon the educational section of the Social Science Association, the desirableness of introducing a complete course of scientific instruction in our Normal Schools, not from text books, but with experiments and demonstrations by special teachers; and I now hold that it would be still better to organize a special Normal School for the training of scientific teachers. The world will require them everywhere before many years are passed, and it would be fitting that, in the United States, Massachusetts should set an example, timely, in the right direction. But even this must be heralded in some way or other, and I see no better or more efficient way than the circulation of sound information upon the topics regularly to be taught. Your desire, therefore, to give to the AMERICAN NATURALIST a wider circulation among the schools, and throughout the State, meets fully my approval, and I will support your efforts in every way that may appear practicable. It would be a step in the right direction if you could secure for your periodical the same facilities and aid which are granted to the "Massachusetts Teacher," as the AMERICAN NATURALIST is

doing, in an able manner, in the department of natural history, what the Massachusetts Teacher is aiming at in the general field of school instruction. Moreover, it can fairly be said that the volumes of the AMERICAN NATURALIST thus far published would afford to teachers most desirable information in their preparation for the new task.

Wishing you ever so much success in the furtherance of your enterprise,

I remain, very truly yours,

L. AGASSIZ.

[*Letter from Professor Gray.*]

CAMBRIDGE, MASS., March 7, 1871.

Dear Mr. Putnam:—It unfortunately happens that I have a lecture on Thursday at 11 o'clock, which I cannot postpone, and which will prevent my going in to meet your committee. I wish you would say, in my behalf, that I think your application one eminently fit to be made, and I hope it may prevail. As you know very well, I have followed your journal with interest and attention, and I must say that you have achieved a great and rare success in making the AMERICAN NATURALIST at once *truly scientific* and *truly popular*, and I have good occasion to know that this is a thing not often done. Yet in an educational view this is all important. Then your typography and illustrations are first rate and you deserve encouragement for that. I know that while your journal does efficient service at home, and aims simply at that, it is very highly thought of in Europe, as well it may be.

If there should be a second hearing, and you think I could be of any use, I should like to say what I think of it to your committee.

I can write only this hurried line.

Believe me to be yours, most sincerely,

ASA GRAY

[*Letter from Mr. Hagar, Principal of the State Normal School.*]

STATE NORMAL SCHOOL, SALEM, MASS.,
March 9, 1871.

F. W. PUTNAM, Esq.:

Dear Sir:—I regret that my school duties will not allow me to be present to-day at the legislative hearing in reference to the AMERICAN NATURALIST. I should be glad to say a word in behalf of that most valuable publication. Having taken it from the first, I have had an opportunity to judge of its merits, and I am clearly of the opinion that it is admirably adapted to awaken and promote in the minds of those who peruse it a lively interest in the study of Natural History.

It seems to me that if the Legislature of Massachusetts should furnish the means of placing the NATURALIST in the several school libraries of the State, or, at least, in the hands of the teachers of high schools and the principal grammar schools, it would do much toward building up a department of education which is now generally neglected, though of great importance.

I earnestly hope that the Committee on Education will regard with favor your application in behalf of the NATURALIST, and that the Legislature will aid you in your laborious efforts to introduce more of practical science into our public schools.

Yours truly,

D. B. HAGAR.

[*Remarks by George B. Emerson, LL.D.*]

Mr. Chairman:—I think it of the utmost importance, in the education of every child, to open his eyes, as early as possible, to the beauty, properties, and curious structure of the objects around him. This will lead him to form the habit of observation upon the simplest objects, will add to his capacity for observation and thought, and will open to him a

source of great and inexhaustible happiness throughout life. A person whose habits of observation are thus formed, will be insensibly led to occupy himself more with the works and thoughts of God, than with man's works and thoughts; and he will see and learn a thousand things, which, without these habits, would have remained unseen and unknown. To the future farmer these habits will be of special use. Every farmer ought to be an observer. He cannot otherwise understand the management of the earth he tills, or of the vegetables and fruits he cultivates, nor how to provide for his friends, the birds, or against his enemies, the insects. The AMERICAN NATURALIST seems to me admirably well adapted to form this habit of observation, and to awaken and gratify a love of the beautiful. I should be glad to put it within the reach of every teacher in all the schools of the state.

For more than half a century I have had no higher ambition than to be a successful teacher.

Not many years after I came into this town, in 1821, to be the first Principal of the English High School, I was one of a few, who, meeting first in the office of Dr. Walter Channing, united to form the Boston Society of Natural History. After a few years I became president of this society, and continued in the office for some time. I did not feel as if I were neglecting my chosen work in giving a portion of my time to Natural History. I needed recreation; and in what more suitable form could I find it than in taking long walks with Dr. Charles T. Jackson, or A. A. Gould, or D. H. Storer, to Roxbury or Malden Hills, or Chelsea Beach, or a drive with Prof. J. L. Russell, to see Wm. Oakes at Ipswich, or with Oakes himself, to the Essex woods, or to examine the trees in West Cambridge? This was recreation in the open air, with an interesting object in view. I wish that every teacher, worn with confinement and anxious toil, could get refreshment in the same way. The subject of suitable exercise and refreshment for the teacher is of vital importance. Many of the best and most

devoted teachers, especially females, are breaking down, from time to time, for want of air, exercise, and sunshine. The looking for objects for their lessons in Natural History would give them the very variety they want, for it would oblige them to take long walks over hills and through woods, in the sunshine and in the shade, to get these objects.

Knowing the great value of something of Natural History in the earliest stages of education, I should be glad to see it introduced into every school, not in the shape of lessons to be learned, but as forming the subject for many general lessons given in a conversational way, and leading to conversation in the school and at home.

It is now common, in many of the very best schools, for the teachers to give instruction — not merely to hear lessons — but to give real instruction; and there are few subjects in which more interesting and valuable instruction can be given than the several departments of Natural History; and few sources from which the best materials may be drawn more surely than they may from the numbers of the AMERICAN NATURALIST.

Very valuable instruction on these subjects has now for several years been given in the Normal Schools at Westfield, Bridgewater and Salem; and many of the teachers that have gone out from these schools are prepared to use, to excellent purpose, the knowledge given in most of the numbers of the AMERICAN NATURALIST. I have no doubt that, if the work were favored by the Legislature, the editors would see to it that there should be something of special interest to the teacher in every future number.

[*Remarks by W. H. Niles, Lecturer Mass. State Teachers' Inst.*]

Mr. W. H. Niles spoke of the NATURALIST as adapted to the use of the teachers of public schools. It differs materially from a text-book, and therein it has a feature of excellence. Text-books are condensed compilations, and are often written by those who have little or no experience as

original investigators. Frequently facts which are clearly related in nature are widely separated in such books, and thus, instead of elucidating the grand laws of nature, they too often become only volumes of disconnected statements. The teacher who assigns lessons from such books with no experiences of his own to add, can never lead his pupils to love and study nature. But in the articles of the NATURALIST we have original papers from professional naturalists, the direct results of the study of nature herself. These articles, in the hands of the teachers, would bring them genuine science fresh from its discoverers.

Again, the NATURALIST gives the latest results of scientific research. Natural History is advancing so rapidly that a text-book a few years old is necessarily wanting in many most important particulars. There must, therefore, be some medium of communication between the investigating naturalists and the teachers, to enable the latter to teach the science as it advances. The NATURALIST is the only publication in this country which furnishes such a medium.

But how are teachers to use the NATURALIST in schools? To assign lessons to be memorized from these or any other books on Natural History is useless. Many of the subjects presented in the NATURALIST are excellent topics for object lessons, and the articles would be very useful to the instructor in oral teaching. It is through such lessons and teaching that Natural History is to take her appropriate place in a thorough system of elementary education. To secure fresh knowledge, and scientific accuracy in teaching it, the NATURALIST should be used by the teachers of public schools.

[*Letter from Mr. Bennett.*]

LONDON, Dec. 1st, 1870.

TO THE EDITORS OF THE AMERICAN NATURALIST.

Sirs:—In the number of your admirable magazine for November, I observe that you do me the honor of reprinting

an article of mine, on the Cultivation of Foreign Trees and Plants, which appeared in the "Quarterly Journal of Science."

It has occurred to me that you might be glad to receive, from time to time, items of intelligence from this country, and the Continent of Europe, in Botany, Geology, and other branches of Natural Science, somewhat earlier than you would obtain them by reprinting from our journals. If so, I shall be happy to act as your correspondent in the matter.

I may mention that I have unusual opportunities of receiving such early intelligence, being sub-editor of "Nature," editor of the Scientific Department of the "Academy," and contributor of the botanical intelligence to the "Quarterly Journal of Science," which you have also often quoted in your journal.

Believe me to remain,

Yours faithfully,

ALFRED W. BENNETT.

[*Letter from Mr. Hiskey, Sup't of Public Schools, Minneapolis.*]

OFFICE OF SUPERINTENDENT PUBLIC SCHOOLS,
MINNEAPOLIS, MINN., Aug. 10th, 1870.

Editors American Naturalist:—Allow me to thank you for the August number of the NATURALIST. The numbers have seemed to me to be growing better and better and better, but this number is so admirably written that I have stopped to write you this letter after reading the first three articles. You, without doubt, have frequent expressions of commendation, still I imagine you have discouragements, and hence it gives me pleasure to express thus spontaneously, my congratulations that the NATURALIST is so admirably sustained.

Allow me to extend to you my best wishes,

And believe me, ever,

Yours truly,

W. O. HISKEY.

The following Notices of the Press were taken from several hundred notices of a similar character and laid before the Committee.

"The leading men of science in America are among its contributors, and it is in every way worthy of the great nation which it is intended to interest and instruct." — *Quarterly Journal of Science (London).*

"It deserves a wide patronage among teachers." — *Michigan Teacher.*

"The AMERICAN NATURALIST for June contains several excellent papers of a kind that are intelligible and valuable to others besides men of science. We regret that a publication so useful and so well conducted — so creditable to the country in every way — should not be supported liberally, as appears to be the case. The editors represent their expenses to be in excess of their revenue. We are glad to repeat that the NATURALIST deserves long life and the amplest development, and we especially regard it as of service to the young for inducing habits of careful and precise observation." — *The Nation.*

"We rejoice to see this beautiful magazine, and hope it will be the pioneer in a much-needed educational reform, and do good service in spreading a love and taste for the study of Natural History, now so utterly neglected." — *Massachusetts Teacher.*

"As a means of educating the people, especially the young, its efforts will certainly meet the approbation of all interested in the great cause of education, and we wish it abundant success." — *Maine Farmer.*

"This very ably conducted periodical is edited by a corps of young and enthusiastic naturalists, who, without departing from scientific accuracy, aim to make the study of Natural History so attractive as to win to it a more general and popular attention. It ought to be in every family and in every school library." — *R. I. Schoolmaster.*

"This Monthly Magazine of Natural History has won for itself a high place among the journals of the world. It knows how to popularize science without degrading it. Many of its articles are by some of the best zoologists of the country, and contain the results of original observation. The illustrations are always excellent." — Prof. J. D. DANA *in American Journal of Science and Arts, Jan.*, 1871.

"Science made easy is generally made absurd, and we have little patience with the somewhat popular belief that even small boys may be profitably dosed with science. But there are departments of Natural History, which can be treated popularly and yet scientifically. We have never had in our country a magazine giving *accurate* information on subjects of Natural History and, at the same time, bringing the information within the range of all, until the appearance of the AMERICAN NATURALIST. The editors are themselves accomplished naturalists, and devote their whole time to the study of nature. Hence their statements are entitled to entire con-

fidence. That the magazine is popular, and constitutes a charm for the whole family circle, we know from personal observation. Not only is definite knowledge gained from it, but habits of careful observation are formed. The young folks bring in their queer bugs and butterflies, and if they can not find out all about them and their habits in the magazine, they send the specimens confidently to the editors, and then wait and watch, oh, how eagerly, for the next number. The same with flowers or birds or shells. It matters little what enkindles thought and enthusiasm in the young mind. Once kindled they give light and power through the whole life. We can not too earnestly urge upon our friends to subscribe for the NATURALIST, and, having read the numbers, to bind and preserve them for future reference. They are as equally interesting and profitable for the "old folks" as for the boys and girls." — E. B. A., *in The National Teacher for March*, 1871.

THE

AMERICAN NATURALIST.

Vol. V.—MAY, 1871.—No. 3.

BRAZILIAN ROCK INSCRIPTIONS.

BY PROF. CH. FRED. HARTT.

It is a great shame that the antiquities of Brazil have so far received little or no attention, yet the country is one whose ethnology is extremely interesting, and it is very desirable that the history of its many tribes should be traced out. The neglect of Brazilian antiquities has arisen, no doubt, from the comparative rarity of the relics and the difficulty of exploring the country. Stone implements are found all over the empire, ancient pottery occurs in many localities, especially in burial stations, and Kjökkenmöddings exist on the coast as at Santa Cruz in the Province of Espiritu Santo, on the Bay of Rio de Janeiro, at Santos and elsewhere. But they have attracted very little attention, though they are occasionally mentioned by travellers.

During my expedition last summer to the Amazonas, I lost no opportunity of studying the antiquities of the country, and I was successful in collecting a few facts of importance. On the Rio Tocantins near the lower falls, I found figures engraved on rocks, and from the cliffs of the Serra do Ereré I copied a great number of rude figures and signs drawn in red paint. My good friend, Senhor Ferreira Penna, at Pará, was kind enough to give me a series of drawings from the Serra of Obidos, which locality I did not visit, together with the original MS. and drawings of a Government report on certain Indian drawings on the Rio Oyapock.

Entered according to Act of Congress, in the year 1871, by the PEABODY ACADEMY OF SCIENCE, in the Office of the Librarian of Congress, at Washington.

I sent one of my assistants, Mr. Barnard, to examine a burial station on the Island of Marajó, and he brought me a small collection of pottery presenting some interesting features. In this article I shall confine myself to a description of the inscriptions I have collected, hoping in another article to describe the pottery and other relics.

The Tocantins inscriptions occur at Alcobaça, a point on the left bank of the river, near the first falls, and about one hundred miles from the mouth of the river. Here are exposed on the banks during the dry season beds of a fine-grained, very hard, dark red or brown quartzite, the strata having only a slight dip. Joints divide the beds into large blocks which often lie in place, but along a part of the shore they are piled up in confusion. During several months of the year, when the river is high, the locality is under water, as is the case with similar incised rocks at Serpa on the Amazonas. My guide told me that here were *letreiros*, or Indian inscriptions, and I was fortunate enough, not only to find several, but to be able to bring away with me two small incised blocks. The figures are pecked into the rock by means of some blunt pointed instrument. They are so rude and irregular, that I see no reason why a pointed stone may not have answered the purpose. The grooves are usually wide and not very deep. Occasionally the unskilful hand missed its mark and marred the figure. These figures are usually cut on the sides of the blocks of rock and show much wear; many are hard to trace, and the majority are more or less covered by a shining black film of manganese deposited by the water. The surface of one of my specimens, Pl. 2, fig. 5, has a metallic lustre, like that of a well blackened stove.

Of these inscriptions, Pl. 2, fig. 1, which is about sixteen inches in length and is somewhat badly preserved, appears to represent a human figure, but it has a decapitated look. It may perhaps be intended to represent some lower animal. The position of the arms and legs conforms to the type of ordinary Indian representations of the human form, as we shall see further on.

The other figures are, for the most part, more or less complicated spirals. Pl. 2, figures 2, 4, 5, 7, and 11. One of these, Pl. 2, fig. 4, may represent the human face, the upper diverging lines being the eyebrows, the medial descending loop the nose, and the spiral the eyes. Equally rude representations of the face occur elsewhere.

About half a mile above the locality where the figures occur, I found on the upper surfaces of several masses of sandstone, places worn by grinding. Some of these were circular, about a foot in diameter, quite shallow, and with a convex prominence in the middle showing that a tool, probably a stone axe, had been ground with a circular motion. One of these hollows is represented in Pl. 2, fig. 6. Others were shallow, oval hollows, a foot or more in length, made by rubbing the tool backward and forward. I saw also a long, narrow, and rather deep groove worn in the same way, perhaps in the grinding of arrowheads. These grinding surfaces looked to me totally unlike those made in sharpening metal tools. It is important to note that on the Tocantins, this is almost the only place where sandstones occur. There is a great want of sharp sandstones suitable for whetstones or grindstones, not only on the Amazonas, but in Brazil generally, as I have already elsewhere remarked. This locality would be likely to be frequented by savages for the purpose of grinding and manufacturing stone implements. I saw no chips on the spot. It will be borne in mind that the locality is swept annually by floods.

At Jequerapuá, a few miles farther down on the same side of the river, I found on the rocks the spiral represented on Pl. 2, fig. 3, near which was a conical hole.

Engraved figures occur elsewhere in Brazil, on the lower part of the Rio de São Francisco (Williams and Burton), in the Province Parahyba (Koster), on the Rio Negro, etc.

The Serra do Ereré is situated on the northern side of the valley of the Amazonas at a distance of fifteen or more miles from the main river, but a short distance from the Rio Gurupatuba, a few miles west of the Villa de Monte Alegre. It is a narrow, very irregular ridge, about 800 feet high, running approximately east west, and about four to five miles long. The rock is sandstone in very heavy beds inclined to the southeastward. These sandstones form a broken line of cliffs running along the western side near the top, below which is a very irregular rocky slope. On these walls of rock, at and near the western end of the Serra, sometimes near their base, sometimes high up in conspicuous situations difficult of access, are great numbers of rude characters and figures, for the most part in red paint, some isolated, others in groups. Some rock surfaces are thickly covered with them, many being so washed by rains and defaced by fires as not to be traced out, others being

bright and fresh, suggesting that they were not all executed at the same time. Standing just in advance of the line of cliffs at some distance east of the western end of the Serra is a tall, tower-like mass of sandstone painted not only on the base but high up on the sides, while the cliffs behind and on both sides are covered with figures. All these localities are very conspicuous and some of them are so large as to be visible at the distance of more than a mile.

Not far from the eastern end of the Serra there is on top an enormous isolated mass of sandstone, the remains of a bed almost entirely removed, which mass is distinctly visible from the plain below on the northern side. The irregular western wall of this mass is covered with figures.

The drawings of Ereré comprise several classes of objects. The most important among these appear to be representations of the sun, moon and stars. At the western end of Ereré, on the cliff near the top, is a rude circular figure Pl. 4, fig. 17, nearly two feet in diameter. The general color is a brownish yellow. In the centre is a large ochre red spot, while around the circumference runs a broad border of the same color. Some of the civilized Indians at Ereré called this the sun, others the moon.

On a very prominent cliff some distance east of the tower-like mass of sandstone above described, is another similar figure about three feet in diameter. In this there is a central spot of brick red, then a broad zone of a dirty yellow, followed by a zone of brick red, outside which is another of a dirty ochre yellow. To the right of this are two smaller circular figures, in the upper of which the lines and centre are red, the innermost zone being of a dirty yellow tint. These figures are situated some ten feet from the foot of the cliff. Similar drawings, composed of two or more concentric circles with or without the central spot, occur in great numbers at Ereré. I am disposed to think that they are intended to represent the moon, since they are not furnished with rays.* One figure, Pl. 4, fig. 2, on the cliff at the western end of the Serra, undoubtedly represents this heavenly body.† Besides the above forms there are rayed figures in abundance. Sometimes they con-

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*I found a report afloat in Pará that some of these figures had been mutilated by Major Continho, Prof. Agassiz's companion on the Amazonas. The report is false, as the figures are not mutilated.

†Similar figures occur elsewhere. Seeman, Memoirs Anthrop. Soc., London, Vol. ii, p. 279, gives two examples, one from Veraguas, New Grenada, another from England.

sist of a single circle, or several concentric circles, the outer one, only, being rayed, but on the side of the great rock on the top of the Serra is a figure a foot in diameter (Pl. 5, fig. 10), and very distinct, formed of two concentric circles, each with a few large, tooth-shaped rays. Part of this figure is obliterated. At the same locality is another figure consisting of a circle with serrated rays with only a spot in the centre.

Not infrequently, on the painted rock at the western end of the Serra, occur circles, single or double, sometimes nucleated, which bear rays only on the upper side, Pl. 5. fig. 12, Pl. 6, fig. 1. There are rayed spirals as well, Pl. 4, fig. 3. Some of these appear to represent stars. They are either drawn or impressed. In some cases the palm and fingers were covered with wet paint and then pressed upon the rock. Whether these figures always represent stars is doubtful. At the western end of the Serra is a curious rayed head, ornamented on top with what looks like a *queue*, suggesting a comet. At the same locality is the remarkable figure, Pl. 4, fig. 9, three and one-half feet high, which looks as though it might represent the impersonation of the sun. Just west of the tower-like mass is a rock face covered with a large group of what are apparently figures of the heavenly bodies. They are represented in Pl. 5, fig. 1, and are large and distinctly drawn. The whole group is some six or seven feet long. Of animate objects the human form and human face are very frequently delineated. They are all exceedingly rude and are just such figures as children are fond of drawing. Sometimes the body and limbs are represented each by a single line, as in Pl. 3, figures 3 and 8.

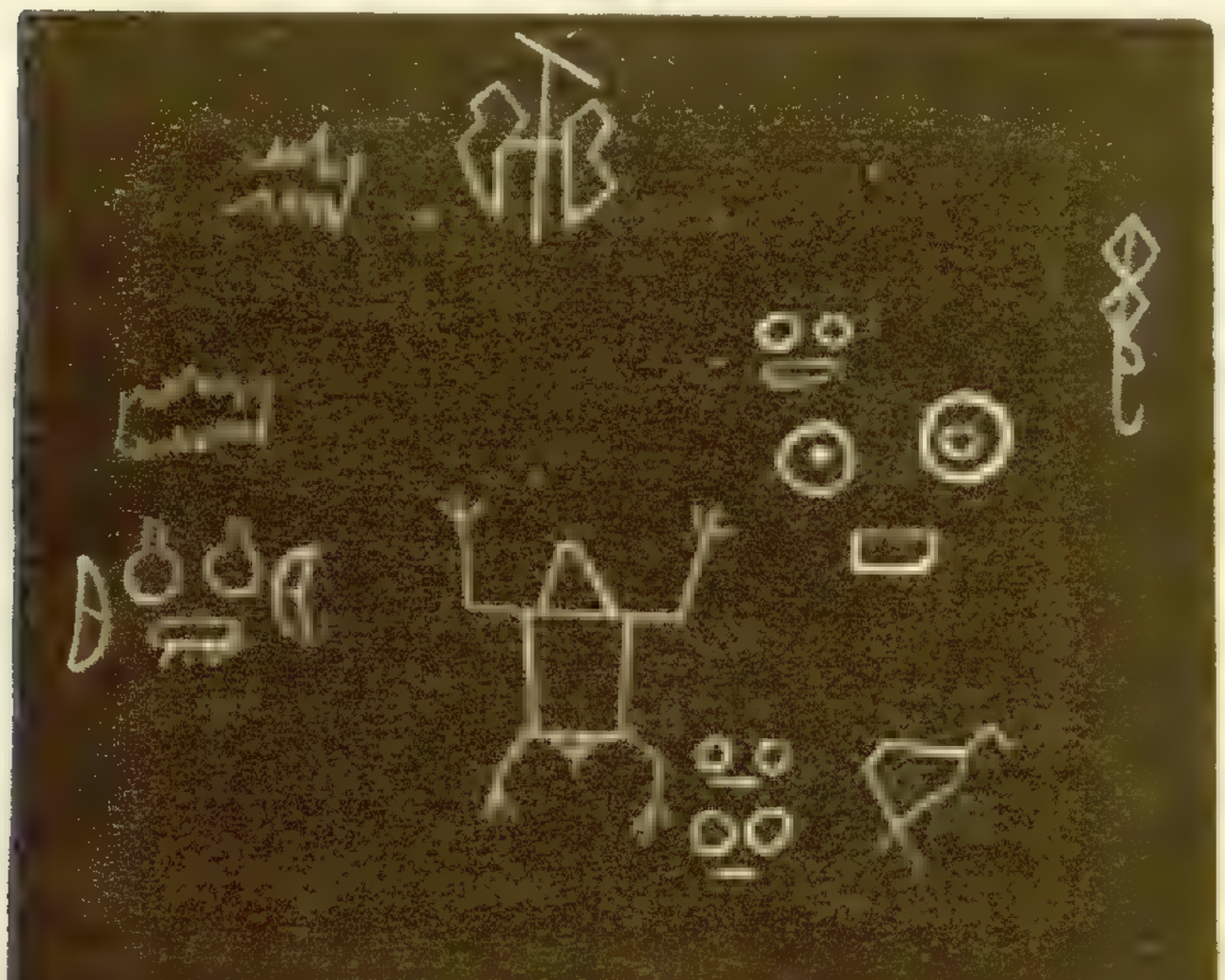
It is noticeable that human figures are never drawn in profile, which is the rule with similar drawings by North America Indians (Catlin). The eyes and mouth are usually alone represented, one eye being often smaller than the other. There is often no nose, or a heavy V-shaped curve is drawn over the eyes, the apex projecting down more or less between them, representing the nose, as in Pl. 3, fig. 1, Pl. 4, figures 12 and 15.

In some ancient pottery to be described in a future paper the same peculiarity is observable in the representation of the human head, the eyebrows and nose forming a prominent T-shaped ridge. As the most of the busts in terra cotta show the head flattened from before backward, I would suggest that the Indians who made

the drawings at Ereré, and the pottery in Marajó may have flattened the head as the Omaguas and Flatheads do to-day, which would give a greater prominence to the brows than in the normally shaped skull.

The stiff angular position of the arms and legs of the figures is interesting, the upper arms being held at right angles to the body, the forearm bent at a similar angle and usually upwards. The legs are wide apart, the thigh extending often straight out from the body. The figures are usually erect, but there is one on the west end of the Serra represented as lying on the side, Pl. 7, fig. 2. Below it is a figure of a snake, the whole appearing to commemorate the death of some one from snake-bite. Some of the heads are rayed as in the case of Pl. 3, fig. 1. These may perhaps represent the sun or moon. Some rough drawings of the human face are made on angular projections of the rock, as is the case with that figured in Pl. 4, fig. 10, where the sharp edge represented the nose. Another face is made by drawing lines around two contiguous, circular depressions, converting them into eyes, and drawing a straight line below for a nose.

Fig. 42.



Group of Rock Paintings at Ereré.

It is interesting to observe that the hands and feet are always represented by radiating lines, usually only three digits being drawn for each hand and foot. The number of digits represented rarely reaches four, and never five, so far as I have observed. An explanation of this may perhaps lie in the fact that many tribes of Brazil are unable to count beyond three or four. O the lower animals, several kinds are represented, but so rudely that it is, in most cases, difficult to determine the species. The large figure, Pl. 5, fig. 6, my Indian guide pronounced a *mucúra*, a species of opossum, and he called the four-legged and long-tailed animals, Pl. 9, alligators. Birds appear to be rarely represented. On Pl. 9, are two figures, *b* and *d*, that may be intended for these ani-

mals. There are several drawings of the *yauraná*, or sea cow, Pl. 4, fig. 3 (?), Pl. 5, fig. 3, Pl. 7, fig. 7. Of fishes, there are two at least, Pl. 5, fig. 8, and Pl. 6, fig. 4. It is worthy of remark that there are no drawings of the dog, ox, or horse, and I have seen no figures of plants. Senhor Penna, in a MS., says that trees are sometimes represented, together with "canoes, oars, benches, and other objects of common use," but I have seen no such figures at Ererê, though they may occur elsewhere.

In the accompanying plates, I have given many examples of drawings of doubtful significance. The scroll, Pl. 4, figures 5 and 7, Pl. 5, fig. 4, Pl. 7, fig. 5, occurs frequently, and also the design Pl. 7, fig. 8, which varies somewhat in different drawings. The complicated rectilinear figure, Pl. 6, fig. 2, is painted on the side of the isolated rock mass on the top of the Serra and is about sixteen inches in height.* The Greek fret occurs once or twice at Ererê and quite frequently on the Marajó pottery.

The red paint used in the inscriptions, is, I believe, annatto, perhaps also clay. It is very rudely smeared on the rough surface of the sandstone, sometimes when quite dry. There are some drawings in which the paint was laid on as a thin wash which dripped over the rock. I think the painting was largely done with the fingers. In some places the rock is soiled where the Indian assisted himself by the hand in climbing. The yellow color was prepared from clay.

The drawings of the Tocantins and of Ererê were carefully copied. The figures on the plates were transferred directly to the wood from my original sketches. I do not claim for them photographic accuracy, but I am sure they give faithfully the Indian idea. The original inscriptions are even more rude in finish than might be inferred from the plates. Precisely similar figures to those of the Tocantins and Ererê occur on the Rio Uaupés (Wallace) scraped on hard granitic (gneissic?) rock.

I have given on Pl. 9, accurate reductions of the copies of the figures on the Serra da Escama, kindly placed in my hands by Senhor Penna. A note, accompanying the sketches, says that the drawings were found on seven stones on the top of the Serra da Escama, about 400 bracas distant from the city of Obidos. The most of these are wholly unintelligible to me. One, fig. 2, appears to represent the sun, and another the moon or sun.

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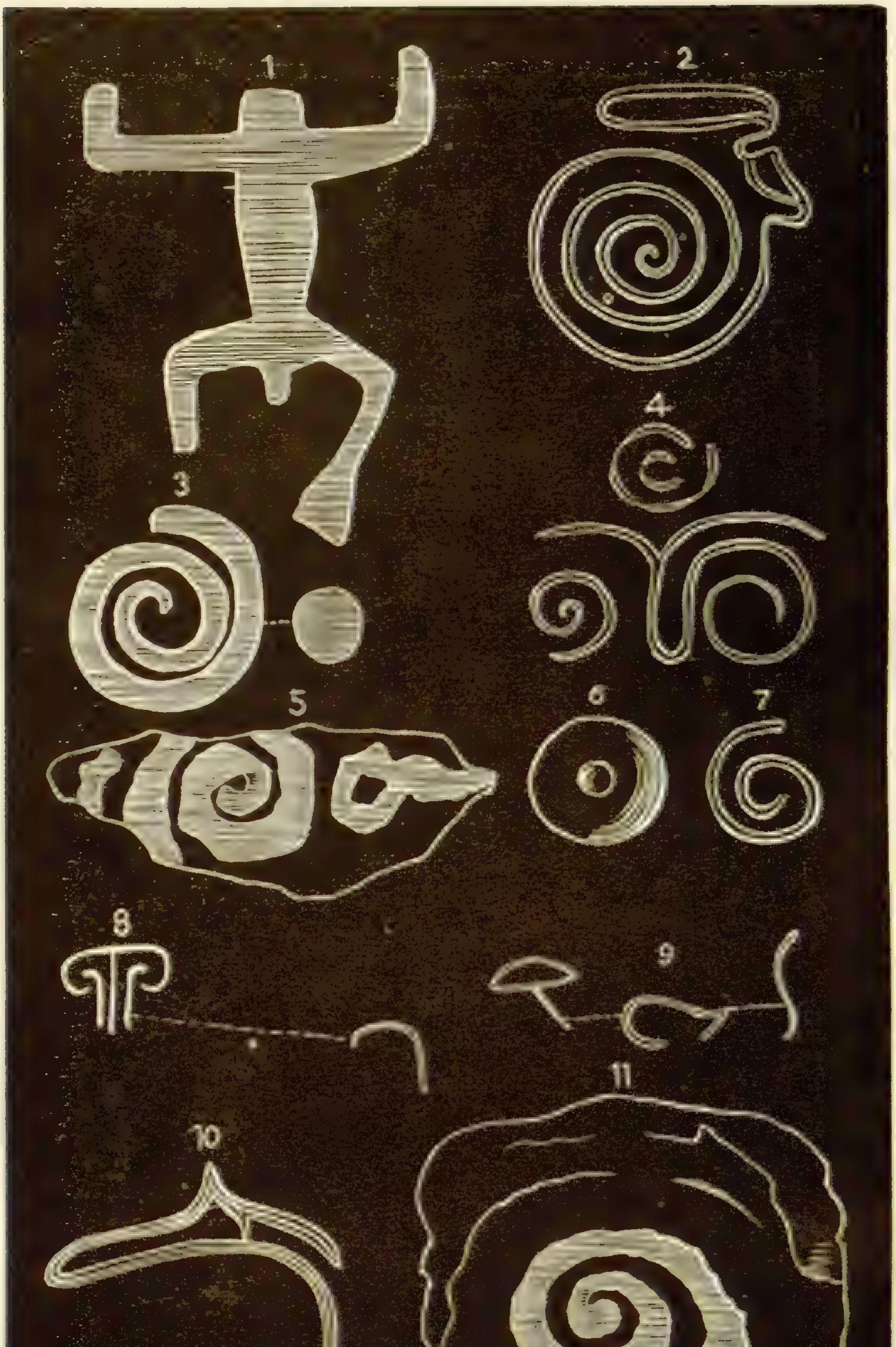
* In the plate the *right* is the *lower* side of this figure.

According to traditions, Bento Maciel, the first donatory of the ancient Capitania do Cabo do Norte, set up marks fixing the limits between his Captaincy and French Guayana, but these marks, when the boundary question afterward arose, could not be found. In 1727 the Captain, João Paes do Amaral, who had been on service in the north, reported having discovered them on the Rio Oyapock. So important was this announcement that the Governor of Pará immediately sent the Alferes Palheta with a party to report on the discovery. This expedition proved unsuccessful, and in 1728 another expedition under Captain Pinto da Gaya was sent out. This officer discovered the supposed marks on the top of a hill called Mont d'Argent and was disappointed to find them nothing but Indian drawings. These he had all carefully copied in ink, his drawings being submitted to the government, with his report. The original papers and sketches Senhor Penna has been so kind as to place in my hands. Of one of the sets of drawings I have made an accurate reduction on Pl. 10, by the aid of photography. Figures 2, 3, and 4, on the same plate, are from another set of sketches accompanying the above report. These figures resemble in many points Indian drawings from Brazil, but the square spiral recalls some Mexican ornaments.

The antiquity of the rock paintings and sculptures of Eastern South America is undoubted, and they are mentioned by many of the ancient writers, as well as by Humboldt and others in more recent times. It is well known that the drawings of Ereré, and those of Obidos, about to be described, existed more than two hundred years ago. There can be no doubt that they antedate the civilization of the Amazonas, and there is a strong probability that some of them, at least, were drawn before the discovery of America.* I hold it most probable that the rock paintings and sculpturings were made by tribes which inhabited the Amazonas previous to the Tupí invasion. The sculpturings are supposed to be older than the paintings. This is also, I believe, the opinion of Senhor Penna. I think the Ereré figures have a deep significance. A people that would go to so much trouble as to draw figures of the sun and moon high up on cliffs on the tops of mountains must

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* At Ereré occur the half obliterated sign, I. H. S., and the date 1764 (Pl. 4), evidently the work of the Jesuits. These last inscriptions are very fresh and are drawn in a lighter red on the lichen-blackened or whitened surface that obscures the older inscriptions.

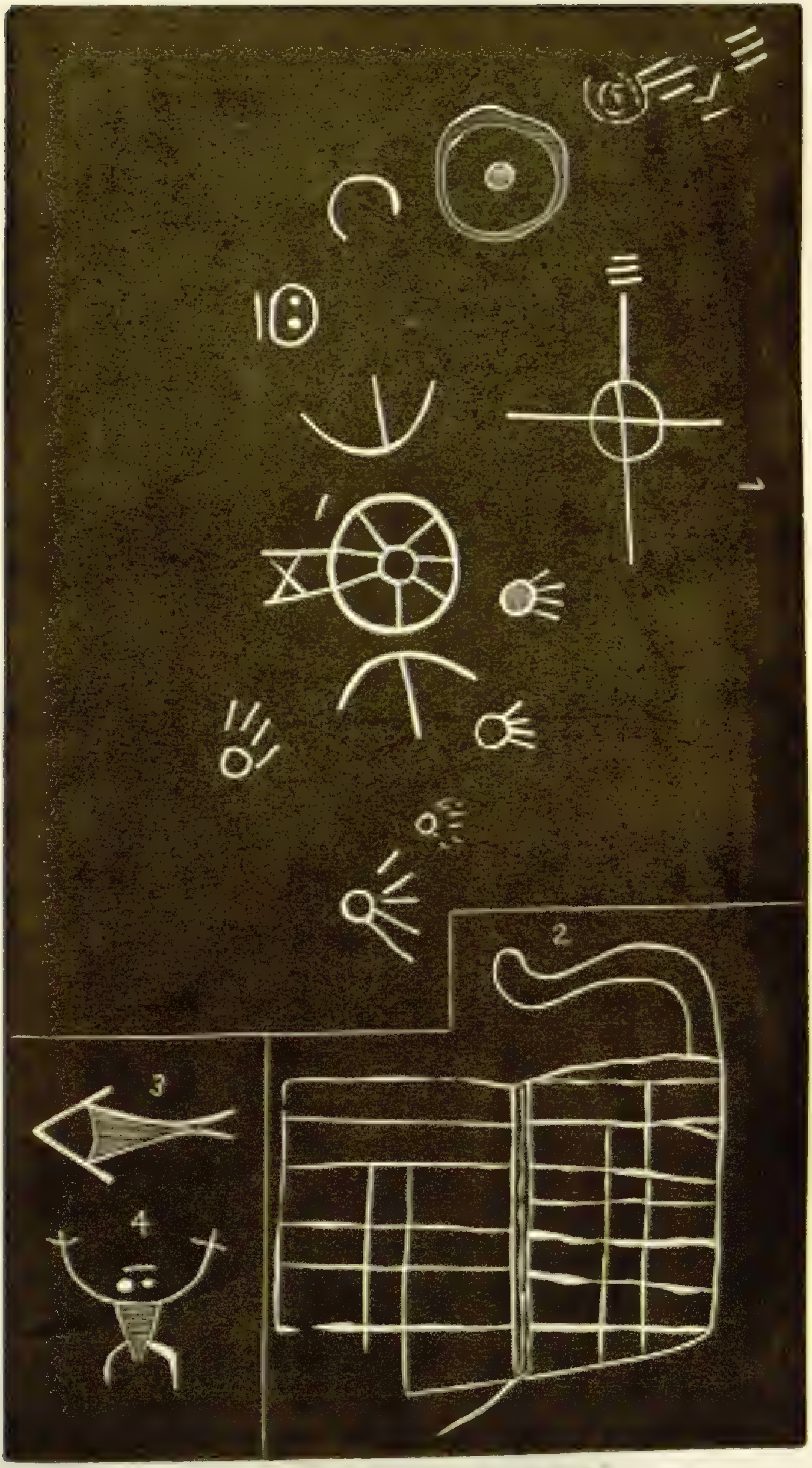


ENGRAVED FIGURES LOWE TOCANTINS.

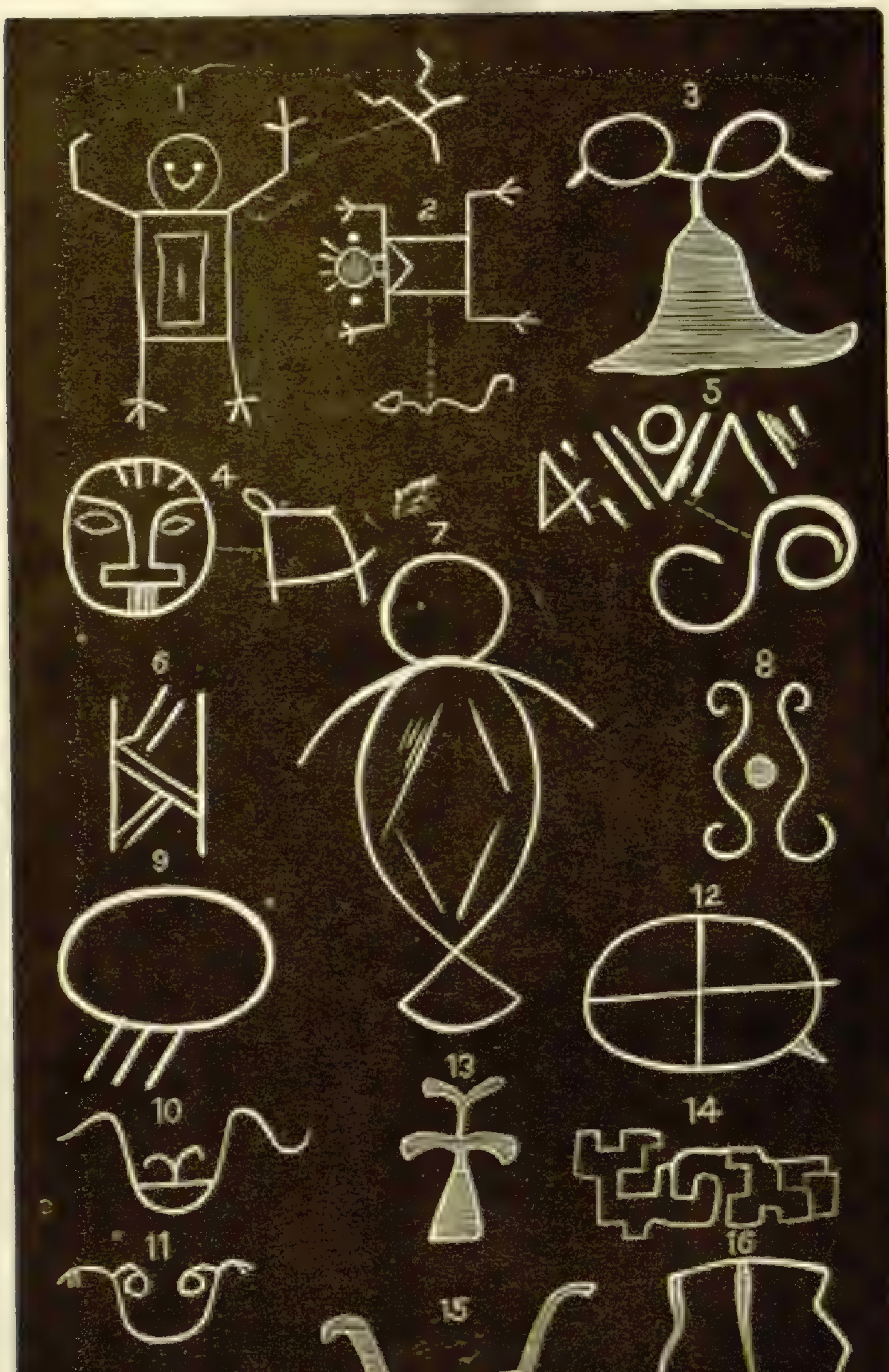


ROCK PAINTINGS AT EBERE.

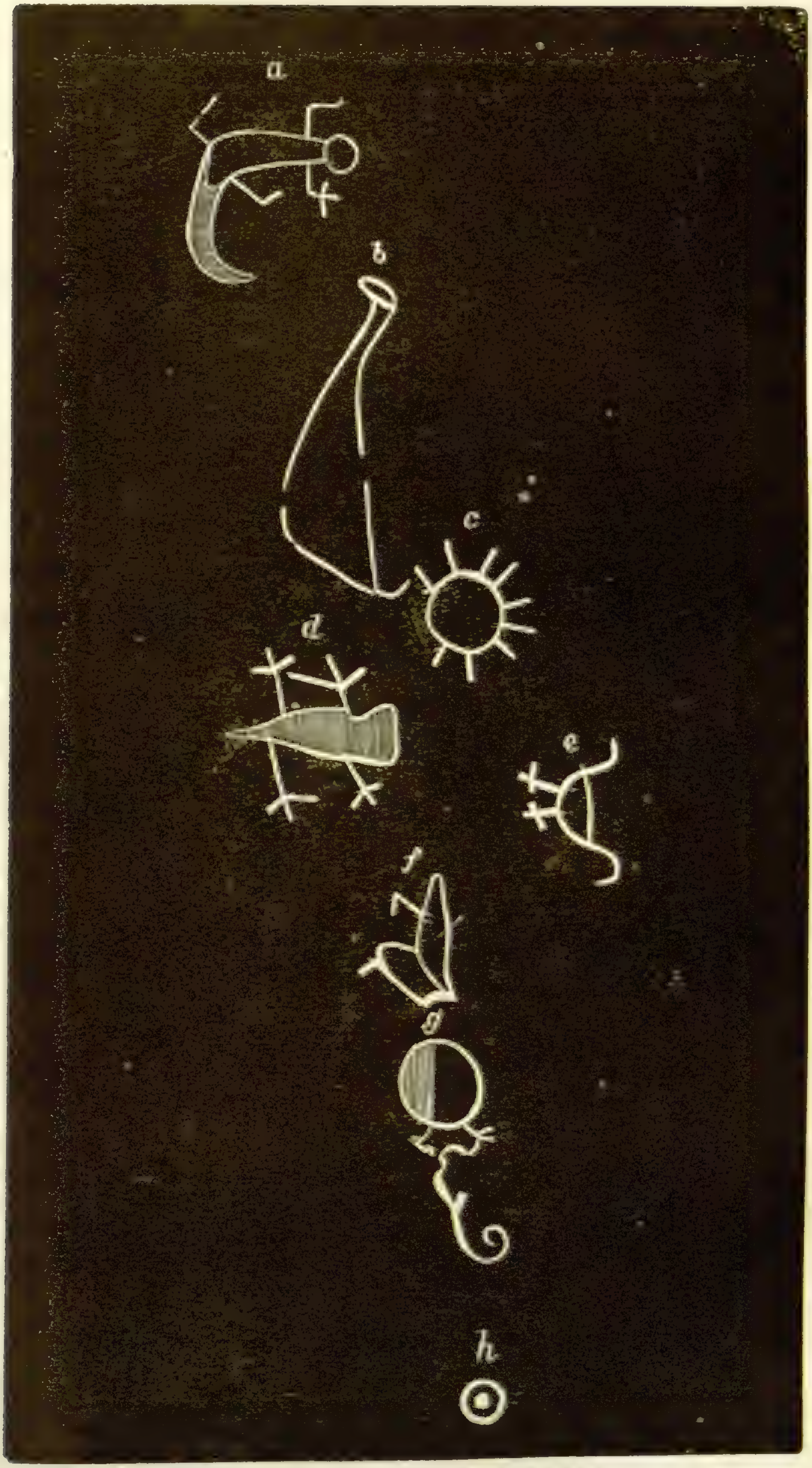
ROCK PAINTINGS AT ERERÉ.



ROCK INSCRIPTIONS AT ERERE.

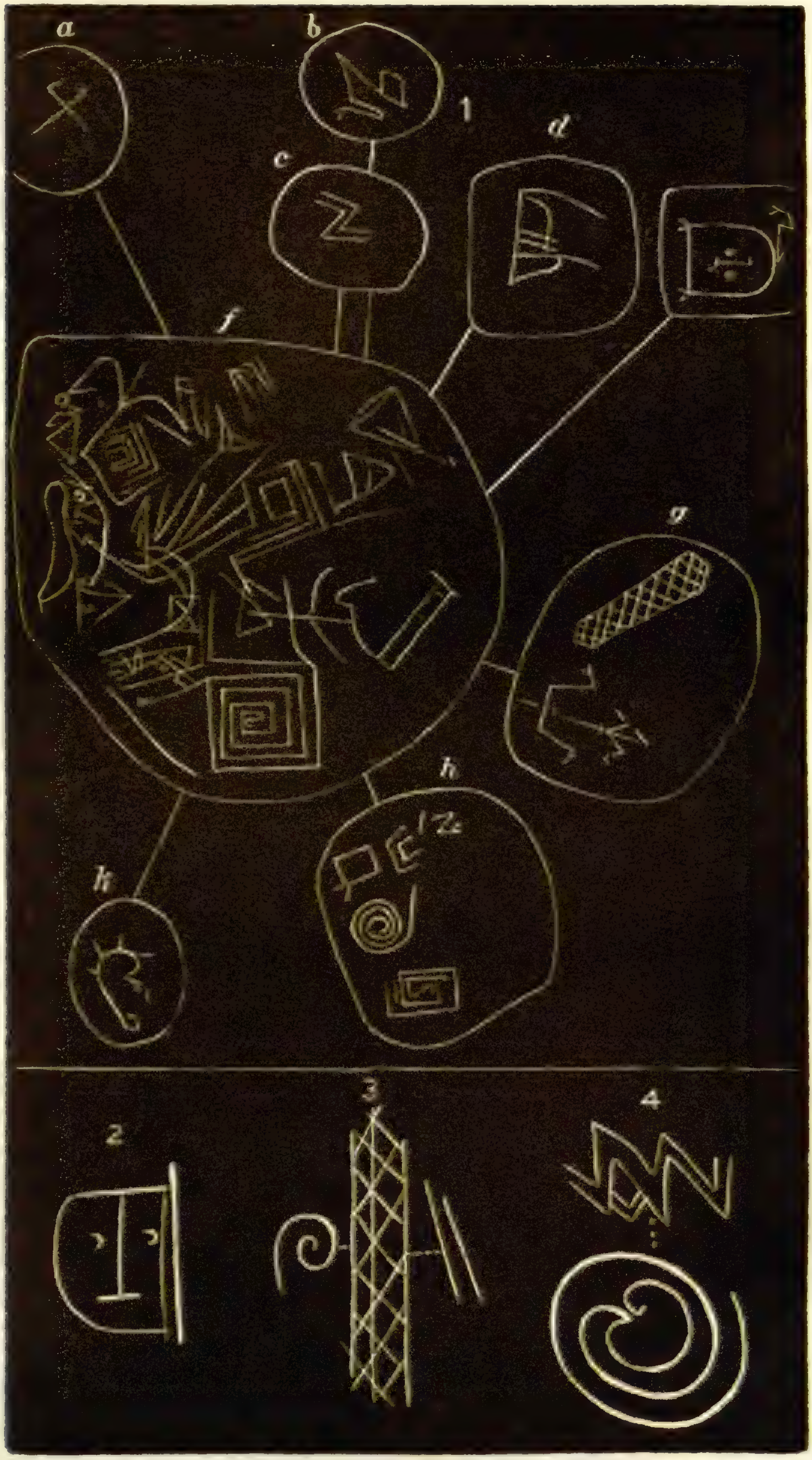


ROCK PAINTINGS AT ERERÉ.



ROCK PAINTINGS AT ERERE.

ROCK INSCRIPTIONS. SERRA DA ESCAMA OBIDOS.



ROCK INSCRIPTIONS, MONT D'ARGENT, RIO OYAPOCK.

have attached a great importance to these natural objects, and I think that these figures point to a worship of the sun by the tribes which executed them. The clustering of the inscriptions in prominent places, and especially on and in the vicinity of the rock tower at Ererê, seems to me to indicate that these places had something of a sacred character and were often resorted to. Many of the figures seem to be the capricious daubings of visitors, as, for instance, the human faces drawn on angular rock projections. Some of the animal forms may have had a sacred character.

I know of no trace of sun worship among the uncivilized Indians of Pará to-day, nor do they make rock paintings or inscriptions. The greater part of the Brazilian Indians, such as the Tupís. Botocudos, etc., appear to have had no idea of a God, and no form of worship. We have no historical account of the practice of sun worship among the ancient Indians of the Amazonas. In the burial stations of Marajó small clay figures occur which appear to be idols. The probabilities are, that the tribes anciently inhabiting the Amazonas were more advanced in religious ideas than those Brazilian Indians of which history gives us an account.

DR. KOCH'S MISSOURIUM.

BY P. R. HOY, M. D.

In March, 1840, I visited the spot on the Pomme de Terre. Benton county, Missouri, where Dr. Koch had recently disinterred the skeleton of that large male Mastodon now in the British Museum, which the Doctor mounted and named *Missourium tetracaulodon*. Owen subsequently remounted the specimen and made a *Mastodon giganteus* out of Dr. Koch's distorted work.

The excavation was about fifteen feet in diameter and six feet deep, half filled with water. I was told by one of the men who assisted in the excavation, that they did not get all the bones out, as the water was so deep as to interfere materially with their work. So I hired a negro to go into the pit and fish about. while I from the bank, felt around with a hoe. In this way we succeeded in procuring one molar tooth. two pieces of a tusk. and

several pieces of the skull, long bones, etc., etc. The larger piece was from the base of the left tusk, two feet in length, and flattened on the inner side, evidently produced by the friction of his trunk. This specimen retains the fine polish as perfectly as when worn by the living animal. This interesting specimen I recently presented to the Academy of Science of Chicago.

Dr. Koch's report, in the "Proceedings of the St. Louis Academy of Science," is unreliable in every particular, saving the locality. The Doctor certainly exercised a lively imagination when he stated that "the bones were found in a layer of vegetable mould which was covered by twenty feet in thickness of alternate layers of sand, clay, and gravel," and that under this extensive stratification he found the identical flint arrowhead that the *Mound builders* used in slaying this giant of past ages, taking advantage of his helplessness, being mired hopelessly!!!

This skeleton was discovered by a man who scooped out a hole in the "lick" for the purpose of obtaining drinking water. He struck upon the scapula at a depth of *two feet*. This discovery was reported to Dr. Koch, at Warsaw, and he visited the locality and secured the prize.

I am pained to record this evidence of Dr. Koch's want of accuracy in this matter, but the cause of science seems to demand the truth. Dr. Koch's report has been quoted in proof of the antiquity of man. The position and state of the bones rather go to show that the Mastodon lived in an age not so remote as usually supposed. I should not be surprised if the evidence were speedily found to prove that man was contemporaneous with the Mastodon. but, certainly, the *Missourium* affords none.

FLYING SPIDERS.

BY J. H. EMERTON.

One of the most curious habits of spiders is that of flying, as it is often called. This has no resemblance to the flight of birds or butterflies, for spiders have no wings nor any organs which could answer the purpose of wings. Their ability to rise in the

atmosphere depends entirely upon currents of air acting upon their bodies or upon threads of cobweb attached to them. By this means they are blown about like the down of thistles or any light objects, rising sometimes to a great height and again, upon a change of weather, falling, often far from the place whence they rose.

In the autumn of 1870 I received a letter from an officer on one of the United States vessels, in which he stated that one day while at anchor near Montevideo, after a strong wind, the rigging was filled with cobwebs, and little spiders dropped down on all parts of the deck.

Mr. Darwin, when in the same region during the voyage of the Beagle, several times noticed the same occurrence. He says in his narrative of that voyage:*—

"On several occasions, when the vessel has been within the mouth of the Plata, the rigging has been coated with the web of the gossamer spider. One day (November 1st, 1832) I paid particular attention to the phenomenon. The weather had been fine and clear, and in the morning the air was full of patches of the flocculent web, as on an autumnal day in England. The ship was sixty miles from the land, in the direction of a steady though light breeze. Vast numbers of a small spider, about one-tenth of an inch in length, and of a dusky red color, were attached to the webs. There must have been, I should suppose, some thousands on the ship. The little spider, when first coming in contact with the rigging, was always seated on a single thread, and not on the flocculent mass. The latter seemed merely to be produced by the entanglement of the single threads. The spiders were all of one species, but of both sexes, together with young ones. . . . . While watching some that were suspended by a single thread, I several times observed that the slightest breath of air bore them away out of sight, in a horizontal line. On another occasion (Nov. 25th) under similar circumstances, I repeatedly observed the same kind of small spider, either when placed, or having crawled, on some little eminence, elevate its abdomen, send forth a thread, and then sail away in a lateral course, but with a rapidity that was quite unaccountable. I thought I could perceive that the spider, before performing the above preparatory steps, connected its legs together with the most delicate threads, but I am not sure whether this observation is correct.

"One day at Santa Fé I had a better opportunity of observing similar facts. A spider, which was about three-tenths of an inch

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* Journal of the Voyage of the Beagle, p. 187.

in length, and which, in its general appearance, resembled a Citigrade (therefore quite different from the gossamer spider), while standing on the summit of a post, darted forth four or five threads from its spinners. These, glittering in the sunshine, might be compared to rays of light. They were not, however, straight, but in undulations like a film of silk blown by the wind. They were more than a yard in length and diverged in an ascending direction from the orifices. The spider then suddenly let go its hold and was quickly borne out of sight. The day was hot and apparently quite calm: yet under such circumstances the atmosphere can never be so tranquil as not to affect a vane so delicate as the thread of a spider's web. If during a warm day we look either at the shadow of any object cast on a bank, or over a level plain, at a distant landmark, the effect of an ascending current of heated air will almost always be evident, and this probably would be sufficient to carry with it so light an object as the little spider on its thread."

In Temple's Travels in Peru * it is mentioned that, when sailing up the river Plate, "the rigging of the ship, from top to bottom, was literally covered with long, fine cobwebs that had been blown off the shore, having attached to them their insect manufacturers, who dispersed themselves in thousands over the deck."

Such showers of cobwebs are common in Europe, especially in the autumn. They are said to be usually preceded by a great quantity of web upon the ground, which afterwards rises, and when the wind changes, or the sun begins to go down, falls again.

Mr. Blackwall, † who has devoted many years to the study of English spiders, gives the following interesting account of one of these showers of gossamer:—

"A little before noon on the 1st of October, 1826, which was a remarkably calm, sunny day, the thermometer in the shade ranging from 55° to 64°, I observed that the fields and hedges in the neighborhood of Manchester were covered over, by the united labors of a multitude of spiders, with a profusion of fine glossy lines, intersecting one another at every angle and forming a confused kind of network. So extremely numerous were these slender filaments, that in walking across a small pasture, my feet and ankles were thickly coated with them. It was evident, however, notwithstanding their great abundance, that they must have been produced in a very short space of time, as early in the morning they were not sufficiently conspicuous to attract my notice, and on the 30th of September they could not have ex-

* Temple's Travels in Peru, Vol. i, p. 49.

† Researches in Natural History, 1832. Linnæan Transactions, Vol. xv.

isted at all; for, on referring to my meteorological journal, I find that a strong gale from the south prevailed during the greater part of the day. A circumstance so extraordinary could not fail to excite curiosity; but what more particularly arrested my attention was the ascent of an amazing quantity of webs of an irregular, complicated structure, resembling ravelled silk of the finest quality and clearest white. They were of various shapes and dimensions, some of the longest measuring upwards of five feet in length and several inches in breadth in the widest part; while others were almost as broad as long, presenting an area of a few square inches only. These webs, it was quickly perceived, were not formed in the air, as is generally believed, but at the earth's surface. The lines of which they were composed, being brought into contact by the mechanical action of gentle airs, adhered together till, by continual additions, they were accumulated into flakes or masses of considerable magnitude, on which the ascending current, occasioned by the rarefaction of the air contiguous to the heated ground, acted with so much force as to separate them from the objects to which they were attached, raising them into the atmosphere to a perpendicular height of at least several hundred feet. I collected a number of these webs about midday, as they rose, and again in the afternoon, when the upward current had ceased to support them, and they were falling; but scarcely one in twenty contained a spider, though on minute inspection, I found small winged insects, chiefly aphides, entangled in most of them.

"From contemplating this unusual display of gossamer, my thoughts were naturally directed to the animals which produced it; and the countless myriads in which they swarmed created almost as much surprise as the singular occupation that engrossed them. Apparently actuated by the same impulse, all were intent upon traversing the region of air; accordingly, after gaining the summits of various objects, as blades of grass, stubble, rails, gates, etc., by the slow and laborious process of climbing, they raised themselves still higher by straightening their limbs, and elevating the abdomen by bringing it from the usual horizontal position into one almost perpendicular, they emitted from their spinning apparatus a small quantity of the glutinous secretion with which they fabricate their silken tissues. This viscid substance being drawn out by the ascending current of rarefied air into fine lines several feet in length, was carried upwards, until the spiders, feeling themselves acted upon with sufficient force in that direction, quitted their hold of the objects on which they stood, and commenced their journey by mounting aloft. Whenever the lines became inadequate to the purpose for which they were intended, by adhering to any fixed object, they were immediately detached from the spinners by means of the last pair of legs and became converted into terrestrial gossamer, and the proceeding just described was repeated."

I do not know of any published account of similar flights of cobwebs in this country, but on almost any fine morning in summer the grass and shrubs may be found covered with threads connecting the extremities of the twigs and leaves in every direction, and floating horizontally from them sometimes to a distance of several yards. I have often seen the short grass in the Salem pasture so covered that every leaf seemed to have several threads passing from it. One morning in June, 1868, I noticed some little spiders about one tenth of an inch long rambling about on the top of a low fence partly shaded by horse-chestnuts and apple-trees. At intervals they would stop, raise the back part of their bodies, and straighten their legs until they stood on tip-toe in the ridiculous position shown in the figure. (Fig. 43.) After a few seconds they would retake their customary position and travel on. I went to the same fence and watched them on several successive mornings, and finally saw one, on the edge of the fence-cap, raise itself as in the figure and immediately after a thread extended upward from its spinners. In a few seconds the thread increased to nearly a yard in length, when spider and all rose slowly upward until the thread became entangled in the branches of the apple-tree above, which were already connected together by numerous threads and occupied by several spiders of the same kind. This took place soon after sunrise on a warm, and apparently perfectly calm morning.

Fig. 43.



At another time, on one of the first warm days in March, I saw a little crab-spider running about on the ends of a barberry bush and dropping from twig to twig until it hung from the most projecting branch by a thread about a foot long. It swung back and forth for some minutes when a gust of wind blew it away so quickly that I could not follow it with my eyes. It had, however, spun a thread as it went which passed from the bush to a juniper about six feet off.

Mr. R. P. Whitfield of Albany, N. Y., tells me that once when passing through a field of oat stubble on a warm day in autumn he observed great numbers of threads floating upwards in the air, the lower extremity being attached to the upper ends of the stubble, and on examining some of the stalks he found numbers of small spiders busily running up and down them. When a suitable place was found the spider would attach a thread to the

upper end of the stalk and then descend one or two inches and return, allowing the air to carry upward the loose thread. At the same time it elevated its abdomen and the current, acting on the loop already formed, drew out the thread from the spinnerets until a sufficient quantity had passed, when it broke off the end attached to the stalk and floated away with the web. In this way he observed several individuals ascend. At the time there was no perceptible current in the atmosphere except the upward current caused by rarefaction.

In the autumn of 1865, in Northwestern Iowa, passing along the smooth surface of the river in a boat, he observed something crossing the river with a skipping motion, striking the surface of the water at irregular intervals. Looking about he saw that the same thing was taking place at other points. Upon intercepting one, which he had watched almost from the opposite bank, he found it to be a small spider (Attus), from the abdomen of which threads of web extended several feet into the air, by which it was floated along. As it crossed the water, the air being cooler, it had descended, allowing the spider to touch the surface of the river.

To account for the ascent of threads and spiders various theories have been proposed. It was formerly supposed that the threads were thrown out from the spider as water is from a syringe, independently of any outside force, and that the threads were afterwards blown into the air carrying the spider with them.

Some have thought that the spiders actually flew in the air without help from webs or from the wind, using their legs as wings.*

Mr. Murray† believed that a spider could shoot its threads in any direction without reference to the wind. He says:—

"Contrary to the assertion that 'spiders have no power of propelling their webs without assistance from the wind,' I fearlessly assert that they can do so in an atmosphere in which the very leaf of the aspen remains motionless; and although their *char volant* obeys the direction of the breeze, this simple fact proves nothing in favor of the opinion of Mr. Blackwall. The aëronautic spider can propel its threads both horizontally and vertically and at all relative angles, in motionless air, and in an atmosphere agitated by winds; nay, more, the aërial traveller can even dart its thread, to use a nautical phrase, in the 'wind's eye.' My opinion and observations are based on many hundreds of experiments. On

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*J. J. Virey, Ferussac's Bulletin Sciences Naturelles. Tom. viii.

† Memoirs Wernerian Soc., Vol. v, pt. 2, 1826; and Loudon's Mag. Nat. Hist., Vol. i, 1829.

favorable occasions I am constantly extending their amount, and as often do I find my deductions supported, namely, that the entire phenomena are electrical. In clear, fine weather the air is invariably positive; and it is precisely in such weather that the aëronautic spider makes its ascent most easily and rapidly, whether it be summer or winter. I have often seen this in winter, during an intense frost, a circumstance which renders the action of warm currents of air, as accessory to its flight, something more than questionable. Our aëronaut may be met with in its descent over the Mer de Glace as well as over the Lake of Geneva; and it will take flight as readily from a point over the frozen sea as from the heated surface soil of the valley of Chamouny.

"Several circumstances concur to shew the phenomena of ascent to be electric. The propelled threads do not interfere with each other; they are divellent, and this divergence seemed to proceed from their being imbued with similar electricity, and the character of that electricity appeared to me to be an interesting subject for subsequent research. . . . . When a metallic conductor is brought near to the suspended spider, it disarranges its projectiles, and the insect, conscious of some counteracting agency, coils up its threads.

"When a stick of sealing-wax is brought near the thread of suspension, it is evidently *repelled*, consequently the electricity of the thread is of a negative character. The descent of the thread is instantly determined by bringing over it the excited sealing-wax; and if strongly excited, and the spider let fall on its surface, it bounds from it with considerable energy. On the 3d of July, 1822, at 4 P. M., thermometer 66° Fahr., two aëronautic spiders, on separate threads, were brought near to each other: a mutual repulsion supervened; and when one was brought in momentary contact with the other, it immediately fell lower in the perpendicular plane.

"An excited *glass* tube brought near, seemed to *attract* the thread, and with it the aëronautic spider. When the insect was thus *positively* electrified, the rapidity which marked its descent, and extent of thread spun out, and which I frequently coiled up, was truly astonishing, being at least 30 feet in length."

The manner in which the thread starts from the body is difficult to determine, on account of the small size of the spiders. One theory is that the spider must attach one end of its thread to a fixed object, so that the wind may have a loop to blow against. Some think it more probable that a small quantity of gummy material is emitted from the spinnerets and drawn into a thread by the current;* others, that the spinnerets of opposite sides are

* Rennie's Insect Architecture, p. 381.

brought in contact and then drawn apart, forming a little web between them which offers enough surface to the wind to be blown away, carrying out the thread with it.

REVIEWS.

Grave-mounds and their Contents.* — In this concise and remarkably interesting little volume, made doubly valuable by its 489 wood cuts, which show that the author took pencil and engraver to his work as well as his pen, pick, and spade, the student in archæology will find much to instruct and aid him in his labors.

The author calls attention to the fact that the grave-mounds of most ancient date are found in the mountainous districts, while those of a later time, though in part associated with the earlier mounds, are spread throughout the country.

In this country the term *mound* has been almost universally given to all our ancient tumuli, and to an American reader the multiplicity of British terms in common use for the same kind of ancient works is at first confusing. Hence, while the term *barrow* is in general use, *tump* is given as the synonyme in Gloucestershire, *howe* in Yorkshire, and *low* in Derbyshire, Staffordshire, etc. The term *low* is so universal in some districts, that about two hundred places in Derbyshire alone have the affix of "low," this affix being a sure indication that a "mound" exists or has existed in the immediate vicinity.

In the second chapter our author gives an account of the construction of the mounds and the various modes of burial, both by inhumation and cremation. In the former, the bodies were most usually placed in a contracted position, lying generally on the side with the hands in front of the face and the knees drawn up, though almost every other position of the body, such as sitting, kneeling, or extended, has been noticed. In burial by cremation, the bones left after the burning of the body were gathered up and

* A Manual of Archæology, as exemplified in the Burials of the Celtic, the Romano-British, and the Anglo-Saxon Periods. By Llewellynn Jewitt, F.S.A., etc. With nearly five hundred illustrations. London: Groombridge and Sons, 1870. 12mo, pp. 306, cloth, full gilt.

either placed in a small heap, sometimes "covered with a small slab of stone, or wrapped in cloth or skin (the bronze pin which fastened the napkin being occasionally found), or enclosed in cinerary urns, inverted or otherwise. In some instances, even when placed in urns, they were first enclosed in a cloth." In regard to the disputed point as to the form of the barrows, "long barrow," "round barrow," etc., which some authors have considered as indicating a difference of race in the occupants, and have even gone so far as to give as a rule, "long barrows, long heads, and round barrows, round heads," our author's observations lead him to the following conclusions:—

"An examination of a very large number of barrows leads me to the opinion that the original form of all was circular, and that no deviation from that form and no difference in section, can be taken as indicative of period or of race."

In the third chapter, in giving an account of the places where the burning of bodies has taken place, he says that:—

"Wherever the burning has taken place, there is evidence of an immense amount of heat being used; the soil, for some distance below the surface, being in many places burned to a redness almost like brick. Remains of charcoal, the refuse of the funeral pyre, are very abundant, and in some instances I have found the lead ore, which occurs in veins in the limestone formation of Derbyshire, so completely smelted with the heat that it has run into the crevices among the soil and loose stones. . . . . Is it too much to suppose that the discovery of lead may be traced to the funeral pyre of our early forefathers? I think it not improbable that the fact of seeing the liquid metal run from the fire as the ore which lay about became accidentally smelted, would give the people their first insight into the art of making lead."

The several facts that have been brought forward to prove that the earliest races of men were, if not habitually, occasionally cannibals, have, perhaps, not been so very conclusive as to secure general belief, but the testimony that the early races indulged to a very extensive degree in the equally degrading custom of human sacrifice has accumulated to such an extent, that it can now hardly be doubted that all races which have risen to a state as high, even, as "semicivilized," have passed through the stage of human sacrifice. That the ancient Britons were no better than the ancient Americans in this respect is suggested by the following sentence from Mr. Jewitt's work:—

"It is frequently found in barrows, where the interment has been by cremation, that there will be one or more deposits in cinerary urns, while in different parts of the mound, sometimes close by the urn, there will be small heaps of burnt bones without any urn. The probable solution of this is, that the simple heaps of bones were those of people who had been sacrificed at the death of the head of the family, and burned around him."

Much has been written, and many popular superstitions are extant, regarding the Stone, or "Druidical" Circles, and Cromlechs, or "Druid Altars." These our author disposes of, at least in part, by considering the smaller circles to be simply the outline or commencement of the mound raised over the place of burial, and the cromlechs as sepulchral chambers, denuded of the earth that once formed a mound over them. That such is the case, his own and other excavations seem most conclusively to show, but while thus reducing popular superstition to simple facts, the mystery as to the means by which the, in many instances, gigantic cromlechs were erected, is left, and it is nearly as great a one as the building of the pyramids.

In this notice we have called attention to only a few of the points treated of by Mr. Jewitt in the first chapters of his little book, relating especially to the Ancient British, or Celtic Period. He also gives an equally instructive account of more recent mounds and burials under the headings of the Romano-British and the Anglo-Saxon Period, thus bringing archæological research well into the domain of history, and in many instances getting from the graves of the dead facts with which to elucidate the history of the living.

Crustacea Dredged in the Gulf Stream off Florida.*—The rich materials dredged by M. Pourtales, in the Gulf Stream, under the auspices of the United States' Coast Survey, are gradually being published in the Bulletin of the Museum of Comparative Zoology at Cambridge. The brachyurus Crustacea, of which many new forms, both generic and specific, were discovered, are now enumerated by Dr. Simpson, with notes on their bathymetrical distribution, though most of the species were from shoal water. In a second part, the general result will be given, to which we shall allude when issued.

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*Preliminary Report on the Crustacea dredged in the Gulf Stream in the Straits of Florida; by L. F. de Pourtales. Part 1. Brachyura. Prepared by Dr. William Stimpson. 8vo. pp. 109–160. Cambridge, 1870.

The Record of Entomology for the year 1870 will be soon issued, and it is hoped that subscribers to the previous parts will feel inclined to support this undertaking another year.

Synopsis of European Coleoptera described in 1868.*—This is a most convenient work for European coleopterists, and is of considerable value to American entomologists. Each species, described as new, is briefly characterized in Latin, so that entomologists of every nationality can read it. When will the time come for the publication of a similar yearly synopsis in America for all the insects?

NATURAL HISTORY MISCELLANY.

BOTANY.

The Jardin des Plantes, Paris: *Feb.* 20.—To-day we drove round to the house of M. Decaisne, whose celebrity as a botanist is too well known for any further comment to be necessary, and under his kind and most interesting guidance I visited a scene which was full of painful interest. The gardens had apparently been a point of especial bombardment, and no fewer than eighty-three shells had fallen within their comparatively limited area. We went out to the glass-houses to judge for ourselves of the effects. On the nights of January 8th and 9th, four shells fell into the glass-houses and shattered the greater part of them into atoms. A heap of glass fragments, lying hard by, testified to the destruction, but the effect of the shells was actually to pulverize the glass, so that it fell almost like dust over the gardens. The consequence was that nearly the whole of this most rare and valuable collection was exposed to one of the coldest nights of the year, and whole families of plants were killed by the frost. Some of the plants suffered the most singular effects from the concussion; the fibres were stripped bare, and the bark peeled off in many instances. One house into which we went presented a most lamentable appearance of bare poles; scarcely a leaf was left.

* Synopsis Coleopterorum Europæ et Confinium, anno 1868, descriptorum. Auctore. G. R. Crotch, M. A. London: Williams & Norgate, 1870. 8vo. pp. 68.

All the Orchids, all the Clusiaceæ, the Cyclantheæ, the Pandaneæ, were completely destroyed, either by the shells themselves or by the effects of the cold. The large Palm-house was destroyed, and the tender tropical contents were exposed to that bitter cold night; yet, singularly enough, although they have suffered severely, not one has yet died. Imagine Kew Gardens under a heavy fire, and Dr. Hooker standing disconsolate in the midst of them, his most cherished plants in ribands, and his glass-houses a mass of powder, and we can form some idea of what M. Decaisne suffered during those fifteen nights, when shells came bursting under his windows, sending splinters into his flower garden and shaking his house to its foundations with every explosion. Feeling that, at all costs, he was bound to stick to his post, he passed the whole of his time actively engaged in covering up his plants in blankets, and straining every nerve to keep the cherished favorites of a lifetime from the ruthless missiles that were searching every nook and corner of the establishment. Two shells fell into the zoological gallery, one into the gallery of mineralogy, where it destroyed some beautiful pieces of palæontology. Three fell into the laboratories and museum, destroying a valuable collection of rare shells, which had just been classified. The houses, historical as having been the residences of Cuvier and Buffon, did not escape, but fortunately, although several of the shells were found to be full of combustible material, nothing was set on fire. All through the whole of the fortnight during which these gardens were subjected to this rain of shells, Messrs. Decaisne, Chevreuil, and Milne-Edwards remained at their post, unable to rest, and have since, at their own expense, repaired the damage done, trusting that, whatever form of government France may choose, it will not repudiate its debt of honor. The British public have nobly come forward to relieve the distress of the suffering population of Paris; I would now make an appeal to the comparatively small section of society whose glass-houses may perhaps be supplied with plants which may replace those which have been destroyed. M. Decaisne is making out a list of his losses, a large proportion of which might possibly be supplied from Kew, while owners of private collections might also be glad to testify their sympathy and interest in the cause of science by contributing whatever they may be able to spare as soon as the amount and nature of the loss is ascertained. I feel no doubt that it will be enough to make the facts known for

the British public to respond with the same generosity which they have manifested in other instances. The animals fared better than the plants — not only have none of them been eaten by the population of Paris, as the latter fondly suppose, but, although several shells burst among them, they have escaped uninjured. Of course, when food was so scarce for human beings, the monkeys and their companions were put upon short allowance. This fact, coupled with the extreme rigor of the season, increased the rate of mortality among them, and one elephant died, but was not eaten. The two elephants and the camel, that were eaten, belonged to the Jardin d'Acclimation, and had been removed in the early stage of the siege from their ordinary home in the Bois Boulogne, for safety, to the Jardin des Plantes, where, however, it would appear, it was not to be found. The birds screamed and the animals cowered, as the shells came rushing overhead and bursting near them, as they do when some terrific storm frightens them; latterly, they seemed to become used to it; fortunately, the part of the garden which they inhabit is somewhat removed from the museums, at which the fire seemed more especially directed. The gates of this favorite resort were kept closed, because the price of firewood is so high, and the scarcity of it such, that the people are unable to resist the temptation of coming into the gardens in search of fuel, and, for the present, it is found wise to shut them out; indeed, so much greater is the necessity for fuel than for food at present, that the provision trains have been stopped by order of the Government to allow the coal trains to pass. — *Special Correspondent of "The Times," quoted in the "Gardeners' Chronicle."*

Ascent of the Sap in Pines. — Some years ago, my gardener pointed out to me that some Austrian and Scotch Pines, which had been completely girdled by mice, still continued to grow, as if no such injury had been received. In order to test this matter, I took an Austrian Pine about five feet high, and girdled it for a space of two inches, at about three feet from the ground. This was five years ago, and the upper portion is still alive. The tree attracts much attention from visitors to my grounds. When girdled, the branch was about one and one-half inches in diameter. The whole portion of stem between the tier of branches above, and that below — a space of about fifteen inches — has since remained of that size, and is dry and hard as a "pine knot." The

parts above and below this dead space increase annually in girth. The upper portion is now about nine inches in circumference. There are branches above and below the girdled portion; the lower ones growing much the stronger. The upper portion makes only two or three inches of growth a year, and the "needles" are of a brighter green than the lower. — THOMAS MEEHAN.

DIMORPHISM IN DEUTZIA. — My friend, Edward Tatnall, of Wilmington, Del., once called my attention to the fact that there appeared to be two kinds of flowers on the *Deutzia gracilis*, a dwarf shrub now common in gardens. I have a plant now in flower by forcing in a greenhouse. One class of flowers is of normal form, with well developed pistils, and the ten stamens with their somewhat petaloid filaments. The other class has the pistils scarcely developed; the anthers seem quite as large and as perfect as in the others, but are quite destitute of filaments. I cannot tell with certainty whether this is an arrangement for cross-fertilization of separate flowers, because the anthers in the hermaphrodite flowers, as we suppose them to be, *appear* perfect; but when the season comes for observing the flowers in the open ground, May or June, no doubt the facts could be definitely ascertained. I make note of these little things now, so that botanical students can observe for themselves when the time comes round. — THOMAS MEEHAN.

CONTRIVANCE IN THE COROLLA OF SALVIA INVOLUCRATA. — In most Salvias, part of the anther develops into a lever which closes the throat, and, when lifted by an insect, causes the pollen to be thrown on its back. Some suppose, and with apparent good reason, that this is to aid in cross-fertilization. In *Salvia involucrata*, the lever arrangements are remarkably well developed, but the arched upper lip curves inward, and prevents the anthers from acting in the manner above described. It would seem as if the plant, after "making" its arrangements for cross-fertilization, "repented," and "made" another to contradict it. — THOMAS MEEHAN.

ALBINO FLOWERS. — During the summer of 1869 I observed, in the University campus, quite a number of specimens of *Trifolium pratense*, with perfectly white flowers. During the past season, although I searched diligently, I was not able to find any white flowers of that species, not even upon stalks which I believe to

have sprung from the same roots that bore the white flowers observed the year previous, they having apparently resumed their specific color.

During the autumn of 1868 I discovered in Northern Iowa a specimen of *Liatris cylindrica* with perfectly white flowers, all the flowers upon the three stalks from the same root being white. This seems more remarkable than that of the white clover mentioned, because the usual color of the latter is at best only specific, while rose-red is regarded as the invariable color of all the species of *Liatris*. In other words, the color is a generic character.—C. A. White.

[We print this notice, with the remark, once for all, that occasional white flowers may be expected in any species, so that it is hardly worth while to specify numerous particular instances.—Eds.]

ZOOLOGY.

Poison of the Cobra.—At the meeting of the Boston Society of Natural History, January 18th, Mr. George Sceva gave the results of an experiment which he had recently made in connection with Dr. Thomas Dwight, Jr., with the poison of the Cobra di Capello, *Naja tripudians*.

January 8th, one quarter of a grain of the dried poison, which had been kept a little more than seven months, was put into twenty drops of water, the poison dissolved, and the liquid reduced by evaporation at a temperature of 85° F., to four drops. This was exposed to the air at a temperature of 22°, and was completely frozen in four minutes, the warmth of the porcelain vessel retarding the process slightly. The poison was allowed to remain in the frozen state for sixteen hours, during which time the temperature fell to 8°, or 24° below the freezing point. On the following day, January 9th, the poison was thawed and diluted with three or four drops of water, and two drops of the liquid injected with a fine-pointed syringe into the pectoral muscle of a pigeon, about half an inch from the keel of the sternum, the point of the syringe penetrating the muscle about one eighth of an inch. This part of the pigeon's body was selected in order to avoid wounding any of the viscera or large blood vessels.

The poison was injected at 4.32 P. M. At 4.34 there was a motion of the bowels. Although this almost invariably occurs, as the first symptom of the action of the poison in the lower animals, yet it cannot be fully relied on in the case of birds, as it frequently occurs from fright.

At 5.10 another motion of the bowels, followed by slight tremors and convulsive movements, clearly indicating the action of the poison.

At 5.15 no further symptoms of importance appeared. At this time he left the room for about two hours, and on returning, at a few minutes past 7, found the pigeon dead; its death having occurred in less than two hours and a half from the time of being poisoned.

Mr. Sceva then made some general remarks on the habits of the Cobra, and on the action of its poison. He said he had been much surprised, in looking over some works on natural history, at the erroneous statements on this subject which many of them contained. He thought these errors might be attributed, in a great measure, to the general aversion which people felt for all poisonous reptiles. This seems to account, when combined with the usual credulity shown in such matters, for the many strange stories and absurd reports that had been published of the poisonous snakes of distant countries, such as India: and in many instances he had found that men holding high positions in the Government civil service and physicians residing in that country, had published statements which had been accepted here and in Europe, as facts well established by their personal observations and careful investigations; whereas they were founded merely on the stories told by the jugglers, snake-charmers and other ignorant people. In some popular works on natural history recently published, which on many subjects appeared to be carefully written, there seemed, in this matter, a great want of careful discrimination. In J. G. Wood's "Natural History of Reptiles," several pages were devoted to accounts of antidotes, such as the leaves and roots of the *Aristolochia Indica*, the "Snake Stone," etc. These, with a great many other reputed antidotes, had been found by recent investigation to be utterly worthless.

Mr. Sceva, during the past three years, while attached to the Indian Museum at Calcutta, had assisted Dr. Fayrer, the Professor of Surgery in the Medical College there, in his numerous ex-

periments with the venom of poisonous snakes. Among those made to test the value of local applications was that of the actual cautery by plunging pointed red-hot irons deeply into the flesh in the places where the fangs had entered, but this failed to destroy the poison.

This result, however, would not surprise one who fully understood the rapidity with which the blood passes through the soft tissues of the body, and the instantaneous action of the poison upon it.

To show the rapid effect of the poison on the blood, Mr. Sceva read one of Dr. Fayrer's experiments that he had witnessed, in which the inguinal fold of the skin of a dog was held by two pairs of long-bladed forceps in such a manner as to include a triangular piece of about three inches in length. The Cobra's fangs were applied to the middle of the free edge, and with a sharp scalpel, held in readiness, the fold of skin was at once cut out, and yet the dog died from the effects of the poison in fifty-nine minutes. Dr. Fayrer, in his report, made the following comments:—

"This was a very interesting and instructive experiment, most clearly demonstrating the deadly nature of the virus and the awful rapidity with which it passes into the circulation. The bitten part was not merely excised, as we speak of excising the parts around the spot which the fangs had penetrated, but the fold of skin into which the fangs had injected the poison was removed within a second after the bite; for the knife had entered almost before the fangs had left. In fact, it could not have been done more rapidly, and yet, within one hour, the animal was dead from the effects of the poison. The infinitesimal portion of time during which the Cobra's fangs were inserted in the tissues was sufficient to have sent the poison through the circulation beyond the reach of incision, and yet how very small must that portion have been."

Mr. Sceva exhibited on the table a living specimen of the Cobra, which he had brought with him from India. It was about five feet in length, and of the variety known in India as the Keuteah. It had eaten nothing while it had been in his possession (since the 8th of June last), a period of seven months and ten days. He had also kept others in India for over five months without food.

He said the common belief that the Cobra would seek to exercise its deadly power by biting any person who should come within its reach, was quite erroneous. On the contrary, it avoids using its fangs as much as possible, except when securing its food. When

two Cobras were placed together in a cage, they would sometimes strike at each other for hours with their noses, and would blow their venom and saliva from their mouths; but he had never seen one bite another, although he had kept a large number of them in cages convenient for observation.

Of the great numbers of deaths (some thousands) occurring annually from Cobras, the bites were almost always received when people stepped upon them.

Until very recently it was almost universally supposed that the poison of the Cobra had no effect on the mongoose, an animal resembling the weasel. It was well known that the mongoose would attack and kill the Cobra, and would sometimes eat a large part of the body, but in these encounters the mongoose, by his great agility, could easily avoid being bitten; and Mr. Seeva had found, on examining a Cobra which had been killed by a mongoose, that all the wounds had been inflicted back of the head. When, however, the mongoose was secured, and a Cobra was compelled to bite its leg, by having it put into the snake's mouth, the mongoose died in a very short time.

Mr. Seeva added, that since making the experiment with the frozen poison, he had found that a similar one had been made on the venom of the rattlesnake by Dr. S. Weir Mitchell of Philadelphia. Dr. Mitchell also found that neither boiling nor a putrefactive change destroyed its poisonous action. These experiments have also been made with the venom of the Cobra with like results.

Distribution of Animals in the South Seas. — Having previously explored nearly every South Sea group, I was surprised at the superior richness of the Viti Islands, as compared to the other locations. Of shells alone, I got about fourteen hundred species, and new ones were occurring, up to the time of my departure. I have not the least doubt but that the group will produce six hundred species more. At the Navigators I found nearly eight hundred species. Tahiti produced five hundred. So it is evident that the nearer we approach the East Indies the richer the Islands become in shells. The same rule applies to every other department of Natural History.

Since I have been collecting in the South Seas I have ascertained that nearly every group has some species of marine shells peculiar to that one location, and which do not occur elsewhere.

Again, certain species are abundant at some particular group, and gradually become more and more rare as we recede from their metropolis, or specific centres.

Each group of islands has distinct species of land shells, and, in fact, every island in a group possesses its peculiar species. For small species of land shells, *Stenogyra juncea* and *Vertigo pediculus* range over the South Sea Islands, and are the only exceptions to the rule. What is most surprising, in most cases, is that we find the species confined to particular valleys, or certain parts of the islands. The small islands are generally richer in species than the larger ones. Succineæ, so abundant at the eastern groups, do not occur at the Viti Islands, while the latter possess many species of large Bulimi, belonging to the section Charis and Placostylus, which are not found at the former islands. Another marked feature in the Viti land shells is the large ground species of Navini. Its mangrove swamps swarm with many species of Auriculidæ, and the rivers abound in large Butissæ.

Fresh water shells are more widely diffused than land shells. Three of the Tahiti *Neritinæ* (*Tahitensis*, *dilatata*, and sp?) occur at Samoa, but not at the intermediate groups. Several species of the Samoa (Navigator Isles) Neritina, Navicella, and Melania are common at the Viti group. The fresh water shells of the Sandwich Islands are all peculiar.

The Viti Islands are extraordinarily rich in Mitridæ and Pleurotomidæ. Of the former I found one hundred and thirty, and of the latter one hundred species.

Most of the Viti fish, crustaceans and echinoderms, are identical with Tahiti species, though many new species were obtained. Nature has been rather chary of her entomological gifts to her eastern groups; but in the Vitis it is quite the reverse. I found a great variety of Lepidoptera and Coleoptera, some of the latter of great size and beauty. *Macrotoma heros*, a beetle, attains a length of four and a half inches, and a large Dorcus abounds. The larvæ of both species are considered a delicacy by the natives and relished by some of the foreigners.

At the Vitis I found many new species of reptiles, and, for the first time, met with frogs and land snakes. One lizard, *Brachylophus fasciatus*, attains a length of three feet. Every species of reptile is eaten by the natives.

While I was in the group, the natives killed the Rev. Mr. Baker

and eight native teachers. Cannibalism is still common at the islands, and many parts of the group are too dangerous to explore. — A. Garrett.

Sexes of the Lobster. — A Correspondent of "Land and Water," makes an announcement, which is endorsed by the editor of that paper, to the effect that the sex of Lobsters can be readily determined by the character of their claws, since, in nearly fourteen hundred specimens examined, it was ascertained that in the male, the blunt, tufted claw is always on the left side, and the sharpest serrate claw on the right, a condition of things exactly reversed in the female. This, however, has been subsequently denied, and the question of determining the sex by means easily understood by the laity, yet remains open.

Occurrence of Land Birds far out at Sea. — We are indebted to the Smithsonian Institution for the following extract from a letter received from the Hon. L. E. Chittenden, in reference to certain birds which came on board the vessel in which he was proceeding to Europe. Frequent mention is made, in the writings of travellers, of birds having been seen far out at sea; but it is not often that so satisfactory an identification of the species is supplied, as that furnished by Mr. Chittenden's letter.

"Steamer Lafayette, 12 M., Oct. 19th, 1869.

Latitude 41° 40; longitude 64° 9'; distance sailed last twenty-four hours, 310 miles. Distance from New York, 589 miles. To Brest, 2441 miles. There has been a strong wind from the northwest the last twenty-four hours. Shortly after daylight this morning, land birds began to alight on the ship. The sailors have caught many, some twenty-five or thirty. They seem very weary and disinclined to move after having alighted, and are easily caught. *They must have been blown off the land*, but it is singular that so many should have been blown away by a wind which is far from being that of a gale. They fly straight to the ship and alight: do not circle around at all. I have been showing the sailors what to feed them with. They have produced several cages, and are having quite an aviary. Among those taken were the following:—Bluebird (*Sialia Wilsonii*); Yellow-bellied Woodpecker (*Picus varius* Wils.); Field Sparrow (*Spizella pusilla* Wils.), several specimens; Chipping Sparrow (*Spizella socialis*); another sparrow, name unknown, but with a white throat, breast and lower part of body yellowish red (probably *Passerella iliaca*); a creeper, probably Brown Tree Creeper. A flycatcher, either the common Pewee or the Wood

Pewee, I think the latter; and two warblers, which I could not recognize, as they were both probably females with no special, distinctive marks."

"This is the entry, with the portions in parentheses added now. The route of the French ships is far to the southward of all the other steamers. You will see from the map that we came about three hundred miles south of Nova Scotia, a rather long flight for the birds. Some of them died, but the greater number fed well, and when we were in Brest harbor I made the sailors set them free. So you may hear of the discovery of several new species in the north of France."

"I told you that I thought there was a robin among the birds that came on board ship; such is my recollection. But it is not mentioned in my note, and I think I must have been mistaken."

Iowa Birds. — The following species, not catalogued in J. A. Allen's excellent "Notes on Iowa Birds" (Mem. Bost. Soc. Nat. Hist., Vol. I., Pt. IV.), have been collected by me in Iowa, and are mostly preserved in the cabinet of Iowa College, Grinnell. When no locality is given, the central adjoining counties of Poweshiek and Jasper are to be understood. In two cases of doubt, an interrogation point is added. The word "summer" for summer resident, is used when justified by recorded dates of capture.

Turdidæ: — Hermit Thrush (*T. Pallasii* Cab.); seen but twice. Olive-backed Thrush (*T. Swainsonii* Cab.); common in a locust nursery last year; wholly absent this year. Ruby-crowned Wren (*R. calendula* Licht.): seen as late as May 2d. *Troglodytidæ*: — Short-billed Marsh Wren (*C. stellaris* Cab.); summer. *Sylvicolidæ*: — Black and White Creeper (*M. varia* Vieill.). Yellow-rumped Warbler (*Dendroica coronata* Gray); common. Chestnut-sided Warbler (*D. Pensylvanica* Baird); summer. Nashville Warbler (*H. rufficapilla* Baird); summer. *Hirundinidæ*: — Rough-winged Swallow (*C. serripennis* Bon.); summer. *Liotrichidæ*: — Mocking Bird (*M. polyglottus* Boie); June 25th, August 4th, and October 21st; in both the central counties mentioned; but no song heard. *Vireonidæ*: — White-eyed Vireo (*V. Noveboracensis* Bon.): June 1st. Yellow-throated Flycatcher (*V. flavifrons* Vieill.): summer. Red-eyed Flycatcher (*V. olivaceus* Vieill.): summer. *Fringillidæ*: — Harris's Finch (*Z. querula* Gamb.); taken twice, the latest May 19th. Black Snow-bird (*J. hyemalis* Selat.); abundant in early spring. Snow-bunting (*P. nivalis* Meyer); Clinton county, and, I think, Poweshiek. Purple Finch (*C. purpureus* Gray); Clinton county. Red Crossbill (*C. Americana*

Wils.); Lee county. White-throated Sparrow (*Z. albicollis* Bon.); October 7th. Tree Sparrow (*S. monticola* Baird); common in March and April. Swamp Sparrow (*M. palustris* Baird); taken in October. Indigo Bird (*C. cyanea* Baird); summer; very common. Cardinal Bird (*C. Virginianus* Bon.); Lee county. *Icteridæ*:— Rusty Blackbird (*S. ferrugineus* Sw.); Clinton and Poweshiek counties. *Tyrannidæ*:— Yellow-bellied Flycatcher (*E. flaviventris* Baird); summer; not rare. *Cuculidæ*:— Yellow-billed Cuckoo (*C. Americanus* Bon.); summer; only taken in a grove in Kellogg, Jasper county. *Picidæ*:— Pileated Woodpecker (*H. pileatus* Baird); Lee county. *Strigidæ*:— Short-eared Owl (*B. Cassinii* Brewer). *Falconidæ*:— Duck Hawk (*F. anatum* Bon.); Clinton county. Sharp-shinned Hawk (*A. fuscus* Bon.); Clinton county. Golden Eagle (*A. Canadensis* Cass.). Bald Eagle (*H. leucocephalus* Savig.). *Columbidæ*:— Passenger Pigeon (*E. migratoria* Sw.); few seen; one taken young, June 26th. Gray or Red-breasted Snipe (*M. griseus* Leach); Clinton county. Tell-tale or Stone Snipe (*G. melanoleuca* Bon.); Clinton county. Yellow-legs (*G. flavipes* Bon.); common in prairie sloughs. Solitary Sandpiper (*R. solitarius* Bon.). Marbled Godwit (*L. fedoa* Ord.). *Gruidæ*:— White or Whooping Crane (*G. Americanus* Ord.); Tama county. *Rallidæ*:— Sora, or Common Rail (*P. Carolina* Vieill.). Coot (*F. Americana* Gm.). *Anatidæ*:— Trumpeter Swan? (*C. buccinator* Rich.); young. Brant (*B. brenta* Steph.); large flocks, doubtless this species. Spoonbill (*S. clypeata* Boie); Clinton county. Gadwall (*C. strepera* Gray); Polk and Clinton counties. Ringnecked Duck (*F. collaris* Baird); young. Redbreasted Merganser (*M. serrator* Linn.); Lee county. Hooded Merganser (*L. cucullatus* Reich.); Lee county. Snow Goose (*A. hyperboreus* Pallas); Lee county. *Pelecanidæ*:— Rough-billed Pelican (*P. erythrorhynchus* Gm.); Lee county. *Laridæ*:— Ring-billed Gull (*L. Delawarensis* Ord.). Forster's Tern? (*S. Forsteri* Nutt.); Clinton county. To this list I may add the Prothonotary Warbler and the Magpie (a straggler), known to have been taken in Lee county. All of the above from Lee and Clinton counties were not taken by myself, but I have no reason to doubt the correctness of the locality given. I thus add fifty-four species to one hundred and eight of Mr. Allen's list, which were observed in seven counties of Western Iowa.

Mr. Allen speaks of the scarcity of certain birds. Of these, the Robin, Blue Bird, Chipping Sparrow, Cat Bird, Yellow War-

bler, Warbling Vireo, Loggerhead Shrike, Bobolink and Great Horned Owl, are abundant in the district now especially reported from. I have not met with Wilson's Thrush, Winter Wren, Titlark, Tennessee and Blue Warblers, Grass Finch, Henslow's Sparrow, Arkansas and Great-crested Flycatchers, Yellow-bellied Woodpecker, Least, Pectoral and Spotted Sandpipers and Sooty Tern. — H. W. Parker.

The Colorado Potato Beetle in Niles, Michigan. — While in Niles, Michigan, this winter, I took somewhat special pains to gain information in regard to the Colorado Potato Beetle, as it had been observed on one farm in that town. On the farm of James Hudson, of whom I made my inquiries, not a bug of this sort was seen before or during the year 1868; but a very few were seen on a farm about half a mile to the west. In the summer of 1869. this beetle appeared on Mr. Hudson's potatoes, when they were about a foot high; when he first saw them only two or three were on a hill, but they increased all through the season.

In April, of 1870, Mr. Hudson in plowing his fields, ploughed up the full grown beetles, and they walked about, being very lively. He planted Early Rose potatoes about April first, and as soon as they were fairly up these beetles commenced their attacks upon them. He began to kill them by squeezing them between two paddles, going over the ground daily, but apparently without checking them. He then mixed Paris Green with ashes and sprinkled the mixture on a dozen rows, the vines at this time being a foot high, and from these rows he secured a fair crop of potatoes. Where the mixture was not sprinkled, the bugs ate all the leaves, and in many cases they ate the stalks to a considerable extent. They now began on a new field hitherto untouched, appearing in such numbers as almost literally to cover both the leaves and the stalks. They were so numerous that in less than an hour one man gathered about twenty quarts of them! They readily drop from the vines and then feign death. The beetles swept right through this field, going at the rate of about ten or twenty rods in a week. Their yellowish eggs were always abundant on the under side of the potato leaves; but they also laid their eggs on weeds, spires of grass, and *even on dry sticks!* While the havoc, above described, was going on, no other species of insects attacked the potatoes. At this time the Colorado bugs were abundant

about the farm-buildings, and even entered the house. Toads are their natural enemies, eagerly devouring them. But on this farm the hens were never seen eating them.

On the farm above mentioned, the bugs disappeared suddenly in the early part of September.

It may be added that they seem to prefer Chenango potatoes to the Early Rose; and that they would hardly touch the Early Goodrich, though growing side by side with the Chenango, which they eagerly devoured. I would also add that these insects do not confine themselves to the vines, but enter the hills and attack the potatoes themselves. — Sanborn Tenney. *Williams College, February*, 1871.

Destructiveness of the White Ants.* — Having to repair and paint my office a year ago, my boy put my stationery for a few days on the floor, when, to my surprise, I found it all eaten through by the white ants, which are destructive of everything upon this Island. Nothing but teak, and not always that, escapes their fangs. Numbers of houses in Jamestown are fairly gutted by them — doors, window sashes, floors and roofs are all eaten up — so that nothing but the bare walls are now standing, their owners being too poor to rebuild with iron and teak.

I send a volume of Allison's History of Europe, to show you the destructive powers of this extraordinary insect. — Thomas Fetnam, *United States Consul at St. Helena.*

Singing Mice. — A communication in the Naturalist some time ago in regard to musical mice, prepared me for a phenomenon which recently came under my observation, which otherwise would have astonished me beyond conception. I was sitting a few evenings since, not far from a half-open closet door, when I was startled by a sound issuing from the closet, of such marvellous beauty that I at once asked my wife how Bobbie Burns (our canary) had found his way into the closet, and what could start him to singing such a queer and sweet song in the dark. I procured a light and found it to be a *mouse!* He had filled an over-shoe from a basket of pop-corn which had been popped and placed in the closet in the morning. Whether this rare collection of food inspired him with song I know not, but I had not the heart to disturb his corn.

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* Communicated by the Smithsonian Institution.

hoping to hear from him again. Last night his song was renewed. I approached with a subdued light and with great caution, and had the pleasure of seeing him sitting among his corn and singing his beautiful solo. I observed him without interruption for ten minutes, not over four feet from him. His song was not a *chirp*, but a continuous song of musical tone, a kind of *to-wit-to-wee-woo-woo-wee-woo*, quite varied in pitch. While observing him I took for granted that he was the common house-mouse (*Mus musculus*), but when he sprang from the shoe to make his escape he appeared like the prairie mouse (*Hesperomys Michiganensis*), a species I had not, however, observed before indoors. I have thus far failed to secure this little rodent musician, but shall continue to do all I can in the way of pop-corn to entertain him, and if his marvellous voice gives him the preëminence in mousedom which he deserves, by the aid of Natural Selection I shall presently have a chorus of mice, in which case you shall receive their first visit. — W. O. Hiskey, *Minneapolis, Minn.*

The European Hornet in America. — This wasp (*Vespa crabro* Linn.) is very common here, and has been to my knowledge for the past twenty-five years, or ever since I have been in this place. I think it is something over twenty years since there was an immense colony in the roof of an old ice house, at the gable end of which was a round hole for air about four or five inches in diameter. This hole formed the entrance to their abode. Both their brood cells and the outer covering are very brittle, so much so, that it is impossible to preserve them whole. The paper seems to be made of green wood, in procuring which, they girdle great quantities of the branches of our lilac bushes.

The mass of comb which I send you, was taken, I think, two years ago last fall. The following are the dimensions of the comb, independent of the outer covering, at the time I secured it: — Eighteen inches long, twenty-three inches in circumference. There were eleven stories or sets of comb. The circumference of each, commencing at the top, was as follows: — 17, 23, 27, 27, 27, 28, 28, 27, 23, 19, 7, inches, making a united circumference of about twenty-one feet. Width of largest cells four lines, making six and a quarter cells to the square inch. This, I believe, makes about one thousand five hundred and eighty-one cells. This nest was between the weather boards and the inner lining of boards, in what

was once an ice house. This cavity was at one time filled with hay, but the hay in many places had settled down, leaving large vacant spaces, in one of which this nest was formed, about four or five feet from the ground. The entrance was by a knot hole.—J. Angus, *West Farms, N. Y.*

[Mr. A. J. Olmstead writes us that this hornet has been seen since 1863, at Morristown, N. J., and that the nest is made of the green wood of the lilac. "It does much damage to fruit, but at the same time destroys many insects."—Eds.]

The Migration of Hawks. — The solitary habits of the Hawks are so frequently referred to in general works, treating of the natural history of these interesting birds, as being especially distinctive of the birds of this family, as to fully indicate the general prevalency of the opinion that they are in no degree gregarious, in confirmation of the observations of Dr. William Wood, published in the February number of the Naturalist (1871), in which he states he and some of his ornithological friends had repeatedly noticed considerable companies of hawks passing over in early springtime. I may add that I have myself observed numerous similar instances, in the autumn as well as in the spring. At Springfield (Massachusetts), I for several years noticed it as a quite regular occurrence, and I have since observed similar flights of hawks in Iowa. On one occasion (in April, 1862) I noticed hundreds slowly sailing over in the peculiar gyratory manner of these birds. They formed a long loose flock, extending both to the northward and the southward as far as could be seen, the whole company occupying more than an hour in passing a given point. Though soaring at a considerable height, it was easy to see that the company was composed of representatives of several species. While this mode of migration is more characteristic, perhaps, of our Buteones (the Red-tailed, Red-shouldered, and Broad-winged Hawks) than of other species, the common *Accipiter Cooperi* is frequently associated with them.—J. A. Allen.

Longevity of a Marine Shell. — Mr. Tryon (Conch. Sec. Acad. Nat. Sci., Philad.) read a letter from Mr. W. M. Gabb, who collected *Littorina muricata* in the first week in September, specimens of which were now living, although having been out of water not less than four months. This he believed was the first case, on record, of the longevity of life illustrated in marine species.

THE WING OF BATS.—In Max Schultze's "Archiv," Band vii., 1tes Heft, is a most exhaustive and interesting paper on the structure of the bat's wing, by Dr. Joseph Schöbl, of Prague. Long ago Spallanzani discovered that bats which had their eyes put out were able, nevertheless, when allowed to fly about in a room, to avoid threads stretched across it. This faculty he attributed to some highly developed sense of touch possessed by the wing. Dr. Schöbl has repeated these experiments; but for the putting out of the eyes he has substituted the less painful method of covering them with sticking plaster. He has kept bats, thus treated, for a year alive in his room, and has entirely confirmed Spallanzani's results. To account for these phenomena, the wings of bats have been examined for peculiar nerve-endings, by Cuvier, Leydig, and Krause, but without any success. The author's discoveries are therefore quite new to science. The following is a short abstract of his results. The bat's wing membrane consists of two sheets of skin, the upper derived from that of the back, the lower from that of the belly. The epidermic and Malpighian layers in each sheet remain separate, whilst the true skin is inseparably fused. In this fused medium layer are imbedded the muscles, nerves, vessels, etc., of the wing. A complicated arrangement of delicate muscles is described, which have their tendons formed of elastic tissue instead of the usual white fibrous tissue. There are also present numerous long elastic bundles stretched in different directions in different regions of the wing. The arteries are each accompanied by a single vein and a nerve, the three keeping company as far as the commencement of the capillary system. With regard to the pulsation in the wing, Dr. Schöbl has nothing new to add to the observations of Wharton Jones and Leydig. The whole wing is covered, both on the upper and under surface, with extremely fine, sparsely scattered hairs. These hairs are most numerous on the inner third of the hinder part of the wing, and they gradually decrease in number towards the tip. The two wings, taken together, contain from eight thousand to ten thousand of them. They have a general resemblance to those on the body, but are simpler in form. Their length is about 0.2500$^{mm.}$ in *Vesperugo serotinus*, the species principally made use of in these investigations. Each hair sac has from two to seven sebaceous glands, according to the species, and one sweat gland opening into its sac. The two outer fibrous layers of the hair sac have no sharp line of demarcation

to separate them from the surrounding connective tissue, but the inner or hyaline coat is highly developed, and, after being constructed beneath the hair bulb, widens out and encloses the sense-bodies (Tastkörperchen), one of which organs is connected with each hair.

The nerves of the wing may be considered to consist of five layers, *i. e.*, there is one occupying the centre of a transverse section of the wing, which gives off on each side of it four others, and these are successively finer and finer as they approach the opposite surfaces. The inner layer and the one immediately on each side of it, consist of nerve fibres with dark borders, the other layers of pale fibres only. The tastkörperchen are connected with the second layer. The fifth layer of finest fibres ends as a network between the innermost layer of cells of the Malpighian layer of the epidermis. The tastkörperchen are shaped like a fir-cone with a rounded apex turned inwards. They lie immediately below the root of the hair; and their core or central substance is formed of a prolongation of the cells forming the two root sheaths of the hair. Their length is 0.0259 and their breadth 0.0175^{mm}. A nerve containing about six dark-edged fibres is distributed to each körperchen. Just before the nerve reaches this organ it splits into two, and three fibres pass to one side of it, three to the other. The fibres are then wound round the body so as to sheathe its cellular core. Dr. Schöbl thinks it probable that the fibres on one side are continuous with those on the opposite side, and that there is thus a bipolar arrangement here. He attributes to the fine network of pale nerve fibres belonging to the fifth layer the appreciation of temperature, pain, etc.; to the tastkörperchen the highly exalted sense of touch. It is curious that both kinds of nerve endings are connected with the Malpighian layer of the skin. In conclusion, the author states that he believes he has found similar bodies in peculiarly sensitive places in other mammals, and promises an early account of them. —*The Academy.*

Differences between Young and Adult Fishes.—Mr. R. Bliss, at a meeting of Bost. Nat. Hist. Soc., spoke of some of the markings which distinguish young from adult fishes. He had recently examined some specimens from India which had a double line on the median space; or rather a single line starting from the gill-

covers, running to the tail and then returning to the gill-covers. He found this to be the young state, and this the manner in which a dark, solid band was formed and became perfect when the fish reached the adult state. Another species forms a band which disappears, leaving only one spot at the head and another at the tail. A third species begins with a band and ends with cross striæ, the band disappearing. These examples, he said, show the necessity of studying fishes in all stages of their growth.

Cardinal Grosbeak.—On the 31st of January last, a day to be remembered as one of the coldest of this very cold winter, a specimen of the female Cardinal Grosbeak (*Cardinalis Virginianus* Bonap.) was shot in the spruce woods at Point Pleasant, about one mile from Halifax. The plumage of the bird forbade the idea of its having escaped from confinement, while its shyness, coupled with the fact of its being found on skinning to be actually fat and in good condition, precluded the possibility of its being a storm-blown waif, brought by a revolving gale from the south. Its crop contained a few partially digested seeds, cereal in appearance.—J. Matthew Jones, *Halifax, Nova Scotia.*

Arrival of Birds.—On March 9th the first Bluebirds and Robins made their appearance in Salem, and on March 10th two flocks of geese passed over the city on their northern journey. The White-bellied Swallow was not noticed before April 2d.

The Chitons.—Dr. P. P. Carpenter, of Montreal, made a verbal communication to the Boston Society on the family of Chitons: but, as his Monograph of the group is now in the press, and will shortly be published by the Smithsonian Institution, it is not necessary to anticipate his results. If any naturalists have species which they wish reported on, he will be happy to name them from the typical series, which (with his other collections) he has presented to the Museum of McGill College.

Cattle Tick in the Human Ear.—Enclosed you will find a tick the history of which is this:—A young man applied to Dr. Boucher, of Iowa City, for a trouble of the ear. Four months before he had been in New Mexico and had slept out of doors many times. The trouble of the ear commenced about that time. His ear pained him many times but not severely. On looking into his ear foreign material was seen, and on removal proved to be the

bug enclosed. It was alive and lived three days thereafter.—E. H. Hazen, M. D., *Davenport, Iowa.*

[It is a species allied to *Ixodes bovis* Riley, or common cattle tick.—Eds.]

American Association for the Advancement of Science.—The Board of Trade of Indianapolis recently held a meeting for the purpose of making arrangements for the next meeting of the A. A. A. S., which will be held at Indianapolis in August next, beginning on Wednesday, the 16th. The meeting was largely attended and a Local Committee of one hundred persons was appointed and divided into sub-committees on *Reception*, *Finance*, *Lodging*, *Excursions*, *Rooms*, *Invitations*, and *Railroads*. Arrangements were made for two excursions during the session of the Association. One to Terre Haute, a distance of seventy-three miles from Indianapolis, where the Association will remain over night and partake of the hospitality of the citizens. On this excursion a visit will be made to the celebrated Block-coal field (iron smelting coal) and Blast furnaces, of Clay County. This coal is now attracting much attention and the visit will be most interesting geologically. The other excursion proposed is to New Albany, on the Ohio River, where there are a number of interesting manufactories, among them the only plate glass works in the United States. One of the largest railroad bridges in the world is also located there. The Association will also remain at New Albany over night.

The people of Indianapolis and vicinity seem to be resolved to make the forthcoming meeting a success, and every facility and accommodation will be secured to the members of the Association.

The following are the officers of the Local Committee:—*Chairman*, Hon. Daniel Macauley; *Vice Presidents*, Thomas McGuire, Esq., and John C. Wright, Esq.; *General Secretary*, T. B. Elliott, Esq.; *Corresponding Secretary*, Professor E. T. Cox; *Treasurer*, F. A. W. Davis, Esq.

The following are the officers of the Association for the Indianapolis meeting:—*Retiring President*, Dr. T. Sterry Hunt, Montreal; *President*, Professor Asa Gray, Cambridge; *Vice President*, Professor G. F. Barker, New Haven; *Permanent Secretary*, Professor Joseph Lovering, Cambridge; *General Secretary*, F. W. Putnam, Salem; *Treasurer*, W. S. Vaux, Philadelphia.

We understand that the sub-section of *Microscopy*, so well started at the Salem meeting, and developed at Troy, will be well represented at the next meeting, and we beg to suggest to the Local Committee the importance of providing a room with proper light and substantial tables for the use of this sub-section, and a safe place for the deposit of the instruments that undoubtedly will be taken to the meeting if members are notified in the general circular that such arrangements have been made.

We also trust that some change will be made by the Association in relation to the Proceedings on the first day, and the time of delivery of the President's address, which certainly should come off before he resigns the chair to his successor, and there seems no more appropriate time for the delivery of the address than the first evening, which it would be well to have permanently allotted to this purpose by vote of the Association. The organization of the meetings of the Association could be very much facilitated by a complete change of the present irregular and confusing mode of proceeding, and we trust the next meeting will inaugurate a decided change in this respect.

Members will remember that the titles of their papers must be sent in advance to the *Permanent* Secretary.

In this connection we call attention to a circular, which has been mailed to the address of every member from the office of the NATURALIST, in relation to the early publication of the papers to be read at the meeting, and to request any person, who has not received a copy and who intends to read a paper in any of the Natural History Sections, to send to the office of the AMERICAN NATURALIST for one.

GEOLOGY.

SOME PHYSICAL FEATURES OF THE APPALACHIAN SYSTEM AND THE ATLANTIC COAST OF THE UNITED STATES, ESPECIALLY NEAR CAPE HATTERAS. — At the meeting, February 1st., of the Boston Society of Natural History, Professor N. S. Shaler gave an account of the coast line in the neighborhood of Cape Hatteras and the Chesapeake Bay. He thought it important in view of the Zoological as well as the physical history of the continent, to determine the causes which had given the existing form to the shore line of this continent. The coast between the Rio Grande and the Chesapeake, presents but two considerable prominences. The first,

that of Florida, is probably entirely the product of organic life, and as such, probably the most considerable geographical feature on our earth's surface the product of that agent alone. Cape Hatteras, however, cannot be regarded as in any way the result of reef building animals, though it has been suggested that possibly the banks so like the reefs of Florida, may rest upon ancient coral deposits. Sections through the reefs show that they are built on clay bottoms. The Delaware and Chesapeake bays may be, in part, at least, accounted for by supposing that the vast ice streams which during the glacial period passed down the main rivers which lead into them, just as they poured down the Hudson and the Connecticut, had eroded the soft rocks upon which they descended from the harder rocks of the Appalachian Mountains just as the streams of the Rhone and Rhine had cut away the soft rocks making the lake basins of Geneva and Constance. We cannot, however, in this way account for the formation of Pamlico and Albemarle sounds, though the mud and sands which form the outlying banks are probably derived from the excavation of the Chesapeake, just as the similar deposits, which enclose the broad water of the peninsula of Eastern Virginia, are derived from the excavation of the Delaware Bay.

It is likely that the promontory of Cape Hatteras is the result of the elevation of an outlying ridge of the Appalachians near Richmond, Virginia. At that point there is a ridge of syenite appearing from beneath the tertiary clays. This ridge clefts to the east: beneath the clays to the north, is similarly hidden, but, towards the south, extends as far as near Weldon, where it may give place to other similar ridges which continue the elevation to the southward. The height of this ridge can be ascertained by following it to the westward, where we find it sinking beneath the coal, the syenite lying more than a thousand feet deep, at a distance of ten miles from the summit. So we see that Richmond is on a mountain one thousand feet or more high, though covered by subsequent accumulations after having been much eroded. The mining sections through the beds of the Liassic coal field give us the best of evidence on this point. This ridge is parallel to the Alleghanies, and must be regarded as part of that system. We must modify our theory of the elevation of the Appalachian chain, so as to admit that, instead of having been altogether the product of forces acting during and just after the carboniferous time

alone, this elevation continued to go on until after the formation of the Liassic rocks of the Richmond coal field which are much disturbed by the elevation of the syenite ridge to the eastward. While the Appalachians have this comparatively recent outline to the eastward, they have an ancient ridge in a comparable position about as far to the westward. The Cincinnati and Nashville Silurian domes are only the highest points of a low ridge which was elevated on a position parallel to the subsequently created Appalachian system. This ridge was elevated as early as the period of the Calciferous sand rock. This is proven by the traces of beaches and broken shells in beds of the Hudson River Period, and by the existence of great deposits of salt in the Calciferous sand rock which could only have been formed when that rock was out of water. We have, in this ridge, the first of the folds of the Appalachian system, which built continually towards the eastward.

The Hatteras projection was due to the elevation of the Richmond element of the Appalachians. The border tertiary rocks were thrown up and have resisted the wearing action about Hatteras. This ridge was possibly of the same age as the Connecticut River dislocations of the Tom and Holyoke series, and of the Martha's Vineyard series, to which it is approximately parallel.

The history of the Appalachian chain showed that they, like most mountains, tended to grow by successive parallel additions. Mountains are characteristically shore phenomena, rarely being developed away from that line.

The character of the topography changes materially south of Weldon. Its character cannot be explained by the ordinary atmospheric influences. The soundings also afford similar indications. The topography near the coast is purely submarine, as formed by the action of the sea. Passing inland, the evidences of the action of the atmospheric agents appear. He thought the whole of this shore indicated a recent origin, an emergence and a slight sinking within the period of man's remembrance. There had been in the most recent geological period a rising and sinking of the coast, as at Charleston, of fifty or sixty feet; Maine, two hundred feet; and greater on the coast of Labrador, as Dr. Packard has shown. These alternations of sinking and elevation could be accounted for by supposing that the sea flows in their central regions, more constantly sinking the land areas, rising

when the pivot point of this rotation was at the shore, the sinking of sea bottom and rising of the land could go on without changing the position of the shore line; if, however, this pivot point were to the seaward of the shore, the movement would cause the land to gain on the sea; if the pivot point were to the landward of the shore, the sea would seem to gain.

He spoke of the great influence which Hatteras had exerted in deflecting the Gulf Stream from its course.

Dr. C. T. Jackson said that the syenite at Richmond, Virginia, must have been elevated in a cold state; there was no evidence of its having interpenetrated the coal measures. He agreed with Professor Shaler in regard to the elevation of the coast, the pivot point being in Virginia. In Carolina a cannon placed in one of the streets is now under water. In the eastern parts of the State of Maine fishermen had noticed what they call the growth of rocks; those which, within their recollection, were submarine, now appearing above the surface.

Mr. Shaler referred to Mr. Heinrichs, who was now working in the coal measures at Richmond, and hoping soon to get down to the the syenite. He expected valuable results from the investigations.

Mr. J. B. Perry said, in regard to the syenite underlying the coal, that there was no evidence of intrusion. The syenite was in existence before the coal was laid down. In regard to the formation of the coast, he alluded to the observations of Elie de Beaumont, that the elevations of a particular period were parallel. The oldest uplifting, that on the west of Hudson's Bay in N. N. W. and S. S. E. direction, called in Europe the elevation of Finisterre, is earlier than the Laurentian, and crosses it. Suppose there were such an elevation under the surface of the water, corals would form upon that ridge, and an easy explanation is afforded of the extension of Florida in this direction. Supposing parallel elevations, another might have had a bearing upon Hatteras. He was satisfied that Martha's Vineyard was elevated at the close of the Pliocene period. Mount Etna was elevated at the same time.

The earlier elevations of the Alleghanies occurred during the Longmynd period, at the end of the Silurian period. The axis of Cincinnati was the beginning of this uplifting.

He had studied the coal measures in the neighborhood of Richmond, and differed from the general conclusions in regard to them. Some of the fish from Virginia, New Jersey, and the Connecticut

valley, are identical, and have a character intermediate between those of the Permian and the Jurassic. The same formation extends from South Carolina to Nova Scotia. The character of the fossiliferous portion of the Connecticut valley shows it clearly to be Triassic. The Permian was a cold period. The Triassic, a warm period, followed. He thought it was neither Permian nor Jurassic, as many supposed, but Triassic.

Mr. W. H. Niles said the question which Professor Shaler had brought forward was one of great interest. He objected to the view taken by Mr. Perry of the formation of Florida and Hatteras. Professor Shaler's view, he said, was consistent with all the physical features of our Eastern coast. The deepest portion of the sea bed lies opposite the highest mountains, showing a parallelism between the Atlantic valley and the Appalachian system. The Cincinnati axis, he said, was instructive because showing that all parallel chains were not raised at the same time. The long terrace of the Atlantic plain forms another parallel. The streams also conform. The depositions are parallel with the mountain chains. He accepted Professor Shaler's explanation of the elevation and depression of land in connection with water deposition.

Mr. Perry remarked that when one line of upheaval crosses another, it will be modified; and a very old one will be largely disguised, yet may have had its effects and been a condition, as in Florida, affording ground for the corals to work.

Mr. Hyatt remarked, that besides the general westerly and easterly motion described by Professor Shaler, there were evidences of a motion transverse to this along the coasts. Thus the north of Greenland, as shown by various arctic explorations, has beaches recently elevated; and historical records, as well as direct observations, have proved that the south of Greenland is sinking. Dr. Packard's observations in Labrador give the evidence of a comparatively recent elevation, probably still going on. Farther south, at the Mingan Islands, the speaker had observed a series of beaches, the lowest of which remained near high-tide mark. On the Island of Anticosti the remains of fresh-water shells were found, which had apparently died from the influx of tide-water into the little estuary, or mouth of a brook, where the water had formerly been fresh. There were two cliffs stretching around the southern shore of this island, each about fifty feet high. The present sea level, however, at high tide, now reached the foot of the inner cliff, over-

flowing the outer cliff to the depth of two or three feet or more, in different localities. The shores of Nova Scotia, according to the observations of Professor Marsh and others, were, if the speaker remembered rightly, sinking. The shores of Maine, as shown by Dr. C. T. Jackson, Dr. Packard and others, were rising. At Marblehead Neck he had observed a water-worn cliff elevated eight or ten feet above high-water mark, and protected by a ridge of shingle, which forms the back of the present beach. This beach now intervenes between the cliff and the water's edge, which is between **thirty and forty feet distant.**

Observations made by the Coast Survey show that the coast in Long Island Sound and southward in New Jersey has been sinking. The formation of Florida Keys shows that that state is rising. These and other facts which proper investigation would undoubtedly bring to light, indicate a series, or perhaps many series, of transverse waves of elevation and subsidence running down the coast at right angles to the direction of the great waves **which elevated the Appalachians.**

Mr. Niles showed that from the earliest times, in the Adirondacks, and at different points southerly, there had been peninsulas corresponding in position with Florida, which was the most southern **and latest.**

Natural History of Deep-sea Soundings between Galle and Java, by Captain Chimmo. — The ooze dredged up from a depth of two thousand three hundred fathoms, where the temperature was found to be 35° F., consisted to the extent of ninety per cent. of organic matter, Foraminifera, chiefly Globigerinæ, together with Polycistinæ, with a few broken sponge-spicules. In the shallow water near Sumatra, the animal life has decreased to only about five per cent. of the ooze, the Globigerinæ having entirely disappeared. The water brought up from great depths was found to contain a large proportion of salts in solution, which crystallized out immediately on exposure to the air. Mr. Busk remarked on the great interest and importance of the observation of the low temperature of the deep water in a latitude within a few degrees of the equator, strongly confirming the conclusions as to a general circulation of the water between the equator and the poles drawn from similar observations in the Atlantic. — *Nature.*

Disappearance of Aurora Island. — Referring to the statement of the disappearance of Aurora Island (one of the New Hebrides group), recently printed in the newspapers, Mr. Tryon exhibited to the Conchological Section of the Academy of Natural Sciences of Philadelphia, at their meeting January 5th, 1871, two species of shells from the collection, supposed to be peculiar to this island, remarking that in the event of the reported submergence of the island being confirmed, these must be classed among the lost species. In his report on the mollusca collected by Wilkes's U. S. Exploring Expedition, Dr. Gould gives the following account of Aurora Island:—

"The little island of Metia, or Aurora Island, to the northeastward of Tahiti, is one of peculiar interest. It is a coral island which has been elevated two hundred and fifty feet or more, and has no other high island near it. On it were found four small land shells belonging to three genera, viz.:—*Helix pertenuis*, *Helix Daedalea*, *Partula pusilla* and *Helicina trochlea*. None of these were found upon any other island. They seem to have originated there, after the elevation of the island, and have a significant bearing upon the question of local and periodical creations in comparatively modern times."

Geography of the Sea Bed. — At the meeting of the Royal Geographical Society, held on Nov. 29, a paper was read "On the Geography of the Sea Bed," by Capt. Sherard Osborn, R. N. The author gave an account of our present knowledge of the configuration of the bed of the ocean, as derived from Admiralty surveys and submarine telegraph expeditions during the last fifteen years. His explanations were illustrated by a number of diagrams showing sections of the North Atlantic and other oceans. It has been definitely ascertained that the greatest depth of the ocean does not reach 3,000 fathoms in any part where telegraphic lines have been laid. The bed of the North Atlantic consists of two valleys, the eastern extending from 10° to 30°, the western from 30° to 50° West Longitude. The extreme depth of the eastern valley is under 13,000 feet, which is less than the altitude of Monte Rosa. This valley has been traced southward to the equator. It is separated from the western valley by a ridge in 30° West Longitude, in which the average depth is only 1,600 fathoms. This ridge terminates to the north in Iceland, and southward at the Azores, so that it is volcanic in its character at both extremities. Its extreme breadth appears to be under 300 miles, and the Atlantic deepens from it on

both sides. Explorations carried on in the Mediterranean, the Red Sea, and the Indian Ocean, showed similar uniformity in the level of the sea bottom; and the general conclusions arrived at by Capt. Osborn were, that in the deep sea there is an absence of bare rock, and that there are no rough ridges, cañons or abrupt chasms; moreover, that the bed of the deep sea is not affected by currents or streams, even by those of such magnitude as the Gulf Stream; but that it rather resembles the prairies or pampas of the American continent, and is everywhere covered with a sort of ooze or mud, the *débris* of the lower forms of organic life.

Colossal Fossil Sea-Weed. — From the microscopic examination of the structure of specimens of the fossil trunks described under the name of *Prototaxites Logani*, and which Principal Dawson affirmed in his Bakerian lecture before the Royal Society, to be the oldest known instance of Coniferous wood, Mr. Carruthers has discovered that they are really the stems of huge Algæ, belonging to at least more than one genus. They are very gigantic when contrasted with the ordinary Algæ of our existing seas, nevertheless some approach to them in size is made in the huge and tree-like Lessonias which Dr. Hooker found in the Antarctic seas, and which have stems about twenty feet high, and with a diameter so great that they have been collected by mariners in these regions for fuel, under the belief that they were drift-wood. They are as thick as a man's thigh. — *The Academy*.

MICROSCOPY.

Improvements in the Lenses of Microscopes. — For some time, people in England have been content to let the improvement of the optical powers of the microscope remain entirely in the hands of the makers, believing, apparently, that Mr. Lister had effected all in his suggestions and improvements that could be desired. Dr. Royston Pigott, an able mathematician, formerly fellow of St. Peter's College, Cambridge, and a Doctor of Medicine of that University, was not, however, inclined to look at the matter in this way, and for many years has been working and experimenting with a view, first, to test the accuracy of our best object-glasses, and, secondly, to suggest means for their improvement. It should be remembered that Oberhauser, Nachet, and especially Hart-

nack, on the continent. not satisfied with the old system of combinations for object-glasses, and not having the benefit of Lister's researches, have made excellent objectives on a totally different system, and during the last few years the last-named maker has carried his system of "immersion lenses"to such a point of excellence as really to surpass the best glasses on Lister's system, in definition, penetration, working distance, and illumination. Those who do not admit the excellence of these objectives, which are now used by nearly all German histologists, have probably seen older glasses, made at a time when Hartnack had not reached his best. It is worth stating, now that the Parisian opticians are inaccessible, that Gundlach of Berlin has succeeded in making excellent glasses of high power at astonishingly small prices, some of his 1-12ths and 1-16ths, immersion 1-16ths (so called), being admirable in their performance. They are not, however, equal to Hartnack's glasses, which, though costing far less than what similar English glasses cost, yet are more expensive than Gundlach's. It is only fair to all parties concerned to state that the terms 1-8th, 1-12th, 1-16th, etc., as now applied to an object-glass, appear to have no definite meaning, but depend on the caprice of the maker, since the magnifying power of glasses, with the same fraction assigned to them, differs enormously.

To return to Dr. Royston Pigott. He found the usual means of testing an object-glass by trying if it gave some particular appearance with a "test-object," such as the Podura-scale, very unsatisfactory, since we have no certainty to begin with as to what is the true appearance of such an object. He therefore examined minute images of objects of which he knew the true form, such as a watch-face or thermometer-scale, forming these images by aid of mercurial globules and the condenser properly adjusted below the microscope-field. By this means he has found that object-glasses corrected so as to show dark, sharply marked spines (like!!!) on the Podura-scale — a favorite test-object with our microscope-makers — give false, blurred, and distorted appearances with his known images, and on making such corrections of the objective as to show the known images in their true form, he finds that the Podura-scale, examined with the corrected objective, is not really marked at all, as supposed, but is beset with a series of bead-markings, which by intersection, when improperly defined, give the curious appearance like notes of exclamation. This important discovery

of the falsity of our high powers (1-8th to 1-16th) has led Dr. Royston Pigott to pay more attention to the lower powers, and he finds that though you may not get so much actual amplification, you yet get a truer effect, and greater clearness of detail, by employing very carefully made low powers (1-2d to 1-5th), and increasing the magnifying power at the other end of the microscope, *i. e.*, the eye-piece. We have in this way seen the beaded structure of the scales of the Podura more satisfactorily than with very high objectives, even when corrected so far as they would admit, and we may say the same of some Diatom-valves, *e. g.*, *Pl. formosum*. It would be most important to know how far such a change of combination would be useful in histological work.

The general upshot of Dr. Royston Pigott's investigations appears to be that it is desirable to shift the burden, hitherto cast almost wholly upon the objective, to the other parts of the instrument. We should be content with an objective as high as a fifth, or even less. A very deep eye-piece is to be used: and to correct residuary aberrations of the objective, and at the same time amplify, Dr. Pigott has introduced an important adjustable combination *between the eye-piece and the object-glass*. There seems to be considerable reason for the step proposed by Dr. Royston Pigott. Just as great results were obtained in passing from the single lens or combination to the compound microscope of eye-piece and objective, so by adding distinct integral factors to these two, such as Dr. Pigott's "aplanatic searcher," we may obtain excellences quite impossible by any amount of attention bestowed on the objective alone, or only with difficulty reached by long labour, leading to **very high price for high powers.**

Dr. Pigott has, during the past year, published some account of his researches in the *Quarterly Journal of Microscopical Science*, and has communicated papers to the Royal Society, one of which is about to appear in the Philosophical Transactions.

Naturally, at first, the makers in London and the Microscopical Society were sorely tried by Dr. Pigott's exposure of the Podura-scale, but we hear, as one good result already obtained, that Messrs. Powell and Lealand have constructed a new 1-8th, both dry and immersion, with great care, which is declared to be the best glass yet made. It has been proposed to form a committee for the purpose of examining carefully as to penetration, definition, and angular aperture, the best glasses of our English makers.

the best American glasses, and the best of Hartnack's, Gundlach's and others; the glasses being mounted similarly, with private marks only for recognition, so as to prevent all possibility of prejudice on the part of the committee. Were this done, the result, whichever way it tended, would be eminently satisfactory. Of this the writer is sure, that many persons — even eminent microscopists — have made up their minds about the qualities of foreign objectives, without having seen any, or only very poor examples, and then when a really fair specimen of such a glass is placed before them, they exclaim with astonishment "Why this is the finest glass I have ever seen." We shall be glad to receive suggestions or assistance, in carrying out the proposed comparison of objectives. Dr. Royston Pigott has expressed his willingness to aid in such an undertaking. — E. R. L., *in Nature*.

Committee for Testing Objectives. — Dr. G. W. Royston Pigott proposes (Monthly Microscopical Journal, London, March. 1871) the appointment of a committee for the examination and comparison of objectives by different makers. Both dry and immersion lenses should be tested; and, to avoid prejudice, they should all be mounted in a uniform and simple style, marked in cipher, and identified as the work of known makers only after the final report of the committee. They should be tested in reference to the following properties: — Resolution, Penetration, Magnifying power, Spherical and Chromatic aberration, and Angular aperture. Dr. Pigott also judges that "deep" eye-pieces should be employed, and a very limited and unusual illumination, points which might be left to the judgment of the committee, who would probably prefer to use all kinds of eye-pieces and various methods of illumination, not forgetting, of course, the separate testing of the different parts of the same objective, by the methods lately introduced by Dr. Pigott. (The writer has excellent lenses by the best makers, in which not only are the different zones of angular aperture unequally corrected, probably a more or less unavoidable error, but also the correction is distinctly unequal [from imperfect centering?] at equal distances from the axis; a pencil, say, at 40° from the axis, being better corrected than one at the same distance on the other side of the axis.)

As this subject is largely an international one, though not of sufficient importance to call for the meeting of a committee repre-

senting the different countries chiefly interested, any movement, if made at all, in reference to it, should be a concerted movement in England, Germany, France, if practicable, and this country, the same lenses being sent for study from one country to the other. Microscopists might thus be informed, not as to which objectives are the "best," but as to which desirable qualities are possessed in an eminent degree by the lenses of the various makers.—R. H. W.

Eyesight and the Microscope.—In using the microscope I have found that the best system is that recommended by Dr. Carpenter, who has probably had as much experience in this matter as any person I know of. It is to alternate the use of the eyes, always keeping the unemployed eye open. But I feel confident that it is of no use to keep the unemployed eye open if it be made to stare at a dead-black surface. It is the exclusion of light from one eye, and the consequent unequal action of the visual organs, that is thus produced, that causes the mischief that we dread; and it matters not whether this unequal action be produced by covering the eye with the eyelid, or by excluding the light from it by other means,—the result is the same. In making observations with the microscope, all extraneous light should be excluded from the eyes. Hence the value of a properly arranged shade. Such a shade, however, should consist of more than a mere flat sheet of pasteboard covered with velvet. It should have a perpendicular portion, rising up in front of the face, and cutting off all light except that which comes through the microscope. And now, having provided a shield of this kind, which, by the way, is easily made of pasteboard blackened on the inside with dead-black varnish (made of alcohol, lamp-black, and a very little shellac), if we punch an inch hole at such a point that the unoccupied eye can see it in the same way that the other eye looks through the instrument, we will find that the fatigue experienced by that eye is vastly less than when it is exposed to the dead-black surface. A few trials will set at rest all questions on this head, and the change from light to darkness is easily made by simply slipping a piece of blackened paper or card over the hole.

With few exceptions, we use altogether too much light with the microscope. Where a full flood of light is passed through a

transparent object, the finer points are apt to be "drowned" out entirely; and it is only by modifying the amount of light by means of the diaphram, that we are enabled to make out the more delicate details. Hence it will be found that the use of the bull's-eye condenser, for concentrating the light on the mirror, and consequently augmenting the *amount* of light passing through the object, is, in general, totally unnecessary. This arrangement of the illuminating apparatus is totally different in its effects from that of the achromatic condenser, and cannot be substituted for it. **as some persons seem to think.**

No man can have worked long with the microscope without being led to a very careful consideration of the relative value of the various sources of illumination at his command. Much thought. and considerable experience, have led me to the following conclu**sions on the subject:—**

The first requisite in the light that we use is *whiteness*. Hence. daylight, the light of a white cloud, the artificial white cloud illuminated by daylight, the light from the old-fashioned argand lamp burning sperm oil, the modern student lamp burning kerosene oil, and its various modifications, and the argand gas-burner, are good—their excellence being about in the order here laid down. Common gas-light, candles, and kerosene lamps are inferior just about in the order we have named. White light is not nearly so fatiguing to the eyes as the reddish glare from a half-smothered combustion. Hence in all cases we must seek to have the most perfect combustion and highest possible temperature of flame in our sources of artificial light. It is true that this gives rise to great heat, but this difficulty is easily obviated by the use of a proper screen or shade, and none will be found better than the one previously described. Indeed, when working by artificial light, it will be found that the heat is one of the most efficient causes of injury to the eyes, and the screen that we have mentioned is, perhaps, quite as useful, from the fact that it cuts off heat, as from its excluding unnecessary light.

The second requisite is steadiness. Nothing is more trying to **the eyes than a flickering light.**

Another requisite is that the instrument should be so steady that the object shall be retained in view and in focus without change. Any tremor is injurious to the eyes, and especially is this the case when that tremor produces a continual change in the

relation of the object to the focus. This difficulty is met chiefly in the use of small, single lenses, that are held in the hand, and it may be safely said that a single hour's work, with a lens of this description held in the hand, or mounted on an unsteady stand, will cause more injury to the eyes than weeks of work where a first-class instrument of far higher power is used. It has always seemed to us that watch-makers, engravers, and those who use lenses, do not sufficiently appreciate this fact. They, in general, mount their lenses on wire stands, which tremblingly respond to every footstep that falls upon the floor, and thus cause continual demands upon the eye for re-adjustment of focus. So, too, we have seen students of botany poring over plants by the hour, and using a small hand-lens, which must have been utterly destructive to the eyes. Wherever a microscope—single or compound—is used for more than a few seconds, it ought to be mounted upon a stand so firm that all vibration, and especially all disturbance of the focussing, will be avoided.—*Good Health.*

ANTHROPOLOGY.

Probable Important Archæological Discovery.—In these days of archæological humbugs we hardly venture to copy any account of a reported discovery, but feeling confident that Mr. Meehan would not have printed Mr. Douglas's letter unless he knew him to be a reliable observer, we give the following:—Mr. H. Douglas, of Waukegan, Ill., writes to Mr. Meehan (who has published the letter in the February number of the "Gardener's Monthly"), that during a recent dry season he was enabled to dig to the very bottom of his peat bed, or "muck hole," some six or seven feet below the surface. Under the peat he found "what appeared to be the bottom [shore] of a lake, showing clear sand, gravel, and small shells, exactly like the shores of the lakes so common in this country. Imbedded in this gravel we found a boulder, and around it were charred sticks, looking to all appearances like the remains of a camp fire, and near it we found several poles that had evidently been pointed at the thickest end with an instrument not very sharp, proving, at least to my satisfaction, that Indians had camped there, and that the sharpened saplings were their tent poles cut with a stone hatchet. While digging last summer about three rods from the spot named, we

found the bones of the elk,—the horns, a jaw-bone, a leg, etc., and would have got them all, but the water prevented."

These bones were sent to Chicago, and were pronounced to be of an extinct species of Elk, and probably identical with the species found fossil in the Irish bogs. We do not know to whom these bones were submitted for examination, but we trust that the Chicago Academy will not let this sub-peat deposit remain long without a thorough investigation, and that both bones and fireplace will receive the careful attention which the subject demands. We should like to have any farther information which may be obtained. Our peat beds have not yet received the attention that they demand, when we remember how rich those of some parts of Europe have proved to be in relics of great archæological importance. No opportunity of investigating our peat deposits should be allowed to pass unheeded.

NOTES.

Some fifteen scientific gentlemen connected with the old American Ethnological Society gathered last evening at the residence of the Honorable E. G. Squier, No. 135 East Thirty-ninth street, to consider the propriety of changing the title of the Association to that of the Anthropological Institute, and the adoption of more serviceable by-laws. Mr. Squier, in introducing the subject of the meeting, said that in the similar organizations of London and Paris the functions of Ethnology had been long since exchanged for the broader ground of Anthropology, so as to embrace under that general title the coöperative labors of the anatomist, the philologist, and archæologist, and combine in one scheme of study whatever relates to historic man. The latest records of the old society having been read by the secretary, Dr. H. A. Stiles, reciting, among other things, the transfer of the effects to the Historical Society of this city, the proposal of change of name was then made by the Chairman, Mr. Alexander J. Cotheal, and adopted unanimously. The "Anthropological Institute of New York" went into session under the same temporary officers. Honorable E. G. Squier was then elected President of the Institute, and

Messrs. J. G. Knox and George Goden, Vice-Presidents. Mr. Squier generously offered to undertake the printing of the records for one year.

Mr. G. R. Crotch, whose annual synopsis of European Coleoptera we have noticed elsewhere, writes that he is hoping to bring out a Nomenclator Zoologicus, which shall be, not a continuation merely, but a revision of Agassiz's "Nomenclator," and completed to the present day. He promises to bring out the Coleoptera soon. Such a work, if any one can be found to do it, is invaluable to the student, and we hope the proposal will meet with every possible encouragement in this country.

Mr. Crotch's leisure is now devoted to a study of the Coccinellidæ of the world. He wants American species, especially some of the common variable species. He would be glad to exchange or purchase. He has large numbers of English and European duplicates, especially in the difficult groups of Staphylinidæ and Necrophaga generally, which he would exchange for any American Coleoptera.

Professor A. Rohde gave a very interesting and instructive entertainment in Salem, recently, under the auspices of the Essex Institute. His Geological Pictures give correct and lasting impressions, and should be exhibited before every college and school in the country.

The *College Courant*, copying from the *New York Times*, has given circulation to the story of a "great discovery" near Dubuque, Iowa, consisting of a chamber cut out of stone and containing important relics of a past race, etc. We are sorry that our friend, the "Courant," has got so decidedly "sold" in this story of the "ark and the dove" in America, but it turns out that the chamber exists only in the cavernous head of a local editor.

A Zoological Record Association has been established for the purpose of continuing the "Record of Zoological Literature" (an annual volume containing an abstract of, and an index to, all that has been done in zoology during the previous year), which has been held in such high esteem by working zoologists that for some time past the British Association has been induced to vote an annual grant of 100*l.* in its support. Owing, no doubt, to the fact of its utility not being sufficiently known to the public, the under-

taking has not proved a financial success. The new association, which includes, we understand, all the leading zoologists of England, hopes to have better luck, and in a few days it is expected that its programme will be before the world. Mr. Stainton, F.R.S., is the Secretary.

ANSWERS TO CORRESPONDENTS.

C. E. B., Iowa State Agricultural College, Ames. — The worms you found on the apple tree are probably those of the codling moth, and the best thing to do is to pick them all off the tree and look under the bark for others. The moth flies in May. These cocoons are easily found after a little experience, and the winter, autumn or early spring is the best time to look over the trees for the cocoons of these and other moths; also to remove the bunches of eggs of the American Tent Caterpillar, and the Canker worm, if you have the latter caterpillar in Iowa.

The larvæ which you say — "were exceedingly abundant on cabbages last season during the hotter portions, and which feed on the leaves, eating them into holes, effectually spoiling their growth, and ruining the crop; and transform on the under side of the leaves, or on shaded portions of the upper surface, forming little cocoons" — are the caterpillars of the Cabbage Tinea (*T. spilotella*). It also infests the turnip, and is common all over the world. In Europe there are two broods, one in June, the other at the end of summer. The larva is spindle-shaped, and of a delicate green color, with a gray head. We have found the larva on cabbage leaves late in September. We shall give a farther account of this caterpillar on another occasion.

S. A. N., Mt. Washington. — The mouse you say is common at the house on the mountain is, perhaps, *Arvicola Gapperi*, but your description is not full enough to make sure. **Specimens would be very acceptable.** — E. C.

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THE
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Vol. V.—JUNE, 1871.—No. 4.

THE YELLOW-HEADED BLACKBIRD.

BY DR. ELLIOTT COUES, U.S.A.



We are indebted for the discovery of this beautiful species to Major Long's memorable expedition, which largely increased our

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then imperfect knowledge of the zoölogy of the West. Bonaparte first published an account of the bird, with a good figure, in his continuation of Wilson's Ornithology, in 1825. It is not so strictly a western species as is generally believed; for in its partial northward migration it ranges obliquely to the eastward, until in British America it reaches a meridian of longitude which it is not known to attain in the United States. It inhabits the region about the Saskatchewan and Red River of the North; and we have Prof. Reinhardt's authority for its presence even in Greenland. Sir John Richardson mentions its abundance at the fifty-eighth parallel, where, however, it is found only in summer. It is singular that it should breed in these almost hyperborean regions, and in the warm parts of New Mexico, Arizona, and California; yet such is the fact. The partial migration just mentioned, which occurs with many birds besides this one, may be explained in two ways. Either the birds bred at the north retire before winter, and return again in the spring, while those reared further south remain stationary, or else there is a north and south oscillation of all the individuals, not of sufficient length to carry them away from any localities except at the extremes of their range.

The *Xanthocephalus icterocephalus*, as this species is called, is one of our handsomest blackbirds, the body being glossy black, the head, neck and breast rich yellow, and the wings having a white spot. The female is smaller than the male, and plain dark brown, with the yellow of the head restricted and clouded over. Together with the Lark Finch (*Chondestes grammaca*) and Prairie Hen, it is one of the earliest indications that the westward bound traveller has of approaching a different ornithological region. I saw some on the prairies of Wisconsin, and a great many in Kansas, at a place called Salinas, supposed by courtesy to be a town, although it consisted chiefly of a very dirty shed for a stable, and another smaller one, a shade cleaner, for a hotel. The birds were the most agreeable inhabitants of the place, and I whiled away some hours in watching them feeding in flocks about the stable yard, with some Cowpen birds and Doves. They were very tame, and would only fly off a few yards when shot at. Salinas is not far from Junction City and Fort Riley, a locality where so many Eastern and Western birds are found together, that it is particularly interesting, as the following extracts from my note-book will show. The memoranda were made during a week's stay, in which time over a hundred specimens were secured.

"Republican Fork, near Fort Riley, *May* 22, 1864. — Large numbers of Semipalmated and Bonaparte's Sandpipers (*Ereunetes pusillus* and *Actodromas Bonapartei*) along the river, mixed together in close flocks. Not fat at this season. Plenty of Baltimore and Orchard Orioles, in the high trees; Yellow-breasted Chats in the bushes; Yellow-winged Sparrows and Black-throated Buntings everywhere; Meadow Larks in the open, and Partridges in the woods. Shot a pair of Red-bellied Woodpeckers, breeding. Saw for first time the Clay-colored Bunting. *May* 23. — Found two very interesting birds I never saw alive before — Bell's Vireo, and Nuttall's Whippoorwill (*Vireo Belli* and *Antrostomus Nuttalli*). The former seems quite common; shot several specimens; it inhabits thickets and clumps of bushes, like *V. Noveboracensis*, but has a different song, the peculiarity of which first attracted my attention. The Whippoorwill was flushed in thick cover, and looked very much like a woodcock as it got up; its night cry is like that of the Eastern species with the first syllable omitted. Familiar Eastern birds about here, not noticed yesterday are: — Indigo bird, Redstart, Kentucky Warbler, Golden-crowned Thrush, White-eyed and Red-eyed Vireos, Great-crested Flycatcher, Pewee (*S. fuscus*), Wood Pewee, Kingbird and Downy Woodpecker. Shot and skinned twenty-three specimens. *May* 24. — Shot a Slender-billed Nuthatch, the first one seen. Large flights of Night-hawks at dusk. A Pectoral Sand-piper in the grass near the stream. Shot an Olive-backed Thrush (*T. Swainsonii*), and several Lark Finches; these last were first observed about St. Louis, Mo., as I was riding in company with Dr. Engelmann of that city. *May* 25. — There are a great many Bartramian Tatlers now on the prairie. Had no trouble in shooting a good bag, their tameness being in remarkable contrast to their usual shyness in places where they are much hunted. *May* 27. — More Eastern birds occur; the Warbling Vireo, Yellow-billed Cuckoo, and Scarlet Tanager. Shipped a box of specimens, and shall leave to-morrow, troops having arrived to escort the stage, in view of possible Indian hostilities. *May* 29. — Salinas, K. T. — Saw first antelope yesterday, and to-day abundance of Yellow-headed Blackbirds."

The Journal goes on to state, that the next day we had prairie zoölogy in earnest; the Lark Bunting, Burrowing Owls, Prairie Dogs, and Buffalo. The Blackbirds were seen almost every day

while crossing the Plains. They would collect about camp in the evening, with flocks of Cowpen birds, and ramble about for food among the mules and horses turned out to graze. In spite of the season of the year, I noticed that a large part of them were in imperfect plumage, the inference from which is, that more than one year is required for them to become perfectly black and yellow. I saw them at various points along the Rio Grande, and first found them breeding a short distance west of that river, near the Pueblo of Laguna. A small stream there spreads into a marsh. overgrown with reeds and tall rank weeds; a favorable spot, that thousands of the birds had selected as a nesting place, and were then busy with the duties of incubation. Pretty much all these birds seemed to be in perfect plumage, and no young of the year had yet made their appearance.

The nest of this species is a compact, substantial structure. measuring five or six inches across, and but little less in depth. Unlike the true *Agelœi*, or Marsh Blackbirds proper, these birds use no mud in the construction of the nest—perhaps because its weight would then be too much for the slender reeds to bear; the nest being placed in a tuft of upright flags or rushes, the stems of which pass through the substance of its walls, and securely fasten it, though it is liable to sway back and forth in the wind. It is plaited and woven entirely of bits of dried reeds, and long, coarse. aquatic grasses, and is not lined with different material, though the inside strands are finer than those outside. The brim of the nest is usually thickened, and folded over a little, to form a firm edge. The eggs may be from three to six in number. They resemble the eggs of the *Scolecophagi* more than those of the *Agelœi*, lacking the curious straggling zigzag lines. The ground color is a pale grayish or olivaceous green, which is spotted all over with several shades of reddish-brown, sometimes so thickly, especially towards the larger end, that the ground color is scarcely perceptible. The eggs vary to a moderate degree in size and shape; two selected specimens measured respectively $1.04 \times .75$ and $1.15 \times .76$.

The duties of incubation devolve mostly upon the female, and while she is setting, the male is fond of mounting the highest perch near the nest, and giving free expression to his joyful anticipations. He twists and turns about in a curious way, and sings, in a manner still more amusing, a queer melody of guttural notes. broken at intervals by an odd grating sound, and again by a few

clear syllables that sound like the tinkling of a bell. When meal time comes around, he goes off, and forages with other Benedicts about the marsh, paying, I suspect, little attention to his mate, although should she be disturbed from the nest, her cries of distress soon bring him back. It is not likely that he brings any food home; and while she is setting, she gets anything to eat that she goes after herself.

These were among the few birds I saw in the arid regions about Jacob's Well and Navajo Springs, on the confines of New Mexico and Arizona. This was in July; some were birds of the year in their first plumage, and the rest were all moulting. There were some in a marsh near Fort Whipple, but not to be compared in numbers with the vast hordes of Brewer's and Redwinged Blackbirds that live there. In this latter locality there were more of them between April and October than during the rest of the year. Such a mountainous region as that about Fort Whipple is not exactly to its liking; although, like the true *Agelaei*, it gathers in marshes to breed, it is emphatically a prairie bird, delighting in broad, open, dry land. It is more decidedly terrestrial than most of its allies, and spends the greater part of its time on the ground. Compared in this respect with the Redwinged Blackbird and the *Quiscali*, it bears much the same relation to these that the species of *Harporhynchus*—the Thrasher, for instance—do to the true Mocking-birds. It is admirably adapted for a terrestrial life by its long and strong feet: on the ground, it usually walks or runs, but frequently hops along, like Insessores in general. In its mode of flight it closely resembles its many allies; and like these may be called omnivorous, although various seeds probably form the greater part of its food.

Jacob's Well, that I mentioned just now, is a queer place, and one always associated in my mind with these birds. Here is what I find in my note-book about it:—

"*July* 8.—We read of the delightful and equable climate of New Mexico: but we live and learn. Last night we shivered under blankets, and blew our numb fingers this morning. By ten o'clock it was hot; at eleven, hotter; twelve, it was as hot as—it could be. The cold nights stiffen our bones, and the hot days blister our noses, crack our lips and bring our eye-balls to a stand-still. To-day we have traversed a sandy desert; no water last night for our worn-out animals, and very little grass. The 'sand-storms'

are hard to bear, for the fine particles cut like ground glass; but want of water is hardest of all. For some time it has been a long day's march from one spring or pool to another; and occasionally more: and then the liquid we find is nauseating, charged with alkali, tepid, and so muddy that we cannot see the bottom of a tin cup through it. Here at our noon-day halt there is not a tree—scarcely a bush—in sight, and the sun is doing his perpendicular best. In the Sibley tent the heat is simply insupportable, and we are lying curled up like rabbits in the slight shade we can find in the rain-washed crevices of the 'Well.' Jacob's Well is an undisguised blessing, and, as such, a curiosity. It is an enormous hole in the ground, right in the midst of a bare, flat plain; one might pass within a hundred yards and never suspect anything about it. The margin is nearly circular, and abruptly defined; the sides very steep—almost perpendicular in most places; but a path, evidently worn by men and animals, descends spirally, winding nearly half way around before reaching the bottom. It is, in fact, a great funnel, a hundred yards wide at the brim, and about half as deep: and at the bottom there is a puddle of green, slimy water. Tradition goes, of course, that this is a 'bottomless pit;' and as the water had not perceptibly diminished after all our party and five hundred mules and cattle had had their fill, the story may go for what it is worth. The water is bad enough—warm, and probably muddy, though the mud is not visible, owing to the rich green color of the dubious liquid. It contains, however, some suspicious looking creatures, 'four-legged fishes,' said the man who caught several with hook and line. They suck the bait like catfish, and look something like them, barring the legs and long, fringe-like gills.*

"It is a scene of utter desolation; our bodily discomfort begets vague fears, and a sense of oppression weighs us down. The leaden minutes creep on wearily and noiselessly, unbroken even by the hum of an insect; two or three blackbirds, hopping listlessly about, as if they wished they were somewhere else but had not energy enough to go there, are the only signs of life that greet our faithful animals and ourselves."

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* They are the *Amblystoma nebulosum*, a kind of batrachian related to the salamanders and tritons of our brooks. The body is shining green above, with a few indistinct black spots, and silvery white below; eyes and gills black; a yellow tint about the legs. They can live a long time out of water, as their skin seems to exude a sort of perspiration that keeps them cool and moist. One that was quite dry and seemed dead, revived on being placed in a bucket of water.

CUBAN SEAWEEDS.

BY DR. W. G. FARLOW.

In 1865–66 Mr. Charles Wright, then engaged in collecting the phænogamous plants of Cuba, upon visiting the seashore in search of maritime plants, gathered and preserved such algæ as came within his reach. This collection, which was kindly given to me for examination by Professor Gray, contained forty-six species which could be identified, besides a few which, from absence of fruit and other causes, could not be made out. Of these forty-six species, eight were Melanosperms, nineteen Rhodosperms, and nineteen Chlorosperms. These numbers probably nearly represent the actual proportion of species of Chlorosperms and Melanosperms growing on the shores of Cuba, the latter being few in number and belonging mostly either to the genus Sargassum of the Fucaceæ, or to the tropical order Dictyotaceæ. That the number of Rhodosperms, collected by Mr. Wright, is considerably less than the actual proportion is owing to the fact that the Melanosperms and Chlorosperms are generally littoral, and could be easily reached by Mr. Wright, while the Rhodosperms are mainly found after storms, or brought up by the dredge. The present article is limited to the Chlorosperms of Cuba as illustrated by this collection.

On our own coasts, the Chlorosperms, or green seaweeds, belong mainly to the Ulvaceæ and Confervaceæ. To the former order belong the grass-green apron-like weeds (Ulvæ) attached to the rocks all along our shores, and the Porphyra (Fig. 45, structure of a plant of the group) of a similar structure but smaller, and of a dark purple color, very exceptional amongst the Chlorosperms, which make the large round pebbles of our beaches so slippery at low tide. To the Confervaceæ (Fig. 46, structure of a plant of this group) of our shores, belong a multitude of species formed of small, generally microscopic, cylindrical cells placed end to end, forming sometimes branching, sometimes straight filaments. In Mr. Wright's collection is an alga (*Cladophora luteola* Harv.) belonging to this order of a most brilliant yellow color, forming tufts scarcely two inches high. Some of our own Cladophoræ are of a greenish yellow color, but we have nothing approaching in

brilliancy this little Cuban plant which possesses a color unique among the algæ.

Besides these two orders, so fully represented on our own coast,

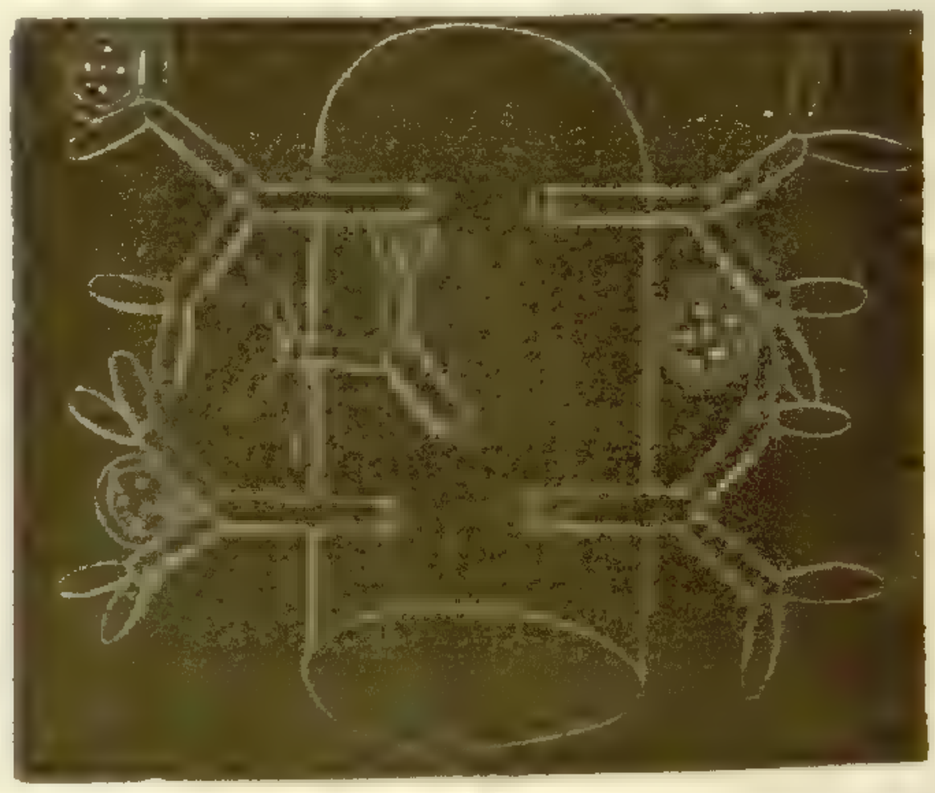
Figures showing diagram of structure in

Fig. 46.



Confervaceæ.

Fig. 48.



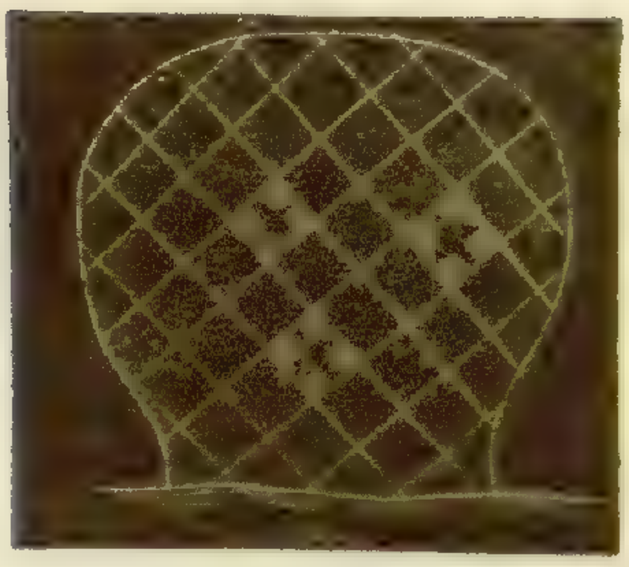
Dasycladeæ.

Fig. 49.



Valoniaceæ.

Fig. 45.



Ulvaceæ.

Fig. 47.



Siphonaceæ.

but so comparatively insignificant in Cuba, we have, if we except Vaucheria, a microscopic alga, the American species of which have

been but little studied, a solitary species of a third order, the Siphonaceæ, to which the most striking Cuban Chlorosperms belong. This plant is the *Bryopsis plumosa*, which grows in rocky pools and looks like a small tuft of delicate green feathers.

The order Siphonaceæ (Fig. 47, structure of a plant of this group) contains plants formed of a single large and generally branching cell, or of several such cells united into a frond. The mode of reproduction, as far as is known, is by zoöspores formed from the whole contents of the cell and discharged by the rupture

Fig. 50.



Caulerpa Mexicana, nat. size.

Fig. 51.



Caulerpa ericifolia, 2-3 nat. size.

of the cell-wall. In Vaucheria, antheridia* have been seen. The largest and most beautiful genus of Siphonaceæ is Caulerpa. This genus has representatives in all tropical seas, some species, as *Caulerpa clavifera*, being cosmopolitan. The single cells of which these algæ are composed are very large, being amongst the largest vegetable cells known; in *C. prolifera*, for instance, four or five inches long. The cell-wall is thick and membranous, and lined with several layers of cellulose. The sac thus formed is filled with a semi-fluid endochrome.† The peculiar character which marks the genus is the presence of branching threads which

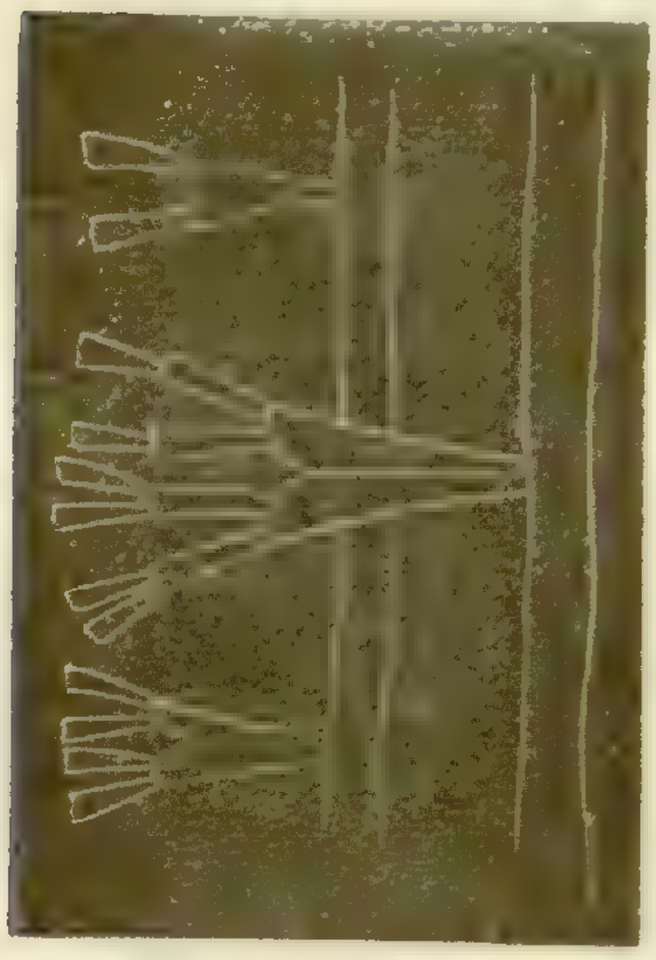
*Certain organs answering to the anthers of flowering plants.

†The coloring matter of the cells.

float in the endochrome and fill a good part of the cell. These threads are merely prolongations of the external cell-wall, and are not newly formed cells, as they contain no endochrome. Harvey has compared the Caulerpæ to loose sponges surrounded by a membranous sac.

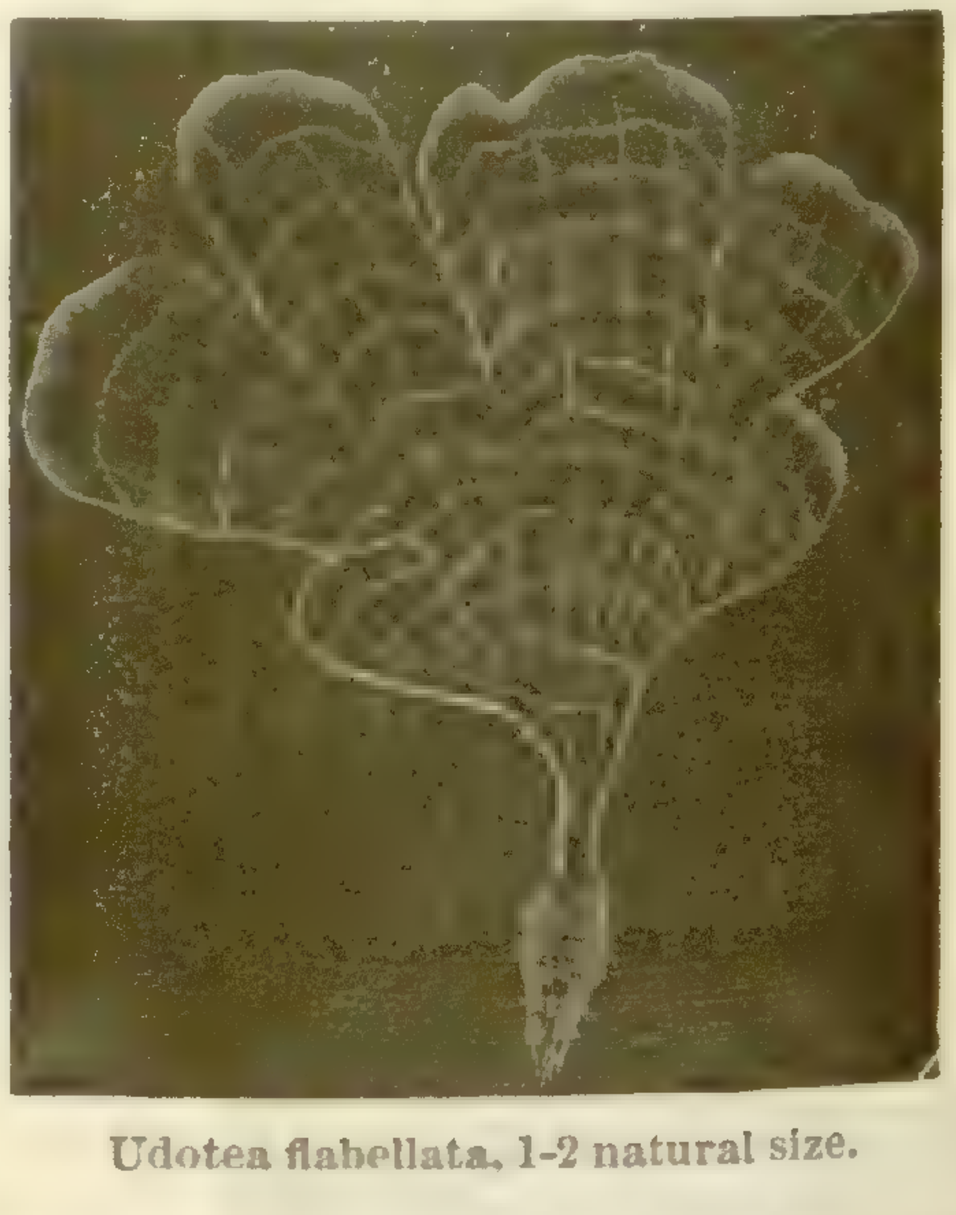
The specific distinction depends on the outline of the frond. Most of them resemble Lycopods or true mosses. In all, there is something which looks like the subterranean stem of a Lycopodium, from which fibrils resembling roots are given off. These have not the functions of roots, but only serve to fix the plant, and in consequence of these trailing stems, the Caulerpæ are able to flourish on a sandy shore where almost no other alga will grow.

Fig. 52.



Halimeda tridens, 300 diam.

Fig. 53.



Udotea flabellata, 1-2 natural size.

From these underground stems, or surculi, grow the fronds proper, consisting of a single cell, as we have described. In *C. prolifera* the frond is simply flat and leaf-like. In *C. plumaris* it is finely pinnate, resembling little feathers. In *C. Mexicana* (Fig. 50, natural size) we have some resemblance to a Jungermannia: while in *C. Lycopodium* and *ericifolia* (Fig. 51, $\frac{2}{3}$ natural size) we have forms presenting a striking similarity to *Lycopodium clavatum* and *dendroideum*. In fact in the dried state many would mistake them for faded *Lycopodia*. The Caulerpæ grow near the shore in great patches as densely clustered as the mosses on shore. They form the lawns of the ocean, but far excel, in brilliancy of color and delicacy of form, the lawns which the most skilful gardener can produce. They are also said to form the chief food of the green turtle of our markets.

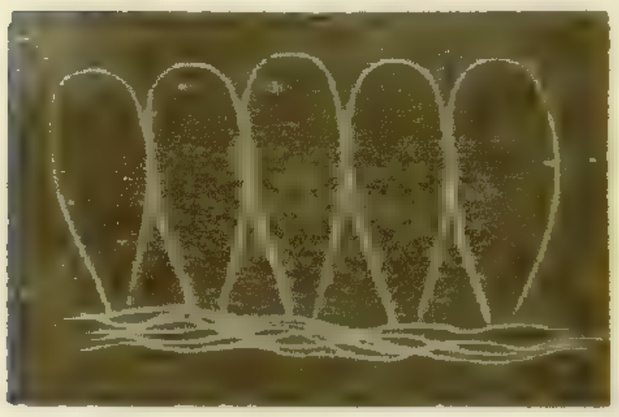
Nearly allied to Caulerpa, are Halimeda and Udotea, which are composed, not as in Caulerpa, of a single cell, but of several similar cells packed together into a frond. These genera would hardly be called plants at all by the common observer, as they are coated with carbonate of lime and resemble corals. In fact, they are corallines or algæ with a calcareous covering. In some species this coating surrounds each filament separately, in others it surrounds the collective mass of filamentous cells of which the plant is composed. Referring to these plants, Cuvier wrote, "il existe dans la mer des corps assez semblables aux polypiers par leur substance et leur forme générale aù l'on n'a pu encore apercevoir les polypes." Lamouroux, however, went farther, and described the polyps which, it is needless to say, existed only in his own imagination. At present, there is no doubt of their vegetable nature. After soaking in dilute hydrochloric acid, they can be sectioned and examined, the coating, sometimes peeling off like a shell, is occasionally perforated like a sieve, or it may gradually dissolve away. Having removed the coating, we find in Halimeda, a series of unicellular filaments which are constricted at intervals. At these constrictions, the cells branch out laterally, something like a fan, and the final ramifications of adjacent filaments, approximating each other, form the surface on which the carbonate of lime is deposited. Besides these constrictions in each filament, the whole mass is also constricted at intervals, making a necklace in which the joints grow gradually smaller. The different forms of these articulations mark the species. In the Wright collection were *Halimeda opuntia*, a tropical cosmopolitan, named from this resemblance to a prickly pear, and *H. tridens* (Fig. 52, magnified 300 diameters), in which the upper edge of each joint is three-toothed.

Fig. 54.



Neomeris dumetosa, 250 diam.

Fig. 55.



Codium tomentosum, 200 diam.

The Udoteæ look like green fans with a short handle. The type

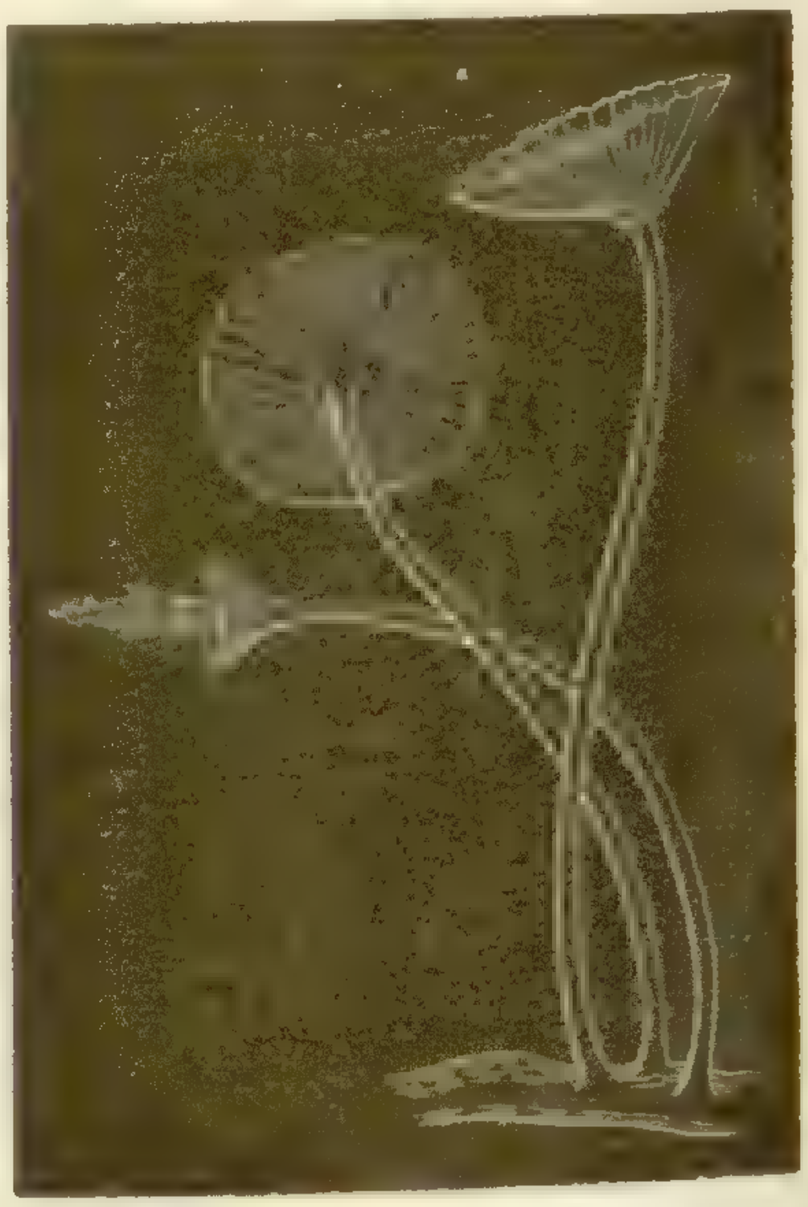
of the genus is *U. flabellata* (Fig. 53, ½ natural size), where the stem is formed of filaments surrounded by a calcareous coating. but, as soon as these filaments reach the expanded part of the frond, they divide indefinitely into root-like branches, the ends of which are placed, as in Halimeda, to form the surface. It is the misfortune of the genus Udotea. that very few of the species conform to the type, and it is to be feared that plants, having an external, but not a microscopic, resemblance, have been huddled together into this very convenient, but not well defined genus. *U. conglutinata* seems to me nearly related to Penicillus of an-

Fig. 57.



Penicillus capitatus, 2-3 nat. size.

Fig. 56.



Acetabularia crenulata, nat. size.

other order. Amongst Mr. Wright's plants was what appears to me a new species, nearly related to *U. flabellata*, but having a much longer stipe, and the filaments in the stipe branching as well at the upper part.

The genus Codium strongly resembles a single joint of a Halimeda, except that it has no calcareous covering, but is of about the same texture as the sponge. It consists of unicellular filaments forming an intricate mass, from the side of which filaments grow large, obovate cells, which, lying side by side, form the surface of the frond. From the sides of these cells, in some species, smaller cells are evolved and in them the sporangium * and after-

*Spore-case, with spores produced in the centre.

wards the zoöspores,* are formed. The only species brought by Mr. Wright was *C. tomentosum* (Fig. 55, magnified 200 diameters), which is found almost everywhere, in the tropics and temperate zones except on our own coast. It is common in Europe and California, but, on our Atlantic coast, it has not been found north of Key West.

Fig. 58.



Penicillus Phœnix, nat. size.

The two orders, Dasycladeæ and Valoniaceæ, are sometimes regarded as forming a part of the Siphonaceæ. Harvey considers them independent orders. The Dasycladeæ (Fig. 48, structure of a plant of this group) comprise plants of a single axial cell surrounded at intervals by whorls of branching cells. It is a small order, represented in the Wright collection by only three species, *Dasycladus clavæformis*, *Neomeris dumetosa*, *Acetabularia crenulata*. The first named looks remarkably like a small sized, dried up, birch catkin, devoid of all interest. It consists of a large central cell, from the sides of which whorls of cells are given off, dividing trichotomously and bearing spores in the axils. The two last species are calcareous. *Neomeris dumetosa* (Fig. 54, magnified 200 diameters) as far as external appearance is concerned, is insignificant enough, being generally not more than an inch long, of a bluish green color and a granulated surface. Viewed with a low power, as half an inch objective, it is extremely beautiful. The central cell is surrounded by rings, from which the secondary cells are given off with a remarkable uniformity. These after a while divide, and each division bears a large, obovate sporangium with a double outline, filled with the most beautiful zoöspores. Enveloping the whole is a membrane composed of hexagonal cells, on which is the calcareous deposit.

Fig. 59.



Anadyomena flabellata, 10 diam.

* Locomotive spores (or seeds) of the algæ.

If the two species just mentioned were insignificant at first sight. the Acetabularia (Fig. 56, *A. crenulata*, natural size) cannot fail to delight any one. It seems as though it were a most delicate parasol made for some of the smaller crustaceans, or like a minute toadstool, except that its color and texture are much too delicate. It has a stem composed of filaments surrounded by a calcareous coating, at the extremity of which is a disk formed of radiating cells filled with zoöspores. Our species is exactly like *Acetabularia Mediterranea*, except that the edge is always crenate. There is a third species in Australia. in which the radiating cells form a shallow cup instead of a disk. In Polyphysa the cells do not coalesce at all. At some seasons of the year, tufts of green filaments grow from the summit of the stem. These are never seen in herbarium specimens.

The Valoniaceæ (Fig. 49, structure of a plant of the group). the last order which we shall mention, although regarded by some as only a sub-order of Siphonaceæ, bears, perhaps. an equally strong resemblance to Confervaceæ. only the cells are swollen and short, rather than narrow and rectangular. Some genera are calcareous. while others are filamentous or membranaceous. In this order, Harvey places the Penicilli, or salt water shaving brushes. which, were they not quite so calcareous, would answer their supposed purpose very well. Their microscopic structure seems to me to place them next to Udotea, that is, if *U. conglutinata* properly belongs to the latter genus. The present genus is not in the least related to the genus Penicillium. to which the yeast plant belongs, as might be supposed from the resemblance of the names. The latter genus belongs to the Fungi. not to the Algæ. Wright's two species were *P. capitatus* (Fig. 57, $\frac{2}{3}$ natural size) and *P. Phœnix*. The former would make a capital shaving brush. The stem is hard and solid. and three or four inches long. The separate filaments then diverge. and each receives a calcareous coating. The spores are probably borne in the root-like processes given off laterally from the filaments in the stipe. *P. Phœnix* (Fig. 58, natural size) is very much smaller, and the terminal filaments are united in threes, so that the plant looks very much like one of those remarkable trees found in the toy villages with which children exercise their imaginations.

Anadyomena flabellata (Fig. 59, magnified 10 diameters). of this order, appears membranous like a small Ulva. but it is.

in reality, only a net-work of cells. The frond begins with a single oblong cell terminating in from five to seven similar but smaller cells which in turn divide in like manner. In this way, a fan-like frond is formed. When moistened, the cells swell up and appear to be connected, but, on drying, the adjacent cell-walls separate leaving a net-work. In Mr. Wright's collection were specimens of the very curious *Blodgettia confervoides*, which Harvey at first supposed was a Cladophora, and which is now temporarily placed amongst the Valoniaceæ awaiting further developments. *Dictyosphæria fasciculosa*, found in all tropical seas, and *Valonia aegagrophila*, looking like a Cladophora which has been living too highly and become bloated, complete our list of Cuban **Chlorosperms.**

THE LESSER APPLE LEAF-FOLDER.

BY WM. LEBARON, M.D.

In the course of my investigations respecting the noxious insects of the State of Illinois, during the summer of 1870, my attention was attracted to a small, and so far as I can learn, undescribed species of moth, belonging to the genus Tortrix, the larva of which is extremely destructive to young nursery apple trees. It may be called the Lesser Apple Leaf-folder. (*Tortrix malicorana*, mihi. First Annual Report upon the noxious insects of Illinois, page 16. *)

Most of my observations upon this insect were made during a visit to the fruit farm of Mr. B. D. Wier, of Lacon, in the northern central part of the State, on the 22d of July, 1870. At

*Having occasion to refer to this report, I will take this opportunity to state, in reply to a suggestion of the Editors of the NATURALIST, that this report, being the writer's first annual Report as State Entomologist of Illinois, was published at Springfield, in accordance with a provision of the law of the State, under date of Dec. 15th, 1870. The whole edition, numbering five thousand copies, was destroyed by the burning, on the 23d of February, 1871, of the Public Bindery in which these reports and other State documents were deposited, for the purpose of being put in convenient form for distribution. As no action has been taken, up to the present time, by the General Assembly, upon the subject of reprinting the lost documents, it is not probable that it will be done. In this event, such parts of the report as are deemed most worthy of preservation will be incorporated in the author's next annual Report.

some distance from the place, my attention was arrested by the blasted appearance of his apple nursery, the foliage looking, at a distance, as if it had been scorched by fire. Upon entering the inclosure, the authors of the mischief were readily detected. Upon putting apart the two halves of the folded leaves, a little worm could occasionally be seen, but at this date, most of them had passed into the pupa state, and many of the moths had already emerged, so that a flock of them could be put to flight almost anywhere, by brushing against the plants. Mr. Wier says that, little known as this insect seems to be, this is not the first year that it has injured his nursery, and that other nurseries in his neighborhood have been equally infested.

This little insect furnishes a remarkable example of the sudden appearance and rapid multiplication of noxious species. The moth is so rare that I cannot learn that it has ever before been seen, even by entomologists. There is not a specimen of it in the collection of either Mr. Walsh or Mr. Riley; and Mr. Glover of Washington, who is himself an experienced lepidopterist, and is familiar with most of the eastern collections, and to whom I had an opportunity of showing my specimens, said he had never seen it, and remarked that the species is so conspicuous, notwithstanding its small size, on account of its bright orange color, that he felt confident that he would recollect it if he had ever seen it; and since then I have received a letter from Mr. Glover, in which he says that he has recently had occasion to examine several of the large collections of insects in Philadelphia and Boston, and that he could find no specimen of this moth. And yet this summer, in a single nursery of young apple trees, specimens enough could have been captured, in a short time, to supply all the cabinets in the world.

The larva of this moth is a small greenish naked caterpillar with a pale amber-brown head and pale incisions. In some individuals the whole body is of a pale brownish tint. These caterpillars occupy the upper side of the leaves, usually singly, but sometimes two or three in company, eating off the upper cuticle and curling the sides upwards till the edges nearly or quite meet, and tying them together with a web. In this inclosure the little caterpillar goes through its transformations. It lines the opposite sides of the leaf, where the pupa lies, with fine white silk.

The pupa is three-tenths of an inch long or a little less, termi-

nating anteriorly in a little knob, and posteriorly in a pair of hooks bent downwards, by means of which it works itself half way out of the closed edges of the leaf before the moth emerges. There is also a series of minute spines on the edge of some of the segments which assist in this operation.

The moth is three tenths of an inch long, the average expanse of wings being half an inch. Antennæ brown annulated with whitish on each joint, most distinctly on the under side; first joint densely clothed with orange scales. Palpi orange, horizontal; the scales project around and beyond the end of the penultimate joint so as to form a little cup in which the small ultimate joint is inserted. Tegulæ more than half the length of the thorax. Head, thorax and fore wings bright orange. The orange scales which cover the wings are observed, when seen under a lens, to be mixed with numerous whitish, almost silvery scales so arranged as to form about ten indistinct, transverse, sinuous or wavy lines. Hind wings, abdomen and legs whitish, with a silken lustre. There is a little plume of divergent scales at the end of the abdomen.

There are at least two broods of this insect in a season. The first brood of moths make their appearance early enough to deposit their eggs in the folds of the young leaves as soon as they begin to open. Another brood was just emerging, as I have above stated, in the third week of July. This brood, as Mr. Wier afterwards informed me, by letter, began at once to deposit its eggs upon those leaves which had escaped the ravages of the first brood of larvæ.

According to my own observation, the caterpillars of the earlier brood draw the edges of the leaf upwards by means of their web, till they meet, thus forming a roof over the insect which protects it from the weather, and must also in a great measure serve to conceal it from birds and other enemies. It must also form a serious barrier to the effective use of any destructive applications on our own part. But Mr. Wier informs me that the young of the last brood, hatching as they do, on the surface of the mature and rigid leaf, do not draw its edges together, but simply protect themselves by constructing a web over the surface of the leaf. In what form they pass the winter has not been determined. Mr. Wier affirms that he has seen the worms on the leaves so late in the fall that they were actually frozen to death.

From the above account it is evident that this insect resembles,

in most of its habits, the larger Tortrix (*Lozotœnia rosaceana*) of the apple and the rose.

If this insect should spread so as to infest other nurseries, as it has that of Mr. Wier, and others in that section of country, it would prove itself a pest of the most serious character; and, as far as we can judge from present appearances, it will be a difficult matter to reach them with destructive agencies, both on account of the closure of the leaf in which they dwell, and their webby covering. Fortunately, as is the case with most other double-brooded insects, the first brood is comparatively limited in numbers; and Mr. Wier thinks that it would have paid him well to have gone through his nursery, early in the season, and picked off the folded leaves.

The importance of combating evils in their incipient stages can find no more apt illustrations than in the department of economic entomology. Many noxious insects can be substantially eradicated in their infancy, which, if permitted to attain a larger growth and a wider range, are wholly beyond our control. This is emphatically the case with the present species. It is evident that whatever applications we may make use of here, must be made before the young insects have time to close the leaf above them, in the case of the first brood, and before they have covered themselves with a web, in the second. These periods will probably be found to be about the first week of May and the first week of August. But the time will vary somewhat with the character of the season, and must be determined by actual inspection. These little worms are so tender, and so unprotected by any hairy covering, that I should expect them to be easily destroyed by any of the ordinary applications, such as lime, ashes or soapsuds, provided we can find a time when the substance applied will really reach them. Mr. Wier informed me that he discovered a bug with many bright stripes, preying upon these caterpillars, which, from his description, I suppose to be the *Harpactor cinctus*, a well-known predaceous insect of the Hemipterous order. But this tribe of predaceous insects is not usually sufficiently numerous to check the increase of such a locally abundant species as the *Tortrix malivorana*.

JUNE RAMBLES IN THE ROCKY MOUNTAINS.

BY E. L. GREENE.

In the latitude of central Colorado, there is not a more charming season for botanizing among the lower mountains, than the first of June. The snow-drifts which lingered so long in many places have now entirely disappeared; and the few impatient flowers that came out in defiance of April's frosts and chilly winds, have given place to an almost innumerable host of others. The pines and spruces are sending out their fragrant shoots with tender foliage, and a number of most beautiful deciduous shrubs are in their perfection of flower and leaf. In passing among the foot-hills, toward the mountains, one cannot fail to notice the abundance of Leguminous plants. Our flora is peculiarly rich in them. The *Oxytropis Lamberti* is one of the most showy, and is also exceedingly variable in size, as well as in the color of the flowers. On the high plains of the Platte, the scapes are only a few inches high, and the corollas of the richest purple. We meet it again, at the base of the mountains, a foot high, bearing yellowish white blossoms. These varieties appear so remarkably different, that we might well regard them as distinct species, but that among the higher mountains we find many intermediate forms. The closely allied genus Astragalus is represented by not less than ten or twelve species. None of these call to mind the common eastern one (*A. Canadensis*) with its tall stem and homely greenish blossoms, but most of them are low-stemmed, with flowers large, and more or less gaily colored. *A. caryocarpus*, a very common plant, has white and purple flowers, which are succeeded by large round pods. These, lying upon the ground under the intense rays of the summer sun, assume a fine purple tinge, which gives them the appearance of grapes or plums, hence the plant is commonly called Ground Plum. *A. Missouriensis* and *A. Parryi* are beautiful plants: the former, with deep purple, and the latter, with white flowers. The legumes of both species are thick and fleshy, and lying on the ground, are curved upwards. Other fine Astragali ought to be mentioned here, as well as plants of other genera, but we must hasten to the mountains.

We desire the reader, whether he be a botanist, or a lover of scenery, to accompany us for a few miles up the cañon of Clear Creek; assuring him at the outset that if he has any due appreciation of any of these things he will not regret, in after days, a few hours' toil among the picturesque wilds of this grand gateway to the higher mountains.

Following the stream for the distance of half a mile above Golden City, we quite suddenly find ourselves shut in on either side by a rocky wall of prodigious height, and either so nearly perpendicular, that to ascend would be impossible, at least in many places. In most hilly and mountainous countries, rivers have their valleys. Not so here; for since the mountains are almost solid masses of rock, the waters, during the lapse of ages, have worn out for themselves, narrow and deep gorges or cañons instead of broad valleys.

On the north side of the stream, there is left sufficient space for a narrow wagon road, and along this sort of terrace we pursue our way. At this season of the year, swollen by the rapid melting of snow in the higher altitudes, Clear Creek is a torrent; and as it comes boiling down over the rocks and forcing its passage through narrow defiles, it seems to jar the foundations of the very mountains. The constant roar drowns all the voices of the hundreds of song-birds that occupy the trees and shrubs which grow among the rocks, and would be tiresome indeed, did we not forget our ears, while admiring with our eyes the manifold beauties of the scenery around and above us.

But at length we issue forth upon a broader pathway, and the mountain sides become less precipitous. We may now begin the work of filling our portfolios. In the more open situations, there grows among the rocks, a fine liliaceous plant, with a large, whitish, tulip-like flower, and narrow, grassy leaves. It is the *Lencocrinum montanum*. Three or four very ornamental shrubs, all with snow-white blossoms, are conspicuous along the water's edge, and under the shade of overhanging cliffs; a raspberry (*Rubus deliciosus*) with smooth stems and entire, roundish leaves, with solitary flowers as large as wild roses; a dwarf, and profusely flowering variety of *Spiræa opulifolia;* and more beautiful than either, the *Jamesia Americana*.

From almost every crevice in the rocks, *Campanula rotundifolia* hangs forth, on thread-like stems, her toneless bells of deepest

blue, and with this grows a very pretty yellow flowered Senecio which we cannot now name with certainty. We notice several kinds of wild currants among the more common shrubs. The one known in cultivation, as the Flowering Currant (*Ribes aureum*) and justly esteemed for its showy and fragrant yellow blossoms, is the only one in flower now, the others being earlier.

We have now come to a rude wooden bridge, apparently constructed some time ago, for the accommodation of some company of gold seekers; for, on the other side, are various indications that mining was once undertaken there, but with short-lived success. The mountains on either side are now gradually drawing very close to the creek, and it is evident that we cannot proceed longer up the stream, for want of a path. We cross the bridge. A deep ravine, shaded by tall spruces, and filled with a variety of underbrush, leads up the mountain at the left. We follow this ravine in the hope of finding yet other novelties. Having climbed up for some distance, over the lichen-clad rocks, and having scratched our hands to a painful extent, among wild gooseberry bushes, we reach at last a kind of broad terrace, where we find a delightful spring of water, whence a clear and laughing streamlet runs musically down to join the noisy flood below. Strawberry plants, and pale Canada violets are blooming abundantly along the streamlet, and among the bushes is a handsome composite with large yellow flowers on stems a foot high, the leaves clothed with soft woolly hairs. This proves to be *Arnica cordifolia*. But what is this little gem of a plant, growing all over the wet, mossy surfaces of the shelving rocks? The delicate stems are only two or three inches high, each supporting three or four pendulous flowers of a deep purple. A nearer view shows the flowers to be those of the shooting star (*Dodecatheon Meadia*). But how very different the whole plant seems from the specimens one sees on the borders of woods, east of the Mississippi, where they grow tenfold larger, and have white or rose-colored flowers. However, the proper authorities have pronounced the Rocky Mountain plant to be only a variety of the original *Dodecatheon Meadia*. Following the ravine, we gather, as we ascend, *Clematis alpina*, *Antennaria Carpathica*, and three specimens of the very rare and interesting *Ranunculus Nuttallii*.

In the midst of all this wildness of scenery, in an almost inaccessible solitude, where it might well be supposed no human

foot, not even of an Indian, had ever trod before us, we are surprised all at once to meet with a veritable log cabin. It stands under the spreading branches of a giant fir-tree, and covers an area just about large enough to furnish lodging room for two persons. From the earth floor to the flat roof of hewn timbers, the height is not more than six feet. A large fireplace has been dug in the bank immediately in front of the broad doorway. Such were doubtless the winter quarters of some hermit hunter and trapper.

Finally, we reach the comparative level of the mountain top, and find ourselves at once in a pleasant grove of stately pines. Several hours have passed since we left the bridge, and now we can only hear a soft deep breezy murmur from the torrent far below. The number of flowers has gradually diminished from the gay profusion of the lower part of the cañon, until on this cool and airy height, we find but a single species. It is *Erigeron compositum*, a pretty little alpine composite, with white, daisy-like flowers. We have not met it before, though here it is abundant.

But the day is fast declining, and we must seek refuge from the chill dews of approaching night. The monotonous din of a cow-bell assures us that we are not far from the haunts of men, so we may yet take a little time to admire the scenery of this new place. Passing from the pine woods we enter upon the most beautiful of pasture lands, where a numerous herd are grazing and slowly wending their way along what seems their homeward path. Little groves of birch and aspen scattered here and there, are rejoicing in their young and tender foliage, while amid their branches, a harmonious choir of robins warble their vespers.

But how shall pencil trace, or pen describe the glory of this sunset? A line of snowy peaks, canopied by clouds of purple tinged with gold, extends along the western sky, while southward, all seems an undulating sea of rich dark forest. The plains below are already darkening in the shadows of the mountains. To them the sun is set, and we must hasten to the nearest "ranch" and secure lodgings for the night.

ADDITIONAL NOTES ON THE STRIPED SQUASH BEETLE.

BY HENRY SHIMER, M.D.

During the past ten or twelve years I have continued every summer to make observations on the habits of the Striped Squash beetle, or Cucumber beetle (*Diabrothica vittata* Fabr.). Since I discovered and published the account of the breeding place of these insects, in the roots, chiefly, of squash, cucumber, melon and similar plants, I have looked long and closely for some natural enemy of the insect. Almost all insects are liable to be preyed upon by some kind of parasite, which is most efficient in checking their undue multiplication, and far more useful in restraining them than anything that man is capable of doing.

But what insect preys on the Striped Squash beetle it appeared difficult to discover. The young appears quite safe from such enemies, living as it does either on or in the roots of the vines, and, I presume, is almost free from such annoyances. The eggs are deposited on the root at the surface of the ground, or on the root just below the upper loose particles of earth, for although the perfect beetle does not burrow into the compact ground, yet it often is found down along the stem or root, just below the surface, under the loose, dry clots or finer particles of earth which are not pressed closely, or beaten down by rains and hardened in drying, "baked," as farmers say. In this situation the egg, before it is hatched, may be, and doubtless is, sometimes preyed upon by predaceous, ground beetles, but by what insects and to what extent I have no means of knowing from actual observation.

Fig. 60.



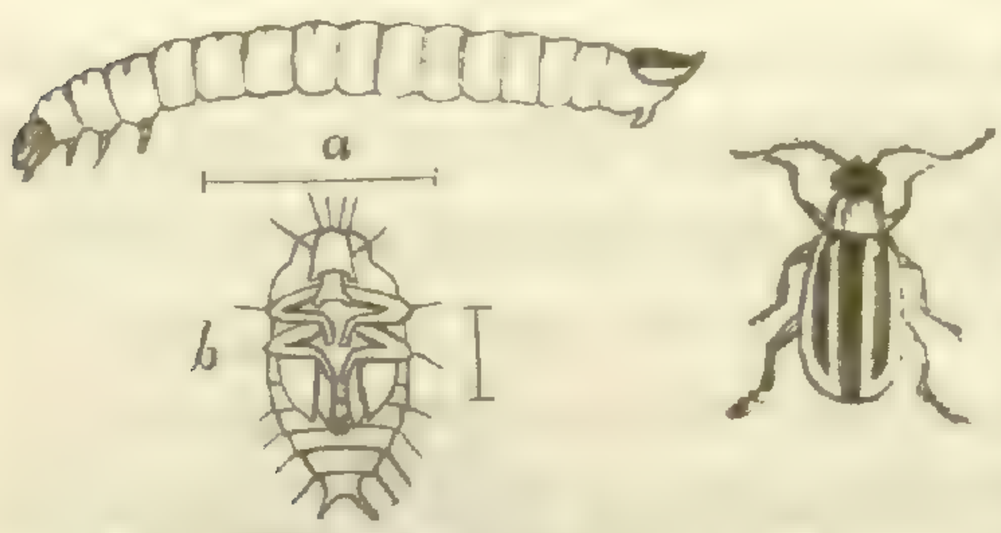
Parasite of the Squash Beetle.

Last May and June we were annoyed by an unusual number of Striped Squash beetles that had developed from the larvæ that entered the ground the previous autumn. As the season was uncommonly dry, we expected, judging from past experience, that

in spite of the best directed preventative efforts, we should have the roots of these vines greatly injured by the larvæ. I looked frequently but found scarcely any larvæ on the roots. The proper time to look for the first young larvæ is when the vine is about beginning to run out over the ground. If the root is and has been free from them, it will be smooth and white, but if affected, its surface, and the surface of the lower part of the stem beneath the ground will appear rough and rust colored. We might speak of all that part of the plant beneath the surface of the ground as root without much impropriety, for in due time it assumes a true root structure, but at this early age the true root is only found below where the seed lies, and above this point it is stem.

I was greatly surprised at finding no larvæ, inasmuch as the perfect insects were swarming among the squash and other vines, now so largely grown as not to require close precautions against the perfect insects, on account of what they might eat themselves. A few of these beetles will soon ruin the plants by their own feeding when the seed leaves alone are developed, but after the third or fourth set of true leaves appear, the growth is so rapid that many beetles may be supplied with food without great damage to the vines. But still at this time the larvæ often do great damage to the plants, and therefore the perfect insects must be kept away if possible (hungry bugs, however, are very hard to manage, and will brave much opposition rather than starve), especially if the plants are scarce, for where the perfect insects abound we usually expect that eggs will be deposited.

Fig. 61.



Striped Squash Beetle, larva and pupa.

But on this particular occasion there was an abundance of vine plants, four or five times as many as were needed for the ground. The prudent gardener who is acquainted with the depredations of these notorious pests, will always plant ten times as many seeds as the plants he needs, so that he will have not only enough for the parent insects that he may not have time or ability to keep away, but also for the larvæ that they will thrust upon his unwilling care. We had then an abundance of good healthy vines, but still it appeared necessary to keep an observing eye upon them lest the larvæ should destroy too many of them, the weather being so dry and

therefore the most favorable for their development. But I could find few or no larvæ, which seemed to me very unusual and remarkable. I searched the ground about the roots long and carefully. I closely and frequently watched for the inexplicable cause of this paucity of larvæ, but all in vain; I could find no enemy about the roots or on the ground that might be destroying the eggs. Thus baffled in my attempts to discover the hidden treasure, I thought of directing my observations to the bodies of the perfect insects themselves. Accordingly, upon dissecting a large, apparently pregnant, female I discovered the secret I so anxiously sought. Instead of a well filled ovary I found a large, dipterous larva filling almost the entire cavity of the abdomen. Others were examined with like results; instead of eggs I found larvæ, one in each female beetle. Some of the larvæ were still small.

On still other beetles I found attached to the surface another species of parasite, drawing its nourishment by penetrating the abdomen. It was apparently some species of mite. I did not find time to study it any further. and have no specimens at command now. I bottled forty or fifty beetles for the purpose of breeding the dipterous larvæ. This was done on the 7th of July, 1870. Twelve days afterwards, that is on the 19th. I was rewarded with five small black flies in my breeding bottle, belonging to the great family *Muscidæ*. genus *Tachina* Fabr., or more correctly according to the later arrangement of flies by Dr. Loew, family Tachinidæ. I sent one of these flies to Dr. Lebaron, state entomologist of Illinois, who locates it in the particular Tachina genus *Melanosphora* Meigen.* The maggot comes out of the body of the fly and forms its brown seed-like pupa on the surface of the ground.

The abdomen of the beetle that has been well eaten out by one of these parasites often appears whitish yellow beneath, instead of black, as do many others.

On the 22d I found other beetles in the field infested with small

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**Tachina* (Melanosphora) *diabroticæ* n. sp. (Fig. 60). Pitch black. Eyes and proboscis light brown. Halteres pale brownish. A crescentric line on each side of the face bordering the eye, almost meeting in the medial line, silvery gray. Anterior portion and sides of the prothorax, in some lights give the same lustrous gray reflections as the face, in others, blackish. Body moderately clothed with stiff black spines. Wings hyaline iridescent, with a smoky yellowish shade towards the base. Expanse of wings, .24 of an inch; width of wing .06 of an inch; length of body .13,—.14,—.15 of an inch. from five dry specimens.

red mites attached to the posterior extremity, not very unlike those often seen about the roots of the wings of grasshoppers, except that these were smaller. These also interfere greatly with the reproduction of the species. I am not aware of any other instance where a perfect Coleopterous insect is so infested with Tachina parasites. A much larger species has been bred from maggots found in the larva of the Colorado potato bug.

ANIMAL LIFE IN THE ROCKY MOUNTAINS OF COLORADO.

BY PROF. W. H. BREWER.

In the summer of 1869, I accompanied the Harvard Mining School Expedition to the Rocky Mountains, under Professor J. D. Whitney, and during the trip, I made some notes that may be worth putting on record, although very imperfect from my ignorance of the specific characters of the animals.

Our explorations were principally in the region about South Park, Colorado, and along the crest extending to beyond the head waters of the Arkansas, and north to Gray's Peak. The altitude of those parts of South Park where we spent most time is from 9,600 to 9,900 feet. I was on the following peaks in fine weather, and on some of them more than once.

Gray's Peak, 14,145 feet; Irwin's Peak, about the same height; Mt. Lincoln, 14,123 feet; Horse Shoe, 13,806 feet; Silverheels, 13,650 feet; Mount Yale, 14,078, besides numerous points over 11,000 feet. (Mt. Harvard, the highest point of the Rocky Mountains, 14,270 feet, was ascended by other members of the party on a very unfavorable day.)

On these peaks, the limit of tree vegetation, as had been already shown by Dr. Parry, is a little over 11,000 feet, and on all the peaks named, there were considerable masses of snow at the time of our visit, which was from the middle of July to the first of September.

In South Park, deer are abundant. Elk were occasionally seen (we saw but three). Mountain sheep are found on the ridges

which extend into the Park, and on all the peaks around, particularly above the limits of tree vegetation their trails were very common, and their traces abundant to the summits of the less known peaks. The streams in the Park abound in trout.

Buffalo are said to have been abundant in South Park, and adjacent mountains previous to 1862; then came the rush of miners, when the buffaloes were speedily exterminated. A few were shot in 1867; one was said to have been shot (near Pike's Peak) in 1868; but we heard of none in 1869. They were frequently described to me as a marked variety known to the hunters as *Mountain* buffalo, and quite unlike the buffalo of the plains, smaller in size, the hair longer, more shaggy, and blacker, with other well-marked differences.* I found their skulls up to 11,000 feet, both in the grassy valleys (called *parks*) and in the forests. All the skulls seen were smaller than those common on the plains.

Grizzly Bears are quite common, and range to above 13,000 feet at this season. Six were seen above this altitude on Gray's Peak and Mt. Yale, and their traces seen in other places. Judging from the few seen, and from skins examined in Denver, they are smaller than those of California, the hair not so long and shaggy, the color more silvery, or truly *grizzled*, than with the Californian animals.

Coleoptera were wonderfully sparse compared with any other region I ever saw, this applying not only to the portions of the mountains visited but also to the plain near the base of the mountains. I always carried a bottle of strong alcohol in my pocket for preserving such as I found but the collection was a ridiculously small one. It is probable, however, that a skilled collector would have been more successful. But few were collected feeding upon herbage, the most being scavenger beetles, found by examining the dung or dead bodies of animals. Some of these latter were found at an altitude of more than 13,000 feet, but they were few.

On the high Sierras of California certain herbivorous beetles are found abundantly; on the summits of similarly high peaks in Colorado they were looked for, but not one was found.

Lepidoptera were very abundant above the forest line, particularly on sunny slopes at 12,000 or 13,000 feet, and where there was an abundant alpine vegetation. In such localities they were vastly more numerous than I ever saw them in similar situations

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* See Mr Hayes' remarks on this subject on p. 118.—EDS.

in the high Sierra Nevada. The kinds most abundant in individuals were specifically (and, I think, even generically) distinct from the more abundant butterflies of the High Sierras. They ranged up to the highest points visited, but were most abundant both in species and individuals above the forest line, but below the exposed rocky summits, flying near the ground, very agile, alighting often, and after short low flights, and concealing themselves in the low herbage, their concealment being more easily effected, as well as more effectual, from the brilliancy of the alpine flowers, which constitute a marked feature of these heights.

Crickets are very abundant, several species are found at 12,000 to 13,000 feet, and in favorable localities the number of individuals is very large; some are very brightly colored.

The most striking feature of insect life, however, there, is the number of grasshoppers. They are numerous at all altitudes visited, and to me appeared to embrace a number of species, of which at least two ranged to the highest points. They fly much more than our eastern species, both as regards the length and height of their flight, and on warm days they fill the air, even to the highest summits. If they chance to alight or fall on the snow, they soon become chilled, and perish there in numbers that challenge belief until seen. It is no exaggeration to say that *tons* of them may be seen. When large snowbanks melt in the summer, the number of dead grasshoppers left on the rocks is so large, that the stench caused by their decay often pollutes the air for a great distance. At altitudes of about thirteen thousand feet, the conditions are most favorable for this to take place, and we saw frequent examples. Mr. Bowles speaks several times of the abundance of grasshopper life. I quote but one passage:—

"The only life was grasshoppers,—here they were still, by thousands, by millions, sporting in the air and frisking over the snow. but the latter's chill seemed soon to overcome their life, for they lay dead in countless numbers on its white surface. In some places the dead grasshoppers could have been shovelled up by the bushels, and down at the edges of the snow, cold grasshopper soup was to be had *ad libitum*. There was a feast here for the bears, but we could see none enjoying it." (Parks and Mountains of Colorado, p. 93.)

The day (August 4th) I was upon Mount Lincoln (14,123 feet) was very clear during the three and a half hours we were on the summit. It is well known that by shading the actual disk of

the sun, and looking into the atmosphere very near it, solid particles in the air can be seen most plainly, and doing this at that place, the air seemed filled with grasshoppers in flight, myriads of them, extending high enough to appear as the finest specks, even with a field-glass. They certainly ranged some hundreds of feet above that summit in immense numbers. An occasional butterfly was seen also on the summit, but they were few.

Several species of flies are peculiarly abundant at 8,000 to 12,000 feet, which at times nearly set our animals frantic, but the most voracious kinds were troublesome only when the sun shone —even a passing cloud would drive them out of sight.

REVIEWS.

THE GENESIS OF SPECIES.*—Among the works called out by Darwin's epoch-making work, as the Germans happily style it, the present volume stands preëminent. It is a series of criticisms by a thorough evolutionist, and one who was originally a Darwinian. It will interest the general reader, the style being clear and attractive, and the spirit of the author thoroughly candid and calm. The author is well known in scientific circles by his original papers on the anatomy of certain of the vertebrates.

The object of the book is "to maintain the position that 'Natural Selection' acts, and indeed must act, but that still, in order that we may be able to account for the production of known kinds of animals and plants, it requires to be supplemented by the action of some other natural law or laws as yet undiscovered." Farther on he says "The view here advocated, on the other hand, regards the whole organic world as arising and going forward in one harmonious development similar to that which displays itself in the growth and action of each separate individual organism."

He thus sums up the difficulties against Darwinism, or the doctrine of "survival of the fittest" maintaining:—

* On the Genesis of Species. By St. George Mivart, F.R.S. London. Macmillan & Co. 1871. 12mo, pp. 296. With numerous wood cuts. $2.00

"That 'Natural Selection' is incompetent to account for the incipient stages of useful structures.

"That it does not harmonize with the co-existence of closely similar structures of diverse origin.

"That there are grounds for thinking that specific differences may be developed suddenly instead of gradually.

"That the opinion that species have definite though very different limits to their variability is still tenable.

"That certain fossil transitional forms are absent which might have been expected to be present.

"That some facts of geographical distribution supplement other difficulties.

"That the objection drawn from the physiological difference between 'species' and 'races' still exists unrefuted.

"That there are many remarkable phenomena in organic forms upon which 'Natural Selection' throws no light whatever, but the explanations of which, if they could be attained, might throw light upon specific origination.

"Besides these objections to the sufficiency of 'Natural Selection' others may be brought against the hypothesis of 'Pangenesis,' which, 'professing as it does to explain great difficulties seems to do so by presenting others not less great — almost to be the explanation of *obscurum per obscurius*."

These theses are the subjects of successive chapters in which they are maintained and defended with much acumen, and with many references to facts, easily comprehended by the general reader, but on which we have not room to dwell. In Chapter IV. on "Minute and Gradual Modifications," he refers to the conception of Mr. Galton in his work on "Hereditary Genius" that "new species have from time to time manifested themselves with suddenness, and by modifications appearing at once (as great in degree as are those which separate *Hipparion* from *Equus*) the species remaining stable in the intervals of such modifications: by stable being meant that their variations only extend for a certain degree in various directions, like oscillations in a stable equilibrium."*

Mr. Mivart gives among other examples of this sudden variation, the cases of young oysters, "which were taken from the shores of England and placed in the Mediterranean, and at once altered their mode of growth and formed prominent diverging rays, *like those of the proper Mediterranean oyster*; as also the twenty-nine kinds of American trees, all differing from their nearest

* Similar views were previously entertained by Messrs. Cope and Hyatt, as will be seen farther on.

European allies *similarly* — "leaves less toothed, buds and seeds smaller, fewer branchlets, etc."

In his sixth chapter on "Species and Time" he maintains with much reason that "the mass of palæontological evidence is indeed overwhelmingly against minute and gradual modification," and that there is "no evidence of past existence of minutely intermediate forms when such might be expected *a priori*." "All the most marked groups, bats, pterodactyls, chelonians, ichthyosauria, anura, etc., appear at once upon the scene. Even the horse, the animal whose pedigree has been probably best preserved, affords no conclusive evidence of specific origin by infinitesimal, fortuitous variations; while some forms, as the labyrinthodonts and trilobites, which seemed to exhibit gradual change, are shown by further investigations to do nothing of the sort." "Now all these difficulties [of time, and the absence or rarity of fossils in the oldest rocks, etc., etc.,] are avoided if we admit that new forms of animal life of all degrees of complexity appear from time to time with comparative suddenness, being evolved according to laws, in part depending on surrounding conditions, in part internal — similar to the way in which crystals (and, perhaps from recent researches, the lowest forms of life) build themselves up according to the internal laws of their component substance, and in harmony and correspondence with all environing influences and conditions." The latter clause is unnecessarily vague, substitute embryological laws, or changes (for the differences between species, and especially genera, arise in all probability for the most part during the growth of the embryo), and we would agree with the author's meaning.

This is as far as the treatise goes, the author's aim being simply to show that "species have been evolved by ordinary *natural laws* (for the most part unknown) controlled by the *subordinate* action of 'Natural Selection,'" acting with the Divine concurrence.

What are these natural laws? The author has evidently overlooked the writings of certain naturalists in this country, who have endeavored to show that Natural Selection is insufficient to account for the origin of generic and specific forms. Professor E. D. Cope in his "Origin of Genera"* has attempted to show, and we think with much success, that genera are produced by the ac-

* Proceedings of the Academy of Natural Science, Philadelphia, 1868.

celeration and retardation of certain parts of the animal, during its growth, and Professor Hyatt previously* showed that the development of the individual Cephalopod is an epitome of the development of the cephalopods generally, and that the successive forms were produced with comparative suddenness.

Previous to the appearance of Mivart's work in this country the reviewer, in the present journal (vol. iv, p. 755), while remarking on the ancestry of the King Crab, Trilobites and other Branchiopoda, accounted for their origin rather by a process of acceleration and retardation, involving a more or less sudden formation of generic forms, than by the theory of Natural Selection, and offered several of the objections against Darwinism which appear in the work under review. The former law, probably in active operation during the earlier portion of embryonic life, accounts for the origin of the differences, while Mr. Darwin simply assumes an inherent tendency to variation. Cope's law may account for the *origin* of the new forms, while Natural Selection apparently plays an entirely subordinate role, and even may be found to account merely for the *preservation* (as suggested by the Duke of Argyll) of the specific form, keeping it within limits by the survival of the fittest, and the lopping off of monstrosities and by the checking of all tendencies to variation in a useless direction.

MEDICAL MICROSCOPY.† — Dr. Richardson's book is an experiment in an absolutely unoccupied field. Other works of somewhat similar nature are books for microscopists who are physicians; this is a book for physicians who are not microscopists. Meagre in its account of apparatus and inaccurate in its scholarship as it must be confessed to be, it is an earnest, straightforward and successful attempt to enable the practicing physician to make the microscope useful in his daily work. Some who use it for this purpose will be disappointed, for successful microscopical work requires a delicate tact and a mechanical ingenuity which are possessed by very few persons, and which are wanting to many even among physicians. Good microscopists, too, are developed, not made;

*** Parallelism between the order and individual in the Tetrabranchiate Cephalopods. Memoirs of the Boston Society of Natural History, 1866, and AMERICAN NATURALIST. Vol. IV, pp. 230 and 419.**

† A Hand-Book of Medical Microscopy. By Joseph G. Richardson, M. D., Microscopist to the Pennsylvania Hospital. 12mo, pp. 333. Philadelphia: J. B. Lippincott & Co., 1871. [This review was prepared for a previous number, but its appearance was accidentally delayed.— EDS.]

and a high success can rarely be attained except by those whose dexterity and skill in effecting mechanical and optical results have been matured by long use before the exigencies of a full medical practice rendered abundant drilling in the work impossible. For these reasons, Medical Microscopy will always remain to some extent a specialty, most conveniently referred to the few physicians more particularly devoted to it. But for the microscopical work which physicians, as such, can do to advantage, for the using of the microscope, like the stethoscope and the test-tube, as an every-day aid to diagnosis, a really available guide book is now for the first time published. For the general reader it is too technical and uninteresting to be compared with other works that are available; to the scientific physician it is a valuable aid.

Students of this book should begin in the middle of it; reading the first part last, if at all. Nothing less than the author's excellent success as a microscopist could save a beginner who had waded through the opening chapters from abandoning the work in confusion and disappointment. The first two chapters are devoted to a description of instruments, apparatus, etc., and it is astonishing that so good a microscopist could be so bad a critic in regard to his own tools. Aside from the tediousness and general confusion prevailing in this part of the work there is much that is liable. unless corrected, to seriously mislead the beginner.

The simple microscope is described as one of a single lens: and the compound microscope, by way of contrast, as one in which lenses are so arranged that each adds to the power of the other. This is precisely what occurs when a doublet or a triple combination is used as a simple microscope, and is radically different from the action of the compound microscope where one lens, or set of lenses, by magnifying the image formed by the other, *multiplies* its power instead of *adding* to it.

Three or four of the microscopes first mentioned are described as furnished with sets of separating objectives like those on cheap European instruments, and these lenses are spoken of with some approval, although it would be more safe to state that to render such instruments really available it is necessary to discard such objectives and furnish at least second-class lenses by some respectable maker. The objectives of Tolles' students' microscopes are very properly called by their honest name, for they are *second-quality* lenses and nothing else, but it should have been intimated

for the information of beginners that the lenses previously mentioned are, by the same accepted standard, far less than second quality. The one-inch lenses furnished lately with Tolles' students' microscopes have been too cheap to be good; but his second-quality one-fourth, one-sixth, etc. (which are most used by physicians), as well as similar powers by Zentmayer, Grunow, etc., are incomparably better than the cheap lenses, often called triplets, mentioned above.

It is stated that the higher objectives are each composed of three pairs of lenses or doublets, properly arranged; although it is understood by microscopists that the posterior combination is often a triplet, and that the anterior pair is often replaced by a triplet or by a single lens.

In regard to the qualities of the objective there is an unfortunate want of clearness and sharpness in the author's use of terms; penetrating power being used sometimes in reference to that resolving power which is the joint result of definition and angular aperture, and sometimes as descriptive of that depth of field to which its use seems to be generally and usefully confined.

But the most astounding assertion in regard to objectives is this, that the lenses of various opticians are almost equally successful up to powers as high as one-eighth inch! If those opticians, whose names are familiar words, have achieved eminence anywhere it has been in the *excellence* of their low and medium powers. Tolles' most remarkable lenses are probably from one-fourth to one-eighth inch focus; and Wales' four-tenths (one-fourths?) and one-fifths are nearly equally famous powers. Ross's lenses, of which none are of very high power, have enjoyed a conceded preëminence; Smith and Beck's four-tenths has been classical for years, while their high power, one-twentieth, has been of very moderate use; and Powell and Lealand's one-eighth and one-sixteenth have doubtless contributed more renown than their one-twenty-fifth and one-fiftieth. And it is probably safe to predict, as the opinion of most microscopists, that the progress of the near future belongs to those opticians who shall use the most extraordinary skill in perfecting and utilizing lenses of moderate focal length.

The subject of test-objects is treated at some length for the avowed benefit of such students as might find it difficult to secure the assistance of an expert in selecting their lenses. Doubtless it would have been safer to advise the student in such cases to

trust entirely to the honesty of a responsible dealer or to the respectability of the maker of the lenses required. The "testing" of first-class lenses, by a person unfamiliar with their use, is simply a delusion.

The binocular microscope certainly merits more than the half page of careless notice given to it. Although its chief use, as yet, is in other departments of study, yet its real value to the physician is not even hinted by the passage referred to. Wenham's binocular, the one in actual use, is almost indispensable in studying opaque injections, vegetable and animal parasites, etc. At the Troy meeting of the American Association last August, the writer showed specimens of animal and vegetable tissues (such as transparent injections, etc.) under this arrangement with good definition, an even light over both fields, and the stereoscopic effect vivid and useful though perhaps somewhat exaggerated, under the ordinary first-class objectives as high as one-fifth inch focus, and up to 120° ang. ap. Probably, however, satisfactory substitutes for Mr. Wenham's arrangement will be in general use for all powers above one-half inch at no distant day.

In giving directions for estimating the magnifying powers, and the amplification of camera-drawings of objects, the author follows respectable authorities into an error of grave practical consequence. To measure the magnified image at the exact distance of the object is plausibly borrowed from the usage of the telescope where the object is at a fixed distance — its apparent size being always its angular extent at that distance, and the image being measured by the object itself, of course at the same distance. But the microscopic object is at no necessary and invariable distance from the eye, and its apparent size, *i. e.*, its angular extent, varies with that distance, and is with no more propriety used as a standard at the distance of the stage, than at any other distance. Would any person measure the image in a simple microscope at the exact distance of the object on the stage? or if, for any purpose, a compound microscope six feet long were constructed, would its image be measured according to the same rule? Or, of two dissimilar microscopes containing similar objects, say Maltwood finders, the stages being concealed so as to be at an unknown distance, would any microscopist hesitate an instant before deciding which instrument magnified the most, such decision depending, of course, on the certainty with which the magnifying power of each could be de-

termined without the least knowledge of the position of its stage? The fact that the apparent size of the object or image is simply a question of angle, and that, if expressed in linear measure, that measure must be taken at a uniform distance for all observations liable to be compared with each other, — in other words, that to use sines and cosines intelligently it is indispensable to assume a uniform radius — would seem to be too simple for argument, were it not that a misunderstanding in regard to it is a common and confusing error. Ten inches having been generally adopted as the standard distance of measurement in microscopy, and being a the same time a most convenient distance, there seems to be no reason for reconsidering the choice; or, for assimilation to the metric system, 250 millimetres might be substituted without any considerable error.

Of the minor errors and inadvertencies in this part of the book, may be mentioned the following: — The use, as a condenser in students' microscopes, of the concave mirror transferred to a separate stand (it may often be mounted on the stage for the same purpose), is mentioned, but without the special commendation which it deserves. It is not stated that Tolles' students' microscope can be obtained with the usual form of fine adjustment which is to be preferred to the "new method" mentioned; nor that "the fine adjustment on the stage" of some of the same instruments, and of those prepared by some other makers at the present day, is so firm as to be reasonably satisfactory, while similarly situated adjustments on a lighter class of instruments are usually so insecure as to be entirely worthless. Following the lead of some of the dealers, the fine-adjustment screw is called a "micrometer screw," an unfortunate phraseology which, to the writer's knowledge, has often proved confusing to students. Powell and Lealand's splendid No. 1 microscope is mentioned as the *ne plus ultra* of instruments, whereas it is only fair to admit that the choice between such instruments as this (including Ross' large stands, etc.) and the best stands of the "Jackson" model, is a fair field for the use of taste and judgment, neither form enjoying a conceded and unqualified superiority. Most eye-pieces are said to be composed of achromatic lenses, a mistake which is liable to mislead beginners. The student is advised, under some circumstances, to increase his power by removing the field-lens of his eye-piece, a worse than questionable procedure; nor is he reminded to blacken the inside of the pasteboard draw-tube

recommended for the same purpose. Wenham's binocular arrangement, notoriously consisting of a single prism, is mentioned as an arrangement of prisms. The use of unground glass slips is mentioned with indifference, though the student should never use them, unless they are to be covered with paper, without rubbing off the cutting edges on a grind-stone or on any wet piece of soft sandstone. As a convenient substitute for the mounted needles whose preparation is directed by the author, crochet needles may be bought of suitable size and style, deprived of their hooked ends and sharpened on an oil-stone or hone; or the form may be purchased in which the needle is removable and easily replaced by a common needle, being clamped into the handle by a screw-movement. Likewise the conical glasses, scratched with a file, for estimating the bulk of sediments, may be replaced by 4 oz. graduated measuring glasses, which, sold by the dealers in druggists' glassware, can often be obtained of exactly the desired shape. "Healthy blood," on page 39, should read healthy human blood. Such objects as the "various species of acari" should not be mounted in the dry way, much less received as typical of a class of specimens peculiarly adapted for such preparation; nor should a book of the present day reproduce from the old authorities the abominable direction to place a dry object upon the slide and protect it by a cover carefully laid upon it and fastened down by gummed paper. Glycerine is, perhaps wisely, recommended to the beginner in mounting wet specimens, although a more difficult medium to manage than Farrant's Gum and Glycerine or Walmsley's Glycerine Jelly.

The use of blue glass (spectacles, etc.) is casually noticed as a means of correcting the yellow glare of artificial light; but the position of the blue glass is not so unimportant a consideration as would reasonably be inferred from the text; in the writer's experience the best results are obtained by a flat piece of glass lying upon the diaphragm or below the achromatic condenser; a curved plate (deep-blue chimney) near the flame, or flat plate in the cone of light over the achromatic condenser, or over the eye-piece, being much less satisfactory: a very pale-blue chimney, just tinted, may be used to take off the glare without whitening the light; and the white, translucent "porcelain" chimneys, recently introduced, may, if quite thin, often be used to advantage. The author, in his enthusiasm for high powers, scarcely urges with sufficient dis-

tinctness that the beginner should confine himself to low powers. not over one-fourth, until great skill has been obtained by long practice. He advises that high-power lenses be sent "to an optician" for cleaning, etc., instead of saying that they should be sent to the maker, or at least to a person accustomed to make the same class of work: imagine a Ross' one-twelfth or a Tolles' one-tenth sent to a local "optician" for repairs! Dr. Beale's directions for adjustment of objectives by measuring the covering glass by the screw-collar movement, are given without an intimation that good performance by lenses made at the present time cannot be obtained in this way. The amplifier is named as a means of increasing power, but without the caution that some of the cheaper kinds sold are not achromatic and are perfectly worthless. Polarized light is mentioned, on authority of an obsolete remark by Dr. Beale, as an expedient of equivocal value; whereas the medical expert finds it of great use in detection of poisons and adulterations, and in some other investigations; and the polarizing apparatus is too carelessly described as consisting of two crystals of Iceland spar. The micro-spectroscope is properly mentioned as a promising means of research, and appreciative mention is made of recent work in photographing microscopic objects. Finally, the list of microscope makers and dealers is rather less than satisfactory.

In regard to the main body of the book, relating to the practical work of the microscope in medicine but little need be said. A single expression of unqualified approval will apply to nearly all of it. With fewer inaccuracies than usually fall to the lot of first editions, such as speaking of ether as "sulphuric ether," mentioning "fibres of flax from — muslin fabric" etc., an excellent and available summary is given of the subjects treated; adequate study being devoted to the literature of the science, and important additions being contributed from the author's experience. The identity of the white blood corpuscles with the similar bodies of mucus, pus, and saliva, more fully and fairly maintained than by any previous authority, is not a theoretical, but a practical question; as students have been for years past perplexed and retarded by their hopeless efforts to distinguish between these bodies, while most microscopists of experience were ready to express themselves unfamiliar with any available distinction. The equally practical questions of the early detection of phthisis, and the detection of blood dises in dried stains, are relieved of much of their former obscurity and

doubt, and the study of morbid growths is exceedingly well simplified and systematized. Cautious microscopists would probably fail to go as far as the author in the recognition of the discs of human blood, as distinguished from those of *some* of the domestic animals, since differences so minute, so subject to variation, and so liable to mismeasurement on account of slight differences of illumination, adjustment of lenses, etc., are justly deemed untrustworthy in cases involving important interests; but, taken with some allowance for the author's enthusiasm, the treatment of the subject is eminently useful as well as novel and interesting.

The almost total absence of engravings is the first feature which attracts attention on opening the book. This, in the chapters which treat of instruments and apparatus, is a sign of maturity, not of poverty. The works of Carpenter and of Beale, first issued at a time when illustrations of stands and accessories were indispensable, very properly retain these illustrations and add to them according to the progress of the times, in order that they may continue to be encyclopædic to all microscopical students of English-speaking countries; but the time has passed, when new works need encumber themselves with such pictures. Stands and lenses and prisms are sufficiently familiar to all except beginners who may well be referred to the elaborate, and often excellent catalogues of the opticians. Beck's catalogue, for instance, studied in connection with two or three others to suggest an idea of the individual differences in the style of different makers, would give a better conception of the various kinds and classes of apparatus than all the illustrations which could reasonably be crowded into a Hand-book of Microscopy. In regard to the latter part of the book, however, the paucity of engravings is an evident fault. The exact appearances of diseased tissues, morbid growths, and abnormal deposits, are not yet completely familiar to the mass of physicians and medical students: if they were, then this book would occupy a crowded, not an open field. In his ambition to reduce the illustrations nearly to a standard of original contributions, the author has strained a point which will probably be yielded in later editions by the introduction of a liberal assortment of wood-cuts, which will relieve the student of the necessity of searching the literature of his profession for exactly the light which this volume is designed to give.

On the whole, the faults of this volume are mostly those of

hasty preparation or of the occupancy of an unfamiliar field — errors which a second edition, sure to be wanted, will easily correct; while its advantages are so manifest that it cannot fail of an extensive usefulness. — R. H. W.

Recent Ornithological Publications. — With the close of the year we have two papers of interest. Dr. H. M. Bannister, whose name is associated with the late explorations in Alaska, offers * "A Sketch of the Classification of the American Anserinæ," which renders our information more precise, if not more extended. Excluding the genera Dendrocygna and Chenalopex, he divides the Geese proper into two sections, *Anserea* and *Philacteæ*. The former of these includes the two typical genera, *Anser* and *Branta*,† in which the sexes are alike, and the plumage nowhere metallic; and three sub-typical genera, all South American, viz.: *Oressochen*, n. g., *Chlœtrophus*, n. g., and *Chlœphaga* Eyt., in which either the sexes are dissimilar, or else the plumage has iridescent tints. The Philacteæ are marked by the presence "of deep rough superorbital depressions, and reversed relative proportions of tarsus and middle toe [the former shorter or not longer than the latter], together with an exclusively sea-coast habitat, and a carnivorous diet, corresponding in some of these respects with the Oidemiæ and Somateriæ among ducks" (p. 130). This section embraces one North American species usually called *Chlœphaga canagica*, here made the type of *Philacte*, n. g.; and the South American *Tœnidiestes antarctica*. Of the naturalness of this arrangement, as well as of its convenience, there is probably no doubt, and though division *genericé* may seem pushed to an extreme, yet this conforms to the usage of the day; the only question is, whether corresponding subtilty would not demand the recognition of Chen, and even Exanthemops, as distinct from Anser. We regret that the paper is defaced by too numerous and inexcusable typographical errors, for which, however, we happen to know that the author is not responsible.

In the list of North American species we notice the absence of *Anser albatus* and *Branta leucopareia*; the former, if only indeed a small race of *A. hyperboreus*, we should judge entitled to recognition; but the latter has doubtless no such claims; nor should

* Proc. Acad. Nat. Sci., Philada., Sept.–Dec., 1870, p. 130.

† Scopoli, 1769, ex Klein, type *A. bernicla* L.; nec Boié, 1822, type *Anas rufina* Pall.; thus equal to, and antedating, *Bernicla* Boié, 1822.

we be surprised if *B. Hutchinsii* itself were finally resolved into a conspecies with *B. Canadensis*, despite the nearly constant discrepancy in the number of rectrices. *A. cœrulescens*, on the contrary, appears perfectly distinct, as Dr. Bannister has it; and *B. leucopsis* has lately been twice authenticated as American. The author queries *A. ferus* and *A. segetum* as American; we do not know upon what authority, having had no previous suspicion of their occurrence in this country. A comparison of the North American and European *Anseres*, given below,* which we are, in part, enabled to make through the personal attentions of Prof. A. Newton, offers some interesting points:—

Thus it appears that while Anser proper is essentially European, and Chen as decidedly North American, they have both been developed in a parallel series, as it were, to an equal number of species, that may be regarded as strictly analogous, each for each. Such a division of the geese is in remarkable contrast to the great number of species as well as genera of ducks that are common to both countries. But without space to pursue the subject, we turn to the second paper above alluded to.

Mr. Ridgway very creditably maintains‡ the position he secured by his first contribution to ornithology, in this more elaborate paper, which is, nevertheless, only "preliminary to a 'monograph of the North American Raptores,'" upon which he has been long engaged. We trust it may soon appear, since, to judge by this forerunner, it promises to be of high interest and importance.

***Genus ANSER auct.**

Americani.]	**[Europæi.**
***a.* CHEN.**	***b.* ANSER *ipse*.**
a.' Variegatus, capite colloque albis.	
Cœrulescens L.	*Ferus* L. Ungue rostri albo, campterio pallidè griseo.
b.' Nivei, rem. primar. nigris.	
Hyperboreus† Pall. Major; long. tot. 2½-ped., alis ferè 1½-ped., rost. 2½-poll.	*Segetum* Gm. Ungue nigro, campterio fuscogriseo, pedibus aurantiacis.
Albatus Cass. Minor; long. tot. bipedal., alis 1¼-ped., rost. bipoll.	*Brachyrhynchus* Baill. Rost. breviss., ungue nigro, campterio griseo, ped. incarnatis.
Rossii Bd. Minimus; rost. verrucoso, etc.	*Erythropus* L. (nec auct.; *minutus* N., *Temminckii* B.) Minimus; similis A. albifronti.
(*b.* ANSER *ipse*.)	
Gambeli Hartl. Simillimus A. albifronti; rostro longiore (1¾—2-poll.).	*Albifrons* Gm. Ungue albo, campterio fuscogriseo, pedibus aurantiacis, rostri long 1½—1¾-poll.

†*Chen hyperboreus* also occurs in Europe. (Germany, Naum. V. D., xi. 221.)

‡ A New Classification of the North American *Falconidæ*, with Descriptions of three New Species. Proc. Acad. Nat. Sci. Philad., Sept.-Dec., 1870, p. 138.

The present paper witnesses his laborious and conscientious application, rewarded with gratifying results in the elucidation of a difficult subject. Hitherto, we are bound to say, our Raptorial birds have been investigated with only moderate success, and, in fact, their technical details of form, etc., have never before been properly worked out, nor adequately presented. To this is due much of the prevalent and acknowledged confusion, for which, fortunately, there will hereafter be little excuse. Mr. Ridgway's analyses and diagnoses are drawn with care and precision, and carried to such circumstantial detail, that his paper is really the next best thing after specimens themselves. He shows a "hawk's eye" for differences, and skill in rendering them antithetically; if his generalizations keep pace with his analysis, he will not be in danger of losing the broad bearings of a subject in the very richness of detail that he elaborates. But a certain embarrassment in this respect may be found, as a matter of typographical execution; at least, we confess that we studied out the interrelation of some of the numbered and lettered paragraphs with difficulty. Besides this small point, the omission, in treating of external characters, of any reference to the ear-aperture of *Circus*, and mention, in several places, of the tibio-tarsal joint as the "knee," call for criticism.

The classification is based upon a character that has hitherto received little or no attention:—the condition of the os lachrymale, that, in most *Falconidæ*, forms a projecting superciliary shield, or "eye-brow," and mainly confers the decided and threatening gaze of these birds. This, with the shape of the nostrils, the toothing or lobing of the tomia,* some points in the structure of the feet, and the facial disc of Circus, furnish a basis for six subfamilies—*Falconidæ*, *Circinæ*, *Accipitrinæ*, *Haliaetinæ*, *Milvinæ* and *Polyborinæ*. If reliance, primarily, upon any single character seems always more or less arbitrary, it is often surprising how well it works, in marking off sections already determined upon other grounds. Thus the absence of a superciliary shield distinguishes *Milvinæ* and *Polyborinæ* from all the rest. To those of us, however, who always associate *Pandion* with *Haliaetus*, it is a novelty to find the genus placed in *Milvinæ;* although, as the surprise wears off, we may well ask why not, seeing how many characters Mr. Ridgway shows that it shares with *Elanus*, among them

*Tomia (Gr. Τομος, a cutting, from γεμνειν); "the cutting edges of the mandibles."

the peculiar formation of the claws, and the reticulated tarsi. Perhaps, however, we may escape a dilemma, by compounding with Mr. Ridgway upon his own suggestion (p. 143), that "most of the characters of this genus are so unique that it is almost entitled to the rank of a subfamily." We are glad to see a certain "subfamily" *Aquilinæ*, done away with; for the Eagles proper seem to be nothing but overgrown *Buteones*, and it might puzzle one to find, for instance, very striking generic characters between *Aquila chrysaetus* and *Archibuteo lagopus*. We willingly relegate them to *Buteoninæ*, even if, in consequence, we must leave the Fishing Eagles alone to support a subfamily *Haliaetinæ*, as Mr. Ridgway does. The only point about which we take serious issue with the author, is in placing Astur and Accipiter with Buteo, etc., in a subfamily *Accipitrinæ*. Aware that it is hard to draw a technical line between the hawks and the buzzards, we are yet persuaded that there is an essential difference. The Astures are only less "noble" than the falcons themselves, whose spirit they share, if, indeed, in a weaker frame, yet in one almost equally fitted for dashing action; while in their mode of preying, the nature of their prey, and their general habits, they are removed from the lymphatic buzzards to such a degree, that we would willingly accept any technical excuse —if it be only the relative length of the wings and tail—to substantiate in the closet our field observations.

Although Mr. Ridgway's classification may be, as he says, "one based upon comparatively artificial characters," we regard it as the best we have, and think it probable that whatever modification may ultimately prove necessary will result mainly from the consideration of exotic material that is not here taken into account.

A judicious conservatism marks Mr. Ridgway's handling of specific matters, in the recognition of geographical races, which has now become imperative, and in due allowance for variation in plumage, not only with sex and age, but in the more puzzling ways of melanism, etc., to which hawks seem specially susceptible. A number of nominal species of Tinnunculus are reduced to regional races; all the gyrfalcons are treated in the same way; our Pandion, Archibuteo, Craxirex and Polyborus, with *Falco anatum*, are referred, as varieties, to their respective analogues. *Accipiter Mexicanus* is dropped; and the silence regarding that somewhat celebrated bird, *Haliaetus Washingtonii*, is expressive. (By the way, as neither *H. albicilla* nor *H. pelagicus* has been actually taken in our country, *leucocephalus* is our only species.) The

agitation in the difficult genus Buteo, raised some years since by Dr. Bryant, is quieted by an unequivocal confirmation of the general tenor of that gentleman's views; *elegans*, *calurus*, *montanus*, *Bairdii*, *insignatus*, *oxypterus*, and *albonotatus* being all suppressed. Those that he gives as valid are, 1 (with four outer quills emarginate), *Cooperi*, *Harlani*, *borealis*, *lineatus*, *zonocercus;* and 2 (with three quills emarginate), *Swainsoni*, *fuliginosus*, *albifrons*, *Pensylvanicus*. Of these, *Harlani* and *Cooperi*, will bear further investigation; neither *fuliginosus* nor *albifrons* really occurs within our limits; so that the total number of our unquestionable species is only five. The northernmost *Asturina* (*A. plagiata*) is allowed; so is *Ictinia Mississippiensis*. *Falco polyagrus* Cass., is properly referred to *Mexicanus* Schl.; certain differences that we pointed out some time since proving dependent upon age. Our Aquila is not mentioned, apparently through an oversight.

The three new species are: 1. The Cuban and Haytian Tinnunculus, called *Falco leucophrys*. 2. The American analogue of the European Merlin, figured and described by Richardson and Swainson as *Falco æsalon*, and subsequently spoken of by Cassin, ourselves, and others under the same name. Mr. Ridgway finds it quite distinct from *æsalon*, as it certainly is from *columbarius*, and dedicates it to Dr. Richardson. 3. *Onychotes Gruberi*, n. g. et. sp., is said to be "utterly unlike any other American species. So much does it differ in structure, that we do not feel sure that it is not from some portion of the Old World, instead of from California" (p. 150), its reputed habitat. —E. C.

The Classification of the Eared Seals.—Having been kindly apprized by Mr. Allen that he would be obliged to answer my review of his esteemed work "On the Otariadæ," I awaited with interest the number of the Naturalist containing it. A few words in justification of the review seem to be called for.

I cannot perceive that Mr. Allen has met the objections urged against the exclusive applicability and consequently the diagnostic value of the characters used in his diagnoses of the *Oulophocinæ* and *Trichophocinæ*, and after a careful perusal of Mr. Allen's comments, I cannot admit that the significance of the tables * and

*The cause of the "rather obscure comparative tables" is due to the way the printer was obliged to express the "irregular" fractions (in the small type used) in connection with the whole numbers, and I may add to the same cause is due the unusual presentation of the dental formulæ.

my remarks are at all diminished. I, therefore, again refer to them in justification of my criticisms, and have only to meet certain statements and objections urged against them.

I. *Trichophocinæ*, "without under fur;" *vs. Oulophocinæ*, "with under fur."

I must repeat my original remarks:—"We may at once concede the applicability of the distinctions based on the pelage, remarking, however, that the character is not as absolute as might be inferred from the expressions used." Mr. Allen has reluctantly admitted the existence in *Trichophocinæ* of sparse hairs homologous with the under fur of *Oulophocinæ*. Dr. Peters especially distinguished the Oulophocine *A. antarcticus* (*O. pusilla* Peters) by the very thin under fur. "Since Dr. Peters wrote, it has been [also] ascertained that" the "young, about eighteen inches long" has the "under fur brown, *very sparse*," and adults, apparently supposed by Mr. Allen to belong to the same species, "are so *nearly destitute of under fur*, except just on the crown of the head, that [Dr. Gray is] convinced they could not be dressed as fur-seals," and he believes "they are a most distinct species," which he calls *A. nivosus*.* Dr. Murie† has also shown that in *Otaria jubata*, there "is a reddish underwool, but very sparsely scattered." It may, therefore, be thought that I have conceded even too much value to the character in question.

II. "Size large and form robust," in *Trichophocinæ; vs.* "size smaller; form more slender," in *Oulophocinæ*.

A distinction appears thus to be plainly made between absolute length and comparative stoutness or slenderness. Mr. Allen, at least, has not attributed the appearance to tautology. Under the heads, then; first, of length; second, of stoutness, the objections of Mr. Allen must be met.

1. *Length*. As Mr. Allen remarks, "slenderness and robustness of form usually [but by no means always‡] involve the head as well as the trunk." Mr. Allen, then, at least, cannot object to the consideration of the length of the head as a fair meter and exponent of the total length of the animal.

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* Observations on the Fur-seals of the Antarctic seas and the Cape of Good Hope, with the description of a new species. By Dr. J. E. Gray. Ann. and Mag., Nat. Hist. 4th s., 1, 1868, p. 219.

† Report on the Eared Seals collected in the Falkland Islands. By James Murie. Proc. Zool. Soc., 1869, p. 105.

‡ See, for example, *Zalophus*.

The following examples will then suffice to prove "that the difference in size seems to be more than reduced to a minimum, and to be degraded to absolute nullity."

Callorhinus ursinus (A "*Oulophocin*") .275 millimetres.

Zalophus Gillespii (A "*Trichophocin*") .270 millimetres.

"The length of a full-grown male [of *C. ursinus*] is between seven (7) and eight (8) feet."* "The mounted skin of an adult male [*Z. Gillespii*] preserved in the Museum of the Pays-Bas [Schlegel] says, is '*six* (6) *pieds et deux* (2) *pouces en totale longueur.*'"† The skeleton of an unusally large specimen of *Z. Gillespii* measures less than seven (7) feet; its skull, 330 millimetres. **Comment is unnecessary.**

2. *Stoutness or slenderness.* Knowing the materials, specimens as well as literature, at the command of Mr. Allen, I was at a loss to know how he had obtained the data which enabled him to classify all the species into two groups, distinguished by comparative robustness or slenderness. I carefully examined his work, and finally noticed the *apparent* characters deducible from the skins, and recalling the case of some animals (especially the small weasels) in which the slenderness of the body is due to the elongation of the vertebræ, I inferred that such hints might have induced Mr. Allen to use such data. I was, indeed, surprised at such a standard, and intimated by the remark that "no data are given concerning the ratio of the girth to the length," what I considered to be a better criterion of robustness or slenderness.

Mr. Allen has, however, at length remarked that his "observation was based on a comparison of the skeletons of *two* of the leading genera—*Eumetopias* and *Callorhinus*—and the figures and descriptions of the other species." I must confess that I am more surprised at this than when I suspected that I had detected Mr. Allen's meter of slenderness in the relative elongation of the skins; in the one case, he had measurements of all the species, such as they were; in the other, he had only *two* species, out of the *eight* admitted (with reserve, however,) by himself, illustrations of the skeletons of two others, and figures foreshortened or from stuffed specimens of others. Now, if Mr. Allen can select from such data evidence in favor of his views, I can select that

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*On the Eared Seals (Otariadæ). By J. A. Allen. p. 76.

†Op. cit., p. 69.

which will rebut them. Whether he is really right or wrong, however, I do not pretend to say. I merely say that the evidence is insufficient, and I only object to his taking for granted what may be a question in dispute.

III. "Ears short and broad," in *Trichophocinæ*; *vs.* "the ears much longer than in Trichophocinæ," in *Otophocinæ*.

Thinking that no fairer meter of the length of the ears could be found than in their ratio to the head, I gave, after the measurement of the skulls, those of the ears.

Mr. Allen, in answer, remarks that I seem "to have forgotten that the bulk of *Eumetopias* is several times that of the largest of the fur seals. So that, while the ear is absolutely but little longer in the fur seals than in the longest-eared hair seals, it is relatively much longer."

I will only reply in the expressive language of Mr. Allen, that the idea of determining the slenderness of the ears—rudimentary structures, too—by their ratio to the "bulk" of the animal, "is, to say the least, a novel one to me."

Mr. Allen has declined to discuss the taxonomic value of these distinctions, *i. e.* to prove that they are of sub-family value. I shall not attempt to prove that they are not. Every well-informed therologist, from his own knowledge of the differences exhibited by otherwise homogeneous genera in the character of the pelage, the variation in size, and the comparative smallness of very small ears, the *only* characteristics still urged for the differentiation of the "sub-families," will decide for himself.

I felt constrained—my great respect for the abilities of Mr. Allen constrained me—to examine the basis of Mr. Allen's classification before dissenting from it and exposing my own views. The great respect which I entertained I endeavored to manifest in my review of his work; in the mode of presentation of objections, Mr. Allen has furnished abundant precedents.

As to my own views, I shall leave to others to decide whether they are more tenable than Mr Allen's or otherwise. I shall only add that after mentioning the combination of characters common to *Zalophus* (which Mr. Allen has apparently overlooked), I presented a dichotomous synopsis exhibiting the subordination of the groups, making special use of the form of the profile, whether decurved, or whether straight or incurved, and the development of the sagittal crest.

To both, Mr. Allen objects; "the comparatively unimportant character furnished by the rostral outline being far less characteristic than its slender elongated muzzle and other features," he says, and he deems the character of the rostral profile to be "too trivial to require more than the incidental remarks already given to it." How, may I ask, is the "slender elongated muzzle" produced if not by the "straight or incurved fronto-rostral profile," *i. e.* the compression of the maxillary and nasal bones, and what is "the slender elongated muzzle" but the expression of such structural characteristic? *

As to the "sagittal groove from which are reflected the low ridges" of most of the species as opposed to the "solid much elevated crest" of *Zalophus*, the characters, it must be remembered, are comparative and only to be considered with relation to each other (like the comparative diagnoses of Mr. Allen). Although backed by Mr. Allen,† I however admit that my language has not been happily selected and may mislead.

It need only be added, however, in the language of Mr. Allen, that "*Zalophus*, so far as the skull is concerned, is the most distinct generic form of the family Otariadæ, it being thoroughly distinct from all the others. Whether such distinct characters are more than counterbalanced by such as Mr. Allen has used for the differentiation of his subfamilies, may safely be left, without further argument on my part, to the judgment of others.

A word as to "conservatism." I used the term "extreme conservatism" because the reduction of species is popularly considered to be an evidence of conservatism. But Mr. Allen's "extreme conservatism" degenerates into radicalism in his attack on the current views with respect to the limits of the species. The *Otaria Hooperi*, for example, has characters sufficiently "tangible" to have deceived all authors who have examined specimens (among them some of the first of living naturalists), as to its affinities, and it has been separated generically from what (with Mr. Allen) I am disposed to consider its nearest ally and congener, and yet Mr. Allen (without having seen it) referred it to *Otaria jubata* as an

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* Mr. Allen apparently having at first recognized this relation of cause and effect. In his diagnosis of *Zalophus* described "the superior profile from the postorbital process anteriorly, gently declined." Allen, op. cit., 48.

† "The sagittal crest (of Zalophus) forms a remarkably high, thin, very bony plate, unparalleled in its great development in any other genus of the family." — Allen op. cit. p. 48.

individual variation. Mr. Allen may be right, but the evidence and weight of authority are decidedly against him.

In conclusion, I would renew my testimony as to the great merit of Mr. Allen's work, and I only regret that I cannot entirely concur with him. Although Mr. Allen has not really met the objections urged against his views, it might not be obvious to all that he has not, and there might be those who would take for granted the proposition that I had "fallen into several by no means unimportant errors." I leave the decision on this charge to the scientific public. And as there seems to be some danger of the real questions at issue being obscured by side issues, I beg to restate them. They are:—

1st. Are the groups *Trichophocinæ* and *Oulophocinæ* entitled to the rank of subfamilies on account of the characters assigned?

2d. Is *Zalophus* a natural associate of *Otaria* and *Eumetopias* in a *homogeneous and natural* group to be *contrasted* with the *Oulophocinæ?*

Everything not bearing on these is irrelevant.

As may be perceived, the consideration of the question of the *values* of characters has been distinctly varied by Mr. Allen, and the discussion shifted to the question of the existence of some of the distinctive characters employed for the differentiation of the *Trichophocinæ* and *Oulophocinæ*. I will therefore repeat my original admission that the *Trichophocinæ* (*after the elimination of Zalophus*) and the *Oulophocinæ* are natural combinations, but not subfamilies, definable by the characters used by Mr. Allen.—Theodore Gill.

The Geology of Iowa.*—These two elegant volumes are the "results of examinations and observations made within the years 1866, 1867, 1868, and 1869." The first volume contains in the first part an account of the physical geography and surface geology by Dr. White, with a chapter on the climate by T. S. Parvin.

The second part describes the general geology of the state, including the Azoic, Lower and Upper Silurian, Devonian, Carboniferous, and Cretaceous Systems, the chapter on the middle Coal Measures by O. H. St. John. The third part embraces the county and regional geology, which is completed in the second volume.

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*Report on the Geological Survey of the State of Iowa. By Charles A. White, M. D.; Orestes H. St. John, assistant; Rush Emery, chemist. 2 vols. 1870. Royal 8vo. Des Moines. With plates and maps.

part first. The second part of the volume is taken up with chapters on the mineralogy, lithology and chemistry. In the appendix is a catalogue of the birds of the state contributed by Mr. J. A. Allen.

Though the survey was cut short by the mistaken policy of the state legislature, many valuable results were obtained that demonstrate the necessity of a still more detailed survey in the future, as the geologist was obliged to suspend work, just as important discoveries of direct value to the state seemed to be imminent. Among the results thus far attained however, is the "satisfactory solution of the question as to the relative position of the strata that underlie and overlie the coalbearing formations, and the determinations of their dips and trends. As a result of this, the opinion is confidently expressed that coal may be sought for over the whole of Southwestern Iowa with reasonable hope of finding plentiful supplies at a not unusual depth as mined in other countries and in other parts of our own. Thus we have reason to hope that the present known coal area of the state, amounting to about seven thousand square miles, will be doubled by the discovery of coal at some depth beneath the surface of an equal area of Southwestern Iowa." The existence of large quantities of excellent peat and gypsum are indicated, and the survey demonstrates the value of some of the magnesian limestones for the preparation of hydraulic lime.

The work is evidently thoroughly done and the details presented in a clear and systematic manner. The geological map-model, facing page 32, is most excellent in its plan and one which will prove of great use in lectures. The different rock formations appear in relation to each other and in their relative extent just as they do in nature. We trust the state may yet finish the work so well begun, and that the fossils, and animals and plants of Iowa may be described and figured.

The Geology of Michigan.*—In his report of progress Prof. Winchell gives an interesting sketch of his projected final report. Should the state finish the survey, which can be done in two years, the publications of the results will be invaluable for the future development of this rich and influential commonwealth.

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*Report on the Progress of the State Geological Survey of Michigan. By A. Winchell, Director. Lansing, 1871. 8vo, pp. 64.

NATURAL HISTORY MISCELLANY.

BOTANY.

Re-spindling of Corn.—I cannot send you a specimen, but I can give you a fact in reference to tassels at the end of the ears of corn.

In the year 1863 I lived about seven miles from Chippewa Falls in this State. There was an acre of corn directly before our cabin door. On the night of the 11th of July of that year a severe frost killed all the tassels which were then just shooting distinctly above the leaves. Though checked in growth the corn finally set for ears, put out its silks (pistils), and also sent forth a new tassel or spindle from *the end of the ear*. This spindle at the end of the ear was a common thing over the whole acre. Mrs. C. and myself often remarked about it at the time as a curious effort of nature to repair damages. The early frosts again in the fall cut off the corn before it matured, but there were cases which we thought would have fructified and matured from this attempt had the season been longer. In most instances, however, the silks were dry before the spindle at the end of the ear shed its pollen.—Charles Caverno. *Lake Mills, Wis.*

The Earliest Known Coniferous Tree.—Allow me to say, with reference to a notice copied in your May number from the "Academy," that the opinion respecting the plant above named attributed to Mr. Carruthers is an entire mistake. *Prototaxites Logani* is an exogenous tree, with bark, rings of growth, medullary rays and well-developed, though peculiar woody tissue: and, if Mr. Carruthers has made such a blunder as that attributed to him, this can only be excused by defective observations or imperfect specimens.—J. W. Dawson.

The Chestnut Tree.—Have we two species of Chestnut here in New England? I refer to the common *Castana vesca*, Var. *Americana*. My friend F. J. Kingsbury Esq., informs me that lumbermen distinguish two very marked varieties by the *wood*. One *white*, the other *red* and less hard and strong. I conjecture that this difference depends solely upon the manner of growth,

young and vigorous trees furnishing the whiter wood.—H. F. Bassett.

[These differences in the wood, in this and other trees, are not accompanied by recognizable differences in their foliage, etc.; they are not even *botanical* varieties: the cause of the difference is unknown.—Eds.

Wasps Carry off Stamens Bodily.—Ch. Morren, of Belgium, is the authority for the statement, that, having noticed that the stamens and pistils of certain Fuchsias were unaccountably removed, he set a watch and found that they were carried off by wasps; and the wasps were observed flying about the garden with the stamens in their mandibles. *Vespa nidulans* was the culprit. What use they make of them is not explained.—*Gard. Chronicle, April* 15.

ZOOLOGY.

Anatomy of the Skunk.—As lizards, toads and snakes had become nice playthings, I had a desire to test the virtues of a skunk with the dissecting knife. Boys and others had skinned the animal by the thousands; so I thought that task not very formidable, and at it I went. The truth is it was not the nicest job I ever did in my life, and the fellow was as fat as his skin could hold; for I got four pounds of the purest, most pliable oil I ever saw. It was mainly pure oleine, with a little margaric acid—as good as neat's foot oil for harness and boots, but with no medical virtue.

I approached the vital organs of the Mephitis with suitable care. I first examined the teeth, as being furthest off. Next I cut off the shoulder and breast just back of the ribs. The lungs were large, the heart fully developed, and the liver enormous. The stomach contained the crop and intestines of at least one of my Thanksgiving pot-pie chickens; so it gave no light on its usual food, except that chickens' corn, oats and flesh were there. The intestines were very broad, and seemed as if mainly made of colon, with hardly a trace of jejunum or ileum. The kidneys were remarkably large, but neither by odor nor by the microscope, showed any singularity; their internal portions were very like those in man.

I approached the pelvis with great caution, and almost superstitious fear. I disjointed first each femur, and left bare the innom-

inata, with the posterior fleshy attachments that contained the essential virus. I examined the cavity of the pelvic bones, without any peculiar result, and at last detached all except the hard, muscular pouches and the common fundamental aperture. These I carefully cut loose, and thus reduced the formidable animal to the last and least parts possible, and they seemed totally inadequate to explain the well known effect this animal produces. I next boldly severed, longitudinally, the rectum and anus; nothing was to be seen worthy of remark, except two teat-like projections in two volcanic or crater-like cavities that seemed suggestive of what might happen. So I cut away all the remaining superfluous parts, and at last had the anal lips, two muscular pouches, and several small glands connected with them. My fortitude here giving out, and it growing dark, I adjourned the matter to the next day.

When I resumed operations, on the parts now weighing only about two ounces out of a Mephitis of nine pounds, I had a strip of skin with the anal lips, the suspicious calices or cones in their cup-like cavities, and the pouches. Microscope was at hand, magnifying glasses, spectacles, and dissecting case that had done much human duty. I began by severing the two muscular pouches, and found no connection between them. Books say, "The animal gives its peculiar and penetrating odor from two glands, situated external to the pelvis." I found the "glands" to be *clear muscular fibre*, with not a particle of smell, or a trace of any glandular structure. So much truth there is in old sayings, repeated for years or ages past! Further to test the matter, I cut slowly to the middle of the mass of *muscular*, not *glandular*, fibres, and came upon a thick, white, leathery capsule, like the crop of a chicken, with the source for the contents, provided by the little glands about it. Now putting on old clothes, and sitting to the windward, I cut through this white capsule: a bright yellow fluid came out, and I instantly felt that "distance would lend enchantment to the view." But I was not to be baffled. So I dipped the point of my scalpel in the yellow fluid, put the tenth or twentieth of a drop of it on a glass, covered it with another strip of glass, and placed it under a power of forty diameters in my microscope. The appearance was peculiar. It looked like molten gold, or like quicksilver of the finest golden color. Pressure on the strips of glass made it flow like globules of melted gold.

By a power of sixty diameters the same color still appeared,

but seemed as if it would by a higher power resolve itself into globules, with some peculiar markings. I tried all the combinations of lenses I had. but could only say: "Oh, that I had a friend to give me a five hundred dollar microscope! Oh, for a lens that would show what this almost resolvable gold is made of!" To the eye, the peculiar and odoriferous secretion of this animal is of a pale bright or glistening yellow, with specks floating in it. By the microscope it looks like a clear fluid, as water with masses of gold in it, and the specks like bubbles of air, covered with gold, or rather bags of air in golden sacks. The air I take to be the gas nascent from the golden fluid. Had I known that my interest in the dissection would have rendered me so forgetful of the pungent surroundings, I would have had chemical reagents to test the substance so easily obtainable.

Another thing was a matter of interest. If I correctly made out the capsule of fluid, the commonly called "glands" are the muscular tunic enveloping and capable of compressing the reservoir, and their sole use is to eject the liquid. The teat-like projections have one large orifice for a distant jet of the substance, and also a strainer, with numerous holes—like the holes in the cones in the human kidney—for a near but diffusive jetting of the matter. The substance is secreted by small glands, dark in color, and of small calibre, connected with the capsule by narrow ducts.—J. S. Parker, M.D., *in Country Gentleman.*

The Nest of the Pigeon Hawk.—In the March number of the American Naturalist, Vol. V. page 56, Dr. Brewer questions a statement of Mr. Winfred Stearns concerning *the position* of the pigeon hawk, and says that "*in hollow trees*" "is a condition in which the nest of a pigeon hawk is never found." On page 537 of Vol. IV. of the American Naturalist, I mention that "in May, 1863, a nest of this species (Hypotriorchis columbarius) with young birds just able to fly, was found *in* a large sycamore, on Duch Island, Delaware River, near Trenton, N. J." Now I then stated *in* the tree, not on it; and such was the exact truth of the matter, and I can hardly see how so widely different birds as this and the *Tinnunculus sparverius* could be confounded. Possibly Mr. Stearns may have done so; but I did not. The sycamore in question is a very large tree, with a hollow in it some eight feet from the ground, in capacity about equal to a flour-barrel, and with an opening not over six inches in diameter, situ-

ated nearly in the centre; corresponding very well to the bung-hole of an ale cask. The irregular floor of this hollow was slightly smoothed with a large mass of twigs; the finer at the surface, and intermingled with hair, feathers and grass. The bottom of the nest was about a foot below the lower edge of the opening. Once since 1863, the pigeon hawks have occupied this tree; and *twice* since, the sparrow hawk. During the other five seasons, I did not visit the locality, or, at least, have no notes of having examined the tree, but seeing no pigeon hawks elsewhere, doubt if they have occupied the locality since 1865. Should they reappear during the coming spring, I shall endeavor to secure birds and eggs to settle the question of the species I have designated "pigeon" hawk.

"The nest with eggs, discovered February 22d, 1865. *in* an elm tree" was more properly *on* the tree, but so sheltered by a curious twisting and overlapping of branches, that its situation would incline one not conversant with the bird's habits, to believe that it *usually* built within the body of a tree, rather than upon the branches or in an open situation.

Dr. Brewer very truly states, "the horizon of one man is at the best very limited, and many ornithological facts occur that are not dreamed of in his philosophy." Indeed, considering the influence that circumstances surrounding an individual must exert, I feel surprised at times at the apparent regularity of habits; but have nevertheless given up every text book as an infallible exponent of the manner of this or that animal's life. I have recorded many instances of peculiarity in bird nesting which I have hesitated to publish, as they might to others seem to border on the Munchausen order of narratives; but when they occur to others, to my knowledge, then I am ready to corroborate, by giving similar cases as occurring in my own experience. As a sample of what seems really incredible, and yet was witnessed by myself, I will mention that I once saw a pair of wrens drive off a pair of song sparrows from their nest which was just finished, *cover it with a leaf from a Paulonia, which they fastened by perforating it with the ends of the upper twigs of the nest, and then cut a hole in the leaf for an entrance.* In a few days the leaf withered, became brittle, and finally was broken up and scattered; and the wrens reared a brood of seven in an open nest. Curious as such instances may be, they have no instruction in them, that I

can see, and therefore is it desirable to jeopardize one's reputation by giving them publicity?

The past winter has been unusually cold, and the effect on the ornithic fauna perceptible. The great white owl (*Nyctea nivea*) has been quite abundant, seven having been killed near Trenton and sent to one taxidermist. The snow bunting (*Plectrophanes niralis*) has been more abundant with us than ever before; and so with other northern species that in winter visit us in varying numbers.—Chas. C. Abbott, M. D., *Trenton, N. J., March* 9, 1871.

[As Mr. Stearns has stated that he was mistaken in the identification of his bird (see p. 253), and thus thrown doubt on the supposed variation in habits of the Pigeon Hawk, we trust Dr. Abbott will settle the identity of his birds beyond question should they occupy the hole in the tree again.—Eds.]

Spike Horned Deer.—As the impression seems still to exist in the minds of some persons, that the spike horn deer is a distinct variety, I must ask for a little more space in your pages to give a few more facts in relation to them, and I have done.

In the first place, I have found, in my study of natural history, that the statements of hunters, both professional and amateur, must be taken with allowance, not so much from their desire to misrepresent, as to their want of knowledge of natural history, anatomy, and the habit of trained observation. They jump at conclusions which upon careful investigation prove to have no foundation.

Some years ago, when I was investigating the question of the Pronghorn Antelope shedding its horns, I wrote to a gentleman, a great sportsman, connected with the army, and who had been stationed for many years on the Plains, for any facts that he could give me in relation to it. He wrote back, that he had hunted the antelope at all seasons of the year, for twelve years, and he *knew* that they *did not* shed their horns. Before the letter reached me I saw an antelope, that had been kept in confinement, shed its horns.

When I was on the Plains, the hunters told me that there were two kinds of bison,* one on the Plains and one which they called the wood buffalo, which was never found in herds, but singly;

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* See reference to this on p. 221 of this Number. The foot-note given on that page was intended to call attention to the statement made above, but by mistake a reference is given to another page.—EDS.

this animal they said was larger than the others. Upon investigation these proved to be old bulls, who had separated from the herd and lived by themselves.

The hunters in Maine used to assert that there were two kinds of moose, a grey moose, and a black one. This difference has proved to be only the effect of age and condition.

Some years since, while hunting in Nova Scotia, I was told by some of the most experienced hunters that there were two kinds of carribou; one they called the sword carribou, from the shape of its horns. It was my good fortune to procure a fine large specimen; upon careful examination I found that it was simply a three year old carribou, whose horns had not yet become palmated; I have the head and horns in my collection. While on this same expedition one of the party shot a moose whose horns were only prongs; this animal measured six feet, nine inches in height to the top of the shoulder. I should think that any one would have said that it was a full grown animal, and yet it proved upon examination of teeth, etc., to be only three years old. I have the head, and it is a little larger than another moose head that I have, whose horns spread five feet and have twenty-four points.

These facts prove that it is possible for a deer to get his full growth before he acquires a full pair of horns. The differences of length of leg, shape of horn, fineness of coat, color, etc., are only individual peculiarities, and are to be found among all species of deer. The *Cervus leucurus* of the Plains is only the *Cervus Virginianus*, and not a distinct species, the difference of name originating with an English Naturalist who had not seen the deer of the Atlantic States. Careful observers will find as much individuality among deer as are found among horses and other animals. These facts should make us careful not to jump at conclusions from mere outward appearance, without patient anatomical examination. — W. J. Hays, *New York.*

Albino Swamp Blackbird. — A beautiful specimen of an albino Swamp or Red-wing Blackbird (*Agelaius phoeniceus* Vieillot) was shot in July, 1870, on the Detroit river, near Lake St. Clair. Its entire plumage was white with the exception of a patch of crimson feathers on each shoulder. It was a young bird, and of small size, and seemed to me sickly-looking. — Henry Gillman, *Detroit, Michigan.*

Pelicans.—In the February number of the American Naturalist (1871) is a communication from Detroit, describing a remarkable specimen of the White or Rough-billed Pelican, which was shot on Lake Huron, and the writer appears to think that the occurrence of this bird on the great lakes is a very rare thing. The size of the specimen described by Mr. Gilman was certainly remarkable, far exceeding anything in my experience. The largest specimen that I ever measured was ninety inches in alar extent, less by eighteen inches, than Mr. Gilman's specimen. This was killed during the present winter in East Florida, and was considered by hunters who saw it, as very large. It was a male in full nuptial plumage and was a magnificent bird.

The White Pelican, *Pelecanus erythrorhynchus*, was formerly not uncommon at the South end of Lake Michigan. I myself possessed a fine male which was killed within the present limits of the city of Chicago in 1840, by Dr. John T. Temple, then of that city, when we were shooting ducks together on the river. I stuffed and mounted the bird and had it for several years in my collection. At that time the white pelican was frequently seen on those waters, though like the swan, it has now disappeared before the march of settlements.

In East Florida, the Brown Pelican, *P. fuscus*, a smaller bird, is most numerous; you will see twenty of these to one of the white species. They both breed in that region, and lay their eggs on the sand bars and lonely islands. At the Inlets of the Hillsboro and the Indian rivers, I have seen flocks of the brown pelican which must have contained several hundreds. They roost on the mangrove trees in the creeks, almost breaking down the branches with their weight, and covering the ground with their droppings. Regularly at young flood they wing their way to the Inlet to fish. This the brown pelican does by diving from a great height, while the white species swims with open bill upon the schools of fish, which it scoops up as with a net into its capacious pouch.

In the Indian river is an island upon which the pelicans breed in vast numbers. A party of hunters visited it this year in March, and found it covered with eggs and young birds, which were being fed by the old ones with fish. Some of these were shot, and most of the others driven away, when suddenly the island was invaded by multitudes of the Fish Crow, *Corvus ossifragus*, which began to devour both the eggs and the callow young, deprived of their nat-

ural protectors. The hunters then turned their guns upon the crows, and slaughtered them in heaps, before they would abandon their prey.* — S. C. CLARKE.

THE PIGEON HAWK. CORRECTION. — When first finding the nest and eggs of which I sent notice to the NATURALIST (September number), I was fully convinced I had discovered a new ornithological fact, and I was confirmed by several persons to whom I told the facts and showed the eggs; I hastened to report, and to call forth facts from other quarters in regard to this hawk. I have since carefully investigated the case, and find I was in the wrong — that the nest was that of the *Sparrow* Hawk, which breeds quite often here. To be sure I also sent one of my eggs to Dr. Brewer, Boston, for identification. He states that the egg is unquestionably that of the Sparrow Hawk, of full size, and unusually well marked; that the parent must have been an old bird, and much in heat when the egg was laid. Mr. Brewer compared it with a number of eggs of the Sparrow Hawk and Pigeon Hawk, and states that it has no resemblance to the latter, and compares with a great number of the former. There can be no question that I have made a great mistake, but I beg that it will be taken only as a mistake.— WINFRID A. STEARNS.

PRESERVATION OF SEA-FOWL. — The rapid diminution in the number of sea-fowl on the coast of Great Britain, of the gulls especially, in consequence of the wanton destruction of the birds and their eggs by summer tourists, induced Parliament to pass a law, a few years ago, imposing a heavy fine upon all offenders, during certain months. The economical argument adduced in favor of this restriction, was that the birds themselves destroyed great quantities of insects in the fields, and served as scavengers for the removal of putrid flesh on the shore; and also, that by their

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*We copy the following from "The Birds of North America," by Baird, Cassin and Lawrence, pp. 869 and 870.

White Pelican. Total length, 70 inches, wing 24.50. *Habitat.* Throughout the United States, rare on the coasts of the Middle and Northern States. Fur countries up to the 61st parallel. There is no observable difference between specimens from the Pacific and Atlantic coasts. The species breeds in the fur countries, generally selecting inaccessible places in the neighborhood of waterfalls. They also inhabit throughout the Rocky Mountains and in California. In winter they are very abundant on our southern coasts, from Texas to Florida.

Brown Pelican. Length of male 56 inches; wing, 22. *Habitat.* From Texas to North Carolina; California coast. The Brown Pelican is a permanent resident of our southern coast and shores of the Gulf of Mexico; also of California. Their nests are placed on trees, and also on the ground.—EDS.

cries over their feeding grounds, usually in shallow, rocky places, the sailors were warned during fog, of their approach to such localities, and thus enabled to act accordingly. Of the reasonableness of the first mentioned plea we have ample evidence in our own country, since, on more than one occasion, the crops in Utah have been saved, by means of the immense flocks of gulls, which came to the rescue from their different abodes on the Great Salt Lake, and other bodies of water of the central basin. The result of the enactment is just beginning to make itself manifest in a greatly increased abundance of sea-fowl on the English coast, where they are said to be many times more numerous than heretofore, and to be much more tame, coming close to the fishermen while cleaning their fish, almost as familiarly as domestic fowl; swimming freely among the boats within reach of the hands and enjoying a gratifying immunity from disturbance. It is even asserted by some, that before the passage of the act, they were much tamer on Sunday, seeming to be aware that by the customs of society, and the restriction in regard to the use of guns, they were safer on that day than any other.

Identity of the American and European Bison. — Professor Brandt of St. Petersburg, in a recent paper, renews the expression of his opinion in regard to the identity of the American and European Bison, both of them in his view being the lineal descendants of the fossil Bison of a now extinct form. The only appreciable differences between the American and European races, according to Professor Brandt, are in the much larger mane and the more developed beard of the American animal, a characteristic, which, in view of similar differences in the manes of lions in different regions, not otherwise distinguishable, he considers of little importance. It may be proper, however, to say that a careful comparison of the crania of the two forms, exhibits differences of a much more tangible character; the relationships of the nasal bones not agreeing at all, and the muzzle of the American animal being much broader than that of its European Congener. According to Mr. Waterhouse Hawkins also, while the tail of the American Bison has the hairs close pressed, with a bushy tuft at the end only, that of the European animal is full and rather bushy from the root, being much the same difference as that existing between the tails of the American Mule or Black-tailed Deer (*Cervus macrotis*), and our common eastern Virginia Deer. — ***

GEOLOGY.

EOZOON AND ITS ALLIES IN LATER FORMATION. — I have for some time been pursuing investigations of Primordial and Silurian fossils akin to Eozoön either in structure or mode of preservation. When these investigations are completed, I hope to show that Eozoön has several foraminiferal successors in the older palæozoic rocks of Canada, and that fossils of various kinds occur in those rocks infiltrated with mineral matter in a manner not dissimilar from that observed in the Laurentian Eozoön.—J. W. DAWSON, *in Nature.*

ANTHROPOLOGY.

THE INHABITANTS OF THE NILE WATERSHED. — Perhaps the most important advance which has been made in geographical discovery during the past year has been the exploration of a large portion of Central Africa, lying to the northwestward of the great equatorial lakes, by Dr. Schweinfurth, already known through his botanical studies in the lower Nile valley, the first practised traveller who has penetrated far into this region. The ruling tribe of the inhabitants of the Nile watershed here, is that of the Niam-Niams, who are described by the Marquis Antinori as men of powerful form and stately carriage, bronze-colored skin, and long sleek hair. On crossing the water-parting into a fertile country, where the oil-palm gives a new character to the landscape, Dr. Schweinfurth came upon a race differing from these in every respect. The Abanga and Monbuttu of the inner watershed are distinguished by the lighter color of their skin, and their blonde and frizzled hair is worn by both sexes in a high chignon. Though inhabiting a richer land than the Niam-Niams, and in advance of them in agriculture, and the arts, cultivating the banana and other fruits, trading in copper, and forging weapons in iron, the Monbuttu rank far beneath them in the scale of humanity, since they indulge in cannibalism to an extent which appears to be unparalleled on the globe, a practice in no way explicable here by necessity, since the land abounds in game of all kinds. To the south of the Monbuttu is a dwarf race named Acka or Ticki-Ticki; the average height of the men of this tribe is five feet, but many do not reach this measure. — *The Academy.*

NOTES.

GOVERNOR HOFFMAN has approved the act, recently passed by the New York Legislature, authorizing the Board of Commissioners of the Department of Public Parks in the city of New York "to contract, erect and maintain, in and upon that portion of the Central Park formerly known as Manhattan square, or any other public park, square or place in said city, a suitable fireproof building, for the purpose of establishing therein, under suitable rules and regulations to be prescribed by the said Board from time to time, a Museum and Gallery of Art," and also a suitable fireproof building for a "Museum of Natural History, at an aggregate cost not exceeding a sum of which the annual interest, at the rate of interest at which a fund or stock shall be issued, is thirty-five thousand dollars for each of said buildings," and adding that "it shall be the duty of and lawful for the Comptroller of the city of New York to create and issue, in the manner in this act provided, such additional amounts of a public fund or stock, to be denominated the "Museums of Art and Natural History Stock," as shall be necessary to provide the money required for erecting said buildings, to an amount not exceeding the aforesaid limitations."

Capt. Hall will leave for the Arctic Regions in the steamer Periwinkle, which will probably be rechristened the Polaris, about the first of June or as much earlier as he can get away. He will be well fitted and provisioned with every thing which can be devised for carrying a large amount of nutriment in a small space. One of the boilers of the vessel which uses steam and sails indifferently, is being fitted to burn animal oil or blubber. He will be accompanied by Dr. Emil Bessels, well known as the naturalist of the last Spitzbergen Expedition, and the author of several valuable papers on the development of articulate animals, as naturalist. Morton, formerly of Kane's expedition, and others well acquainted with the Arctic Regions will accompany the Captain in his search for the North Pole. The Secretary of the Navy and other officials have done their best toward forwarding the objects of the Expedition, and as far as can be foreseen it will possess all the necessary elements of success.

A new scientific organization has been established at Washington under the name of "The Philosophical Society of Washington." The following is the list of officers:—*President*, Prof. Joseph Henry (See'y Smith. Inst.). *Vice presidents*, Gen. Horace Capron (Comm. of Agric.), Prof. J. E. Hilgard (Asst. Sup. Coast Survey), Gen. M. C. Meigs (Quart'mast. Gen. U. S. A.), and Wm. B. Taylor (Principal Examiner Pat. Off.). *Treasurer*, Rev. Peter Parker, D. D. *Secretaries*, Dr. B. F. Craig (Chemist, Surg. General's Off.), Prof. Theodore Gill (Asst. Libr. of Congress). *Executive Committee*, Prof. Thomas Antisell (Chemist Dep. Agric.), Maj. Gen. J. K. Barnes (Surg. Gen. U. S. A.), Prof. S. F. Baird (Asst. See'y Smith. Inst.), Col. T. L. Casey (Eng. Dep. U. S. A.), Prof. J. H. Coffin (Nautical Almanac), Adm'l Thornton Jenkins (U. S. Navy), Prof. Simon Newcomb (Naval Observatory), Gen. W. T. Sherman (U. S. A.), and Dr. J. J. Woodward (Army Med. Mus. Surg. Gen. Office).

In a late number of this journal, we called attention to the expedition of Mr. G. W. Belfrage of Waco, Texas, to New Mexico, for the purpose of collecting insects. We may say, here, that during his absence, shares in his collections may be had at any time by paying the money ($25.00) to Swenson, Perkins & Co., 80 Beaver street, New York.

While Mr. Belfrage is industriously collecting in the extreme south, a good, neat and careful collector is needed for the northern and western states. Specimens of the smaller moths, carefully mounted, of the rarer and smaller beetles, hymenoptera, and diptera are wanted by entomologists, who would pay a fair price for them. College students and others could more than pay the expenses of a summer trip by careful and minute collecting.

Messrs. J. A. Allen and Richard Bliss, jr., of the Museum of Comparative Zoology at Cambridge, Mass, with Mr. C. W. Bennett of Holyoke, Mass, started late in April on a six months collecting trip to the Plains and the Rocky Mountains. The primary object of the expedition is to collect the larger mammals of the West.

Professor Henry, of the Smithsonian Institution, has received the decoration of "Commander of the Order of St. Olaf," from Charles King of Sweden and Norway. A joint resolution has been offered in Congress to enable the Professor to accept the honor.

At a recent meeting of the Board of Overseers of Harvard University, the President presented votes of the corporation electing Francis Parkman, Professor of Horticulture, and Daniel D. Slade, Professor of Applied Zoology in the Bussey Agricultural Institution, which is a department of the University.

Mr. F. G. Sanborn has been appointed instructor in practical entomology in the Bussey Agricultural Institution of Harvard University.

Congress recently appropriated $40,000 for the annual expenses of the U. S. Geologist, Dr. F. V. Hayden, who is surveying the Rocky Mountain region of Colorado.

ANSWERS TO CORRESPONDENTS.

F. C.—Camphor does as well as anything to keep insects out, but the best thing is to see that your insects are not infested before placing them in *very tight* boxes or drawers. This, with constant watchfulness, will keep your insect free from harm.

C. W. writes "We have a favorite cat which by our reckoning has killed in her day, being now about ten years old, not less than three thousand (3000) rats and mice. Last summer she had a very sore leg which was cured but it either left her with an itching humor which bred lice, or becoming lousy her constant scratching causes her to appear as if having some itching disease. However it may be, I send you some of the lice.

The lice are probably the common cat lice of this country thought by Dr. W. I. Burnett to be probably the same as the European species, *Trichodectes subrostratus* Nitzsch. They probably caused the "itching disease."

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THE ANCIENT INDIAN POTTERY OF MARAJÓ, BRAZIL.

BY PROFESSOR CH. FRED. HARTT.

Fig. 62 (Face).

Fig. 63 (Back of Head).



Head of Idol, Marajo.

THE existence of Indian burial places at various localities, in the Valley of the Amazonas, in which the dead were interred in earthen vases or pots, seems to have long been known. Von Martius* mentions the occurrence of these vases near Manáos, at Fonte Bôa and Serpa, on the Rio das Trombetas, and elsewhere. He besides incidentally refers† to the recent discovery of large collections of them at a place on the Island of Marajó, or Johannes.

* Zur Ethnographie Amerika's zumal Brazilien, p. 440.
† Op. cit., p. 178.

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called Os Camutins.* These last he supposed to be of Tupí origin. The same author says that the Tupís sometimes buried their dead in vases which were rude and unornamented. The Omaguas still use this mode of interment, but the vases are buried in the huts. I was informed at Rio das Contas, in the southern part of the Province of Bahia, that the Patachos bury their dead in earthen jars.

I do not know that any systematic examination has ever been made of any of the ancient Amazonian burial places. Last summer, while at Pará, Senhor Ferreira Penna, late Provincial Secretary, and the author of a very excellent little book† on the western part of the Province, called my attention to the fact of the existence of the Marajó pottery at Lake Arary. Being unable to visit the locality in person, I sent one of my assistants, Mr. W. S. Barnard, to examine it. Mr. Barnard reports that Indian burial stations are quite numerous in the centre of the island. The principal ones are, however, the Island of Camutí in the Rio Anajas, near the Fazenda de São Luiz, and probably the same called Os Camutins, by Von Martius; another near the Fazenda da Fortaleza, consisting of a mound from eight to twelve feet high, built up on the flat campos, forming an island during the annual overflow, and full of vases; another on the campo near Lake Guajará, which Mr. Barnard thought might contain four or five acres; but the most interesting appears to be the *Ilha das Pacoras*‡ in Lake Arary, which was visited by my assistant.

The Ilha das Pacovas lies close to the western side of the lake, opposite the beginning of the Rio Arary, which forms the outlet to the lagoa, and just to the south of the mouth of the Igarapé das Armas. It is oblong in shape, about ninety paces in length from north to south, and about forty paces in width. In the month of November, when the water was low, it was somewhat over ten feet in height above the level of the lake. It is for the most part covered with large forest trees. Situated at the northern end of the island, and separated from it by a narrow channel, is a little crescent-shaped islet apparently built on as an addition,

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* *Camuti* is the Tupí word for *pot*. The Portuguese often write it *Camutim*. Treated as a Portuguese word, the plural would, in this case, be *Camutins*.

† Entitled, "A Regiâo Occidental da Provincia do Pará," and published by the government.

‡ *Pacova*, Portuguese form for Tupí *pacúa*, a banana. The island takes its name from the banana trees growing upon it.

and not so high as the main island. Both were evidently raised artificially, and are full of burial vases and pottery of all kinds. The vases, which are about three feet in height, are, in some places, buried as many as three or four above one another, but they are more or less scattered. The waves have worn away the edges of the island making a sloping shore full of broken burial jars and thickly strewn over with fragments of pottery.

Mr. Barnard made no excavations. He, however, collected specimens, in a more or less broken state, of what was at hand. His collection consists entirely of pottery. Bones were very rare, and very much broken up. I regret exceedingly, that of these re-

Fig. 64.

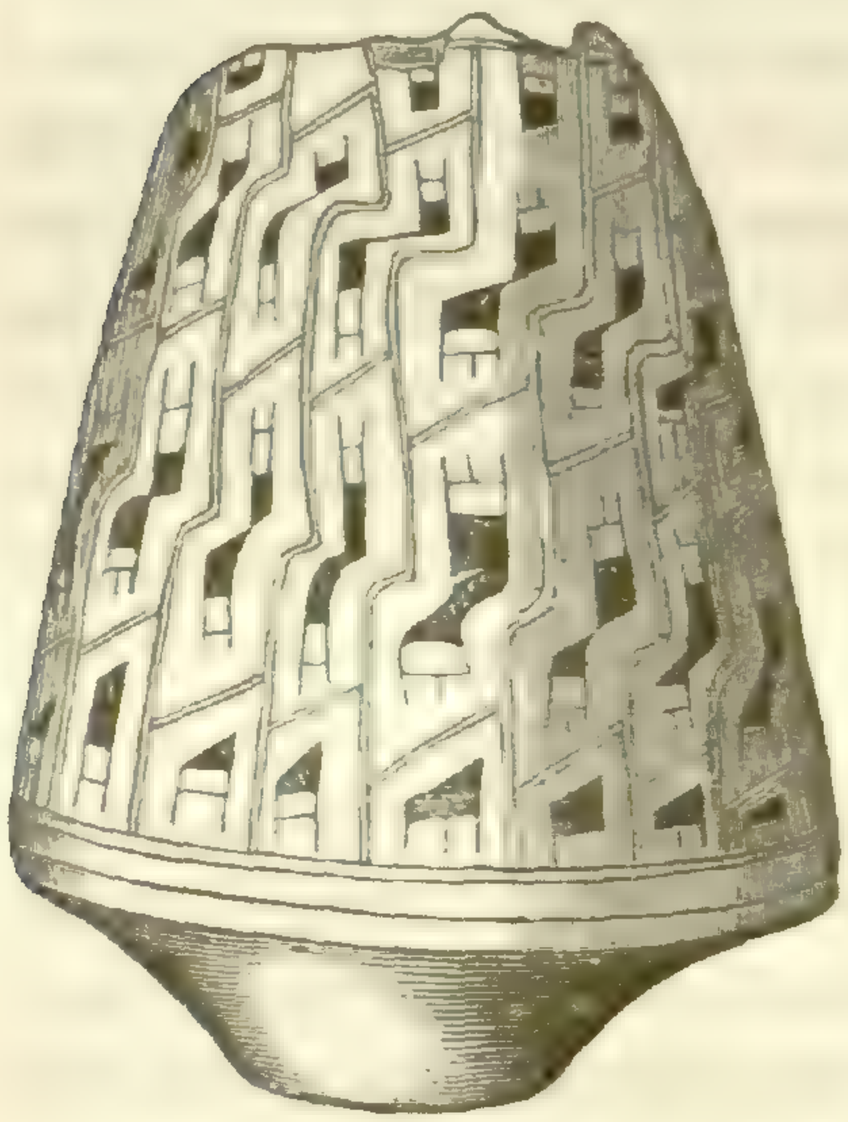
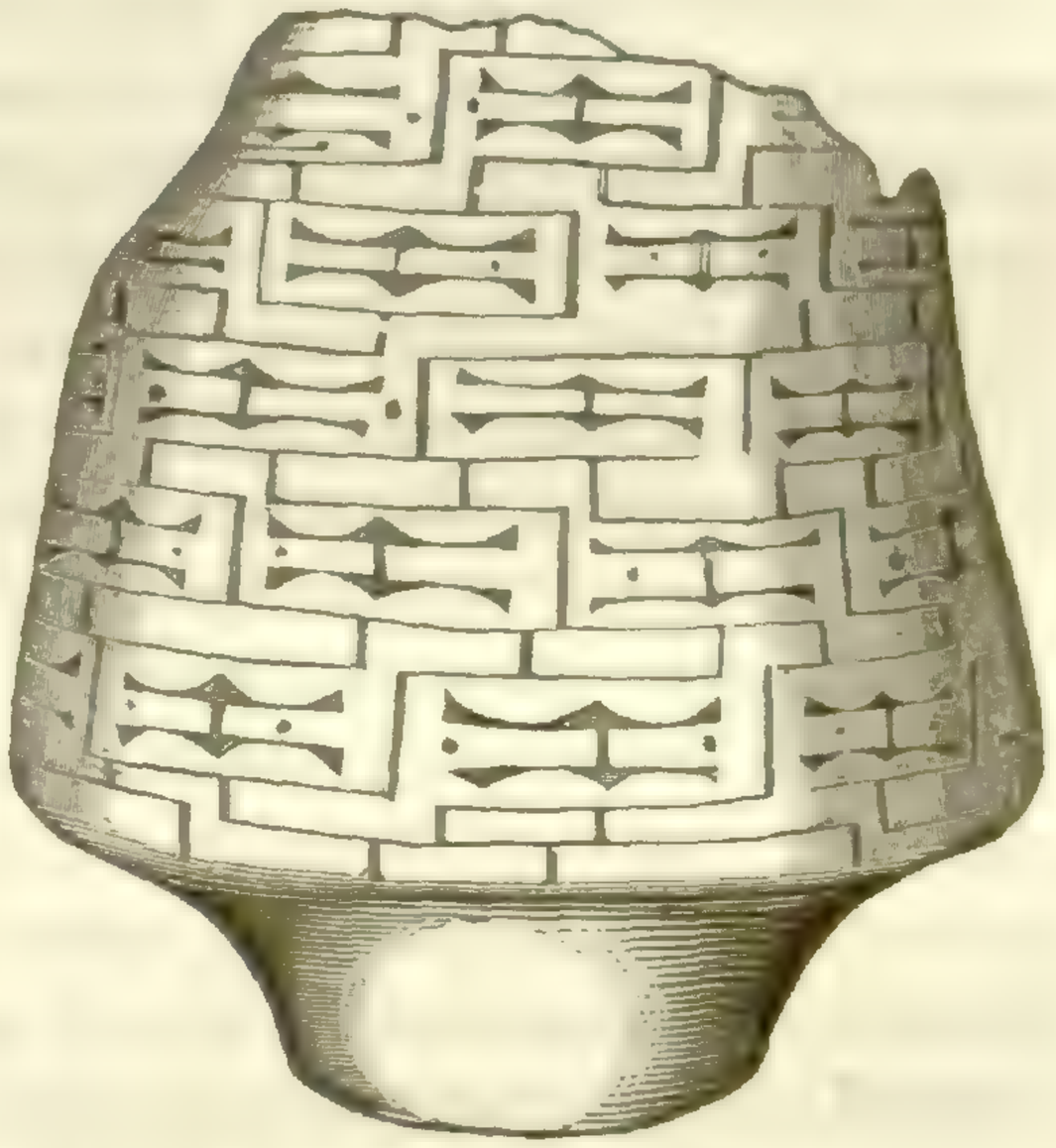


Fig. 65.



Indian Burial Jars, Marajo.

mains, none were brought home, but I may state here, that an expedition is on foot to thoroughly explore this, as well as some of the other localities.

Of jars or vases used for burial purposes (*ygáçaua*, * *ygaçaua-ocú*, *camuti*, Lingoa geral) there are two in the collection, large specimens which show quite well the form, together with a number of fragments. The two more perfect specimens (Figs. 64 and 65), are of the same general shape, but they differ in the style of ornamentation. Both consist substantially of two truncated cones united by their bases, the apicial angle of the lower cone being much more obtuse than that of the upper, so that the greatest

* Ygaçaua (*igaçaba* of Tupí dictionaries) properly means a large waterpot.

diameter of the vessel would be at about one-tenth its height, measuring from its base. The vase represented in fig. 64, judging from the curving outwards of the upper broken edge, as well as from the ornamentation, must have been little less than twenty inches in height. The diameter of the mouth I cannot give; the greatest diameter, measuring inside, is fourteen and three-fourths inches; that of the base is about five inches inside. The sides of the upper part of the jar slope regularly. Those of the lower part are slightly concave. Though skilfully made, it is nowhere exactly round, and bears no marks of having been shaped on a wheel. All the Marajó pottery was made by hand. The material is a rather fine clay with little or no sand. I have not observed, in the ancient Marajó pottery, any admixture of the ashes of the Caraipé tree (*Licanea utilis*), which are extensively used, at present, both by Indians and whites. The vase under discussion has broken with a very irregular fracture. The thickness at the base is about half an inch, at the top about a quarter. The outside of the vase appears to have been shaved down smooth, probably with a piece of wood, and washed with a fine whitish clay which has darkened in burning. The surface is very smooth, but quite irregular. The base and inside have not been polished. The ornamentation is unique and is well shown in the engraving. The lines are deeply engraved. The broad shaded portions of the chair-like figure have been roughly scraped, apparently by a stick with a broad flat end. These portions, as well as the lines of the figure, have received a wash of red clay laid on very daubily. The broad line, just above the base, is colored in the same way, but the double lines, separating the figures, are uncolored. As will be seen from the engraving, there is considerable variety in the rendering of the design.

The other vase (fig. 65) differs from that just described, in being a little larger, and in having the sides of the basal portion more concave. The material and the surface finish are the same, but the wash of cream-colored clay is of a somewhat lighter color, and the surface has a hard, glazed look. The pattern is quite as singular as that of the vase just described. The designs and all the double lines are washed with red clay daubed on as before. This vase is slighter than its companion.

Both of these vases were probably furnished with projecting knobs or ears (*nambí*) around the mouth. These are often in the

form of heads of animals and men. They are readily broken off, and large numbers of them were picked up on the shore amongst the broken pottery. In the collection is a fragment of another burial urn, whose greatest diameter must have been about two feet. It appears to have been made on the same pattern with fig. 64. The design was substantially the same, but the chair-shaped figure was more drawn out and disposed horizontally. The surface of the vase has the same creamy wash, and the engraved design is painted red. The bounding lines are treble or quadruple, and not colored.

Another fragment is of quite a small vase about eight or ten inches in diameter. The upper part, for apparently somewhat less than one-third the length, is swollen out, and ornamented with scroll-shaped bosses, curious knobs, and engraved figures. The part immediately below this raised portion is cylindrical, and ornamented with figures thrown into relief by deep, wide, engraved lines. The upper bulging portion received a wash of creamy white clay, and the lower part a similar coat of red clay. The whole surface was evenly smoothed, and the line-figures were cut in, or scraped out. One of the tools, used in cutting, had a narrow chisel-like edge, and was probably the tooth of some rodent. Where large surfaces have been cut down, the parallel marks of the tool are very distinct. The mouth of this vase was slightly funnel-shaped, and the lip probably bore ornaments.

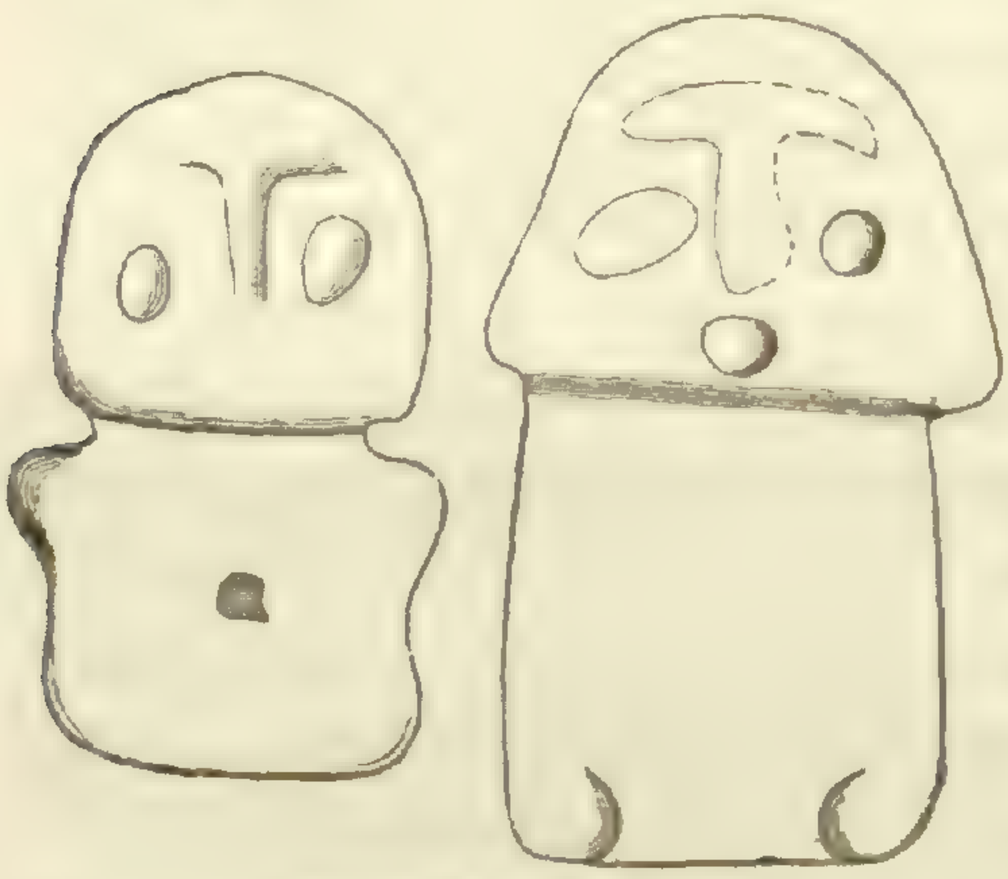
In addition to the above vases there are two other fragments of less interest. One indicates a vase, the body of which must have been about eight inches in diameter, and over a foot high. It is rudely smoothed inside, but the outside is rough and without ornament. The other was, in the body, at least, cylindrical, and about five inches in diameter. The outside was washed with red clay. A sort of geometrical pattern is cut through this into a lighter material below.

It is just possible that some of the smaller vases, above described, may not have been intended for burial purposes. The largest are too small to accommodate a skeleton, even if disarticulated. All the bones found in the urns were fragmentary. The probabilities are that the bodies were burned, and that only the ashes and charred bones were placed in the urns. An analysis of a small amount of black ash-like earth, found adhering to one of the jars, was made for me by one of my students, and found to contain a very large percentage of phosphate of lime.

There are two or three disk-shaped objects in the collection, which were probably used as covers to the jars. One of these has on one side curious engraved figures, which do not appear to be mere ornaments, but to be of a hieroglyphic character. This I am unable to figure here, but I shall describe it in another paper.

Of images or idols there are several in the collection, the most being in a more or less fragmentary condition. The largest of the specimens is represented in fig. 67. The body is nearly cylindrical, with two projecting knobs at the base for feet. A constriction represents the neck. The head was made quite round at first, but the after application of a high, wide, and angular ridge of clay, running completely over it from side to side, gives it a flat look. This ridge ends abruptly on each side at the neck and is there produced slightly outward. The brows and nose are represented by a T-shaped ridge of clay, applied in the same way as the crest; the eyes and mouth are simply round prominences. The brow and nose and the right eye have scaled off from this figure. The material is red clay with a wash of white. The surface is very rough, and the whole is very rudely made. The figure, from its weight, is evidently hollow, as were most of the others. The height is five and a half inches.

Fig. 66. Fig. 67.



Indian Idols, Marajo.

The figure represented in outline in fig. 66, is solid. It is exceedingly rudely made of coarse clay, full of sandgrains. The features are very indistinct. The brows and nose are represented by a T-shaped ridge. Slight projections from the shoulders hint at arms, and at the base are two irregular prominences as in fig. 67. The extreme flatness of the head is remarkable. In front is a hole, but whether accidental, or purposely made, I cannot determine. The height of the figure is about three and a half inches.

The same type of head and features recurs in the larger and more artistically finished head, of which fig. 68, is a representation. This last is also flattened, and shows the same transverse crest which, just opposite the eyes, is bent forward on each side. The united brows and nose form a wide, prominent, T-

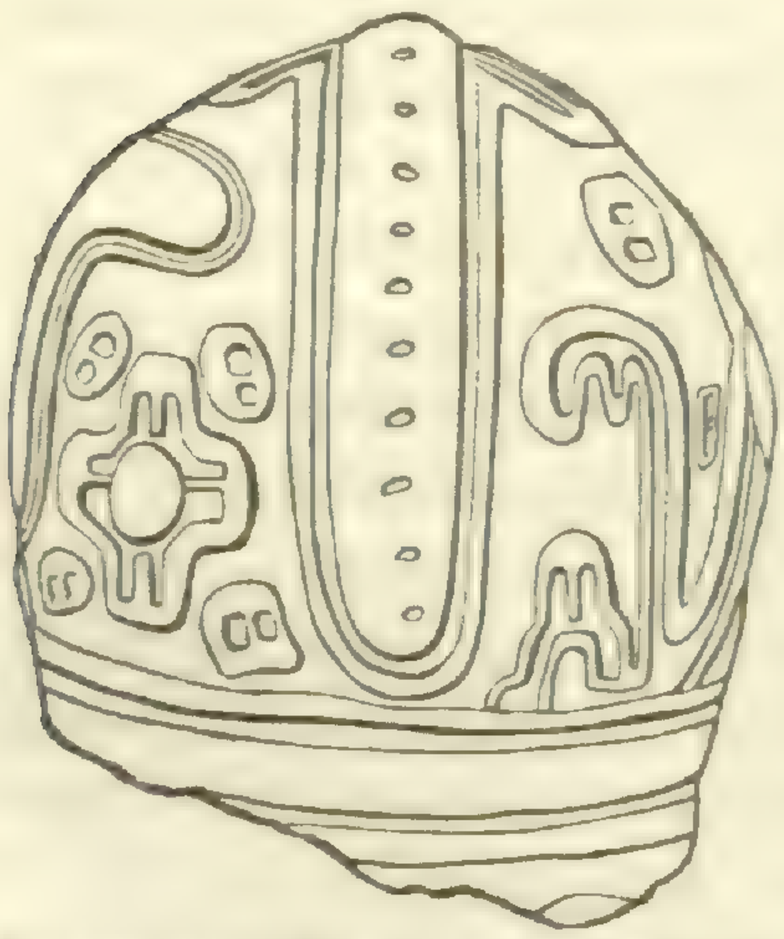
shaped ridge as in the other figures, the alæ of the nose being, however, well formed, though unsymmetrical. The eyes are round and very prominent, the pupil being represented. The mouth is a low, rounded elevation. The face received a wash of white clay. Around the brows and nose runs a wide, shallow groove painted red; a similar groove surrounds the eyes. The broad bands on each side of the mouth are also painted red. The other lines represented in the cut are engraved with a sharp point. The pattern enclosed in the rude circles occurs on other pieces of pottery from the same locality, as we shall see farther on. The back of the head is smooth and unornamented. The figure was hollow, the body probably resembling that of fig. 67. It was built from the base upward, the top of the head being the last part formed. Layers of clay were laid on one above the other, overlapping inside, and then pressed into shape by the fingers, which were introduced through a hole in the top of the head. The imprints of the fingers preserve sharply the impressions of the striæ of the skin, showing the direction from which the fingers were applied. Finally, a cap of clay was applied above, closing the opening, and the figure was worked into shape from the outside. The height of the head is three inches; breadth, four inches. Another head, also separate from the body and represented in figs. 62, 63 and 69, is larger than the others and in some respects more elaborately executed. It resembles them, however, in its being flattened, in its being furnished with the transverse crest, which, in this case, is low and rounded, and in the T-shaped combined brows and nose. It, however, differs from the images just described in the grotesque ornamentation of the eyes, cheek

Fig. 68.



Head of Idol, Marajo.

Fig. 69.



Side view of the head of idol represented in Figs. 62 and 63.

and forehead, and in the figures on the back of the head. All these are so well shown in the engravings as to need no description. The form of the mouth is peculiar. This figure was made in the same way as the last described, being built up from below, the top of the head being the last part formed. Instead of heavy, irregular layers of clay seen in the inside of fig. 68, the inside of this head shows fashioning by the aid of a narrow, flat-pointed instrument of wood or bone, which was introduced from above and before the head was finished, and turned round and round leaving shallow, irregularly concentric furrows, which extend nearly to the top. The outside was moulded so as to give the transverse crest, the brows, nose, eyes and mouth prominence. The surface then received a red wash. After this the ornaments were left in relief by the cutting down of the surface. The principal tool used had a narrow, chisel-like edge, slightly hollowed, which left a little elevation running along the middle of the groove cut by it. This instrument, I believe to have been the tooth of some rodent. The marks it made are very distinct, but it has been difficult to represent them satisfactorily in the engravings. It is hardly necessary to add, that all the features and the ornaments in relief are red, while the background is the color of the light, unpainted clay. A fragment of the body below the neck is preserved, showing part of a red figure in relief, so that, without doubt, the whole idol was ornamented in the same general style as the head. The height of this specimen is four and a half, and the breadth four inches.

Fig. 70.



Head of Idol, Marajo. Front view.

The ornamentation of the head just described might be regarded as capricious, were it not for the occurrence in the collection of the head of another idol (Figs. 70 and 71), which resembles it very closely. This last has not only the same shape of head, but the same pattern of ornamentation, though the latter is expressed in a more simple manner. There are, besides the same

broad raised lines bordering the crest, brows and nose. The mouth is not represented. The ornament about the eye is substantially the same in both, but in the smaller head it has only two salient parts, or rays. It is interesting to observe, that the little eye-like figure of which in the larger head there are four about each eye is not wholly forgotten in the smaller head, but it makes its appearance in the lower outer corner of the right cheek, as an irregular hollow square. The central boss on the back of the smaller head (Fig. 71), and the W-shaped figure in which it stands, form manifestly the same design as that seen on the back of the larger head. The two upper eye-shaped ornaments on the back of the larger head appear on the smaller as hollow squares. The two lower in the smaller head correspond to ornaments, which, in the larger are attached to the border. More of the body of this second image is preserved than of the other.

Fig. 71.



Back view of Head represented in Fig. 70.

The specimen (Fig. 70) is about three inches in length. The ornamentation consists of raised lines forming hollow, angular figures unsymmetrically disposed both in front and behind. Part of the crest is broken away. The ornamentation was unskilfully executed with a very coarse tool. Since these two heads were found lying loose, and at a distance from one another, there is little probability of their having been made by the same hand. The points of resemblance between them indicate the existence of a recognized and common design, which cannot but have a significance. Which is the elder of the two, and which corresponds more nearly to the original pattern, it is impossible to say. These images appear to have been of a sacred character, but whether they were used as idols during the life time of the individual, and buried with his ashes, or were sacred figures used only in burial, is not clear. I am unable to describe the mode of association of these images with the burial urns, as the former were picked up loose.

In connection with the vases and images, pottery of various kinds occurs. There are flask-like water-bottles, quite like those in use in Brazil to-day, cups, flat dishes and pots of various kinds, some very coarse, others highly ornamented with painted and en-

graved lines, and with ears representing animals' heads or human figures.

In Fig. 72, *n*, is represented a fragment of what may have been a ladle. The fragment is slightly concavo-convex and three and one-half inches long. Both sides were scraped down to a very smooth surface, which received a very thin coat of cream-colored clay, giving it a glazed look. The convex or outer side is traced with a rather elegant line-pattern in dark red, not engraved, which appears exceedingly well in contrast with the light background. Near the pointed extremity is a hole, showing wear, doubtless intended for a string. A shallow dish, of which I have a fragment, is painted inside very much in the same way as that just described, while another has a coarse figure drawn in dark umber on a light ground. I may remind the reader, that the variegated clays of the Amazonian deposits furnish very vivid tints, as reds, purples, browns, blues and yellows.* With these colors, the Indian women of Monte Alegre and elsewhere paint elegant designs on drinking cups of gourd (*cuias*), upon a background of *Cumatí* ("*Apocynea* vel *Asclepidea follicularis?*" Mart.). I have observed no trace of the use of the resin of the *Yutahy-sica* (*Hymenæa* sp.) extensively used to-day on the Amazonas, for glazing vessels intended for use over the fire.

The Indians of the Amazonas use an earthen utensil for broiling or smoking various articles of food. It is like a large, deep, heavy basin somewhat wider at the mouth than at the base but with no bottom. This is inverted over a slow fire, the food to be cooked being laid on green stems of *taboca* (*Bambusa*), placed across the opening. This utensil the Brazilians call a *muqueador*.† A broken one ornamented with human features in high relief, was found at the *Ilha das Pacovas*.

There is a little cup in the collection about an inch and a half in height, ornamented with the design, *e*, fig. 72. In the engraving it is placed horizontally, but on the cup it is upright. The cup

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* The yellow clay is called *Tauá*, the white, *tauá tinga* or white *tauá*. The Portuguese form is *Tabatinga*.

† The verb is *muquear*. This is one of the few Portuguese verbs derived from the Tupí. The same process is carried out by making a framework of green sticks supported on upright forked stakes. On this, fish, turtle's eggs, etc., are smoked and half cooked. The ancient Tupís cooked human flesh in this way. On the Amazonas the apparatus is called *muquem*. *Lery*, *Stade* and the old writers give the word *bucan*. Many words now pronounced with an initial *m* or *b* had originally an initial *mb*. Thus on the Amazonas one finds to-day *mboia*, *moia* and *boia* (*boa* constrictor).

is washed white, both inside and out, and the lines are engraved, together with the S-shaped design, which corresponds with the chair-shaped figure on the burial vase represented in fig. 65. This pattern, with its various modifications, resembles so closely the design occurring on the face of the image, fig. 68, and elsewhere, that all seem to be but different expressions of the same primary idea, which, in the beginning, at least, probably had some significance. The S-shaped design like that on the head, fig. 68, is sometimes formed by regular curves, but these are occasionally angular, in which case, the figure resembles the Greek fret. The opposing curves are always drawn with a double line, but the curves

Fig. 72.



a, *a*,′ *a*,″ Ornaments on fragment of pottery; *b*, *b*′, Fragment of a flat dish; *e*, Ornament on a little cup; *f* and *g*, Ornaments on fragments of pottery; *h*, Bead of pottery; *k*, engraved object; *m*, single design from vase, Fig. 65; *n*, Fragment of ladle.

are either not united at all in the middle of the figure, or if united, it is by a single line. In *a* and *a*′, fig. 72, from the same piece of pottery, and *f*, same figure, we have three modifications of the design, with curves united. In *b* and *b*′, fig. 72,* showing both sides of a fragment of a flat plate, they are not united. In some cases, as in *f*, *b*, and *b*′, fig. 72, the figure is ornamented by coarse shading between the double lines or by perpendicular loops or lines. On *b*′ is a cross of the ordinary Christian type, but it is well known that this emblem is one of the simplest of ornaments in use, not only among pagan nations long before the Christian era, but to-day.

* The longest diameter of this specimen is four and a quarter inches.

If the maker of the pottery had attached the Christian significance to the figure he was drawing, he would not have represented it on the opposite side of the same vessel without the transverse bar, and if the Indians, who made the Marajó mounds had been christianized they would not have buried their dead in jars. It seems to me that the Indian artist, finding he had a large space to fill up on one side, drew a transverse line across the perpendicular one to make the figure larger. The cross also appears on *a'*, fig. 72.

The question of the primary significance of the S-shaped design I must leave to the student of the philosophy of art, together with the question of the independent origin of ornament, which also arises in the study of this pottery. The observant reader will detect the same pattern that I have just been describing, in use in carpets, ornamental borders and a hundred other places to-day.

Among other relics from the Arary mound is a large bead of clay roughly represented in fig. 72, *h*. It is very irregular in shape, rudely made, and the ornamentation is badly executed. It is much broken. Its length is two and a quarter inches.

Fig. 72, *k*, represents the end of an object cylindrical in the middle, and suddenly swelling out at both ends, one of which is broken. The design is deeply engraved, and the object was perhaps used as a stamp, but it is so irregular that it would have served very indifferently for that purpose. The width across the face is about an inch and three-quarters. A somewhat similar figure to that on the end is engraved on the side. The perforation extends nearly through from one end to the other. It might be taken for an unfinished bead were it not that two other partially perforated objects of a somewhat similar character are found in the collection. One of these is a lens-shaped piece of pottery, an inch and three-quarters across the flat face, which appears to have been ground into its present form. A hole is bored through it in a direction perpendicular to the centre of the flat face. The other is a pear-shaped object, about the size of a large marble, perforated in like manner from the smaller end. Its use I cannot divine.

We have no historical record of the tribe that built the Marajó mounds. Senhor Penna has had the kindness to examine carefully into the subject for me, and it would appear that the mounds antedate the discovery of America. We have no record of the existence of any tribe in the lower Amazonas within historic times, that buried its dead in jars. I do not feel like coin-

ciding with Von Martius in the supposition that the Marajó mounds were made by Indians of Tupí descent. There are many resemblances between the pottery of Marajó and that of Peru and North America that will be worth study. I hope that future explorations will enable me to clear up some of the doubts expressed in this paper, and cast much needed light on the ancient races of the Amazonian valley.

APPLICATION OF THE DARWINIAN THEORY TO FLOWERS AND THE INSECTS WHICH VISIT THEM.*

The first impression which flowers make upon us with the beauty of their radiate and symmetrical forms, their luxuriant display of colors and the variety and sweetness of their odors, easily begets in us the idea that they were created for delighting and gratifying our senses.

This, however, is a pleasing fancy which the Darwinian doctrine speedily annihilates. This doctrine teaches us that all the species of animals and plants now in existence are only the result of the same laws which, starting from the beginning of organic life on the earth and coming down to our day, have governed and continue to govern all animated things; and these are the laws of hereditary transmission and variation, of the struggle for existence and the consequent necessity that only those forms survive which best respond to external circumstances.

According to the Darwinian doctrine all the characteristics and properties of animals and plants appeared at first only as simple, *individual variations*, which were a necessary consequence of determinate physical and chemical actions,† and which, if they have

*Discourse delivered by Dr. ERM. MÜLLER of Lippstadt at the 26th General Assembly of the Naturhistorischen Verein für Rheinland und Westphalen, 1869. Translated into Italian from the German with Annotations by Prof. FREDERIC DELPINO. Translated for the NATURALIST from the Italian by R. L. PACKARD.

† The lively sense of fraternal friendship which unites me with the able author of this discourse cannot dissuade me from expressing my own views whenever they differ from his. I also am profoundly convinced that all variations were at first merely phenomena of individual variations subsequently fixed by the laws of hereditary descent.

been perpetuated, owe it to the circumstance that, in the struggle for existence, they were advantageous to those individuals in which they appeared. From the Darwinian doctrine, then, there springs the following thesis, which is of general application; that *in all animals and in all plants there is not a single characteristic, a single property, which is not either useful to its possessor, or at least is not inherited from ancestors more or less remote, for whom, at some time, it procured a decided advantage in the battle of life.*

Therefore, if we wish to apply the Darwinian doctrine to the rich and varied kingdom of Flora, we should, in the first place, answer this question: in what manner and by what means have the brilliant colors, the diverse odors, and the variegated structure of their flowers been of use to plants? The solution of this question cannot be obtained from a consideration of the flowers alone, for their properties are not *immediately* useful, but only *mediately;* and the mediation is accomplished by insects.

That flowers are visited by insects in various ways, and that many of them—bees, for example—are constrained to visit them for food, is well known; but this fact does not suffice to explain how these visits can be advantageous to the plants. Colors, odors, pollen, and honey seem at first sight to be of utility only to insects. If, as did C. C. Sprengel towards the close of the last century, we should propose to consider how insects act upon plants, and the wonderful conformity of floral structure which certain plants have with certain insects, we, like Sprengel, would easily fall into the belief that such harmonies are the cause of the insects effecting, without either knowing or willing it, the transfer of pollen from the anthers to the stigmas, while seeking their food in the flowers. But why should nature have entrusted to insects the

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but can in no way admit that the causes of these variations were *only determinate chemico-physical actions*. For who has ever been able to determine them, and who will ever be able? I should rather say that the causal principle of these variations is an intrinsic and not external one; an intrinsic principle reacting during the whole of life against extrinsic influences, or chemical and physical agents. I am far from wishing to deny the action or influence of external circumstances; but I think that these, as long as life lasts, and within certain limits, are ruled over by that internal principle, intelligent and free, which I suppose incarnate in all living things. I candidly confess that my mode of thinking is purely and simply theoretical: but the contrary thesis maintained by Müller and all the naturalists of our age, is also purely and simply theoretical, and always will be! and theory for theory, I prefer my own.

As to which of the two theories, the dualistic or the monistic, will ultimately gain the victory, I think I do not err in saying that the question is and always has been insoluble.

accomplishment of this transfer, when it would have been much more simple to dispose the organs in such a way that the anthers might cast the pollen immediately upon the stigmas? The reason of this Sprengel failed to comprehend, nor should we be more successful without recognizing an important natural law recently detected by the author of the doctrine of natural selection.*

Charles Darwin saw, what Sprengel failed to see, that the principal effect of the action of insects upon plants is the transfer of the pollen of one individual to the stigma of another. To this conclusion he was led by his beautiful researches on the floral structure and the fecundation of Orchids. And from these he subsequently inferred that it is advantageous to every vegetable to have its pistils fecundated by the pollen of other individuals of the same species, rather than by its own. As soon as observation had made Darwin master of this great truth, he resorted to the control of experiment. The experiments made by him with unwearied diligence through a long series of years — scattering upon the stigmas of plants of the same species, sometimes their own pollen, sometimes that of others — placed it out of doubt that *the impollination of the stigmas with the pollen of other individuals, or the intercourse between distinct individuals, produces an offspring more numerous, more robust, and capable of greater development than if fecundation had been produced by its own pollen;* a thesis which subsequently became amply confirmed by the numerous experiments of Hildebrand, my brother Fritz, and others. The enigma of floral structure is then solved, and we will now pass to the

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*The author attributes to Charles Darwin the merit of having first formulated the law of the necessity of cross-fertilization even for hermaphrodites; but this law, already partially seen by Kœlreuter, was comprehended in nearly all its vigor by C. C. Sprengel.

Kœlreuter having in 1761 made the discovery that in the Malvaceæ, Epilobia and Polemonia, the stigmas are developed long after the anthers, and therefore have to be fecundated with pollen from other flowers, makes the following shrewd remark. "An id aliquid in recessu habeat, quod hujuscemodi flores nunquam proprio suo pulvere sed semper eo aliorum suæ speciei impregnentur, merito quæritur. Certe natura nil facit frustra."

C. C. Sprengel went further, and on p. 43 of his work, "Das entdeckte Geheimniss der Natur in Bau, und in der Befruchtung der Blumen" (1793) uses these memorable words: "Since there are so many unisexual flowers, and since among hermaphrodite flowers there are so many that do not mature the male and female organs at the same time, it *appears that nature does not wish that each flower should fecundate itself with its own pollen.*" And he cites as a support an experiment made by him upon the flowers of *Hemerocallis fulva* which, after being fecundated artificially with their own pollen never perfected the seeds.

principal applications of the foregoing thesis in the explanation of the forms and properties of flowers.

If it is true that intercourse between distinct individuals produces a more vigorous and numerous offspring, it is equally true that every variation in the flowers which favors the transfer of pollen from one individual to another secures a notable advantage to the individual in which it takes place, and therefore cannot fail to be fixed and perpetuated by means of natural selection.

Now, as far as we know, there are only two external agents which can effect this transfer, namely, the wind and insects;—naturally with the contingence of very different floral structure.*

The different species of plants, as concerns the variations which first appeared in them, would, by natural selection, accommodate themselves to the wind or the visits of insects, by suitably modelling their flowers either upon an anemophilous or an entomophilous type.† The action of the wind is simple and uniform, while that of insects is extremely varied: therefore their self-adaptation to the action of the wind presupposes a variation in a single and definite direction; whereas that to the visit of insects takes place in as many different ways as there are differences between individual insects; that is to say, differences in size, form, structure, habits, modes of life, sympathies, antipathies, seasons, etc. Therefore, from the Darwinian point of view, we should expect to find: first, that the variations of plants arising from adapting themselves to the multiform actions of insects should have taken place far more frequently than those due to their adapting themselves to the uniform action of the wind; second, that plants modified to receive

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*The numerous observations made by me in this field of biological study put me in a condition to enlarge a little upon what the author says here. The fecundating agents of plants besides insects and the wind I think are the following natural agents:—

The humming birds (Trochilus, Ornismya, Nectarinia, etc.) for a great variety of tropical plants; snails for *Rhodea Japonica* and some Aroideæ; water for *Vallisneria spiralis*, probably for all the Zosteraceæ and all the Florideæ (according to the recent and beautiful observations of Thuret and Bornet).

As to humming birds, never having been able to visit tropical countries I was obliged to limit myself to conjectures, which have subsequently been partly confirmed by letters from Charles Darwin as regards the fecundation of the genus Strelitzia, and from Fritz Müller as regards that of certain Passifloræ, Salviæ and other Brazilian plants.

† The terms anemophilous for plants fecundated by the wind, and entomophilous for those fecundated by insects were proposed on p. 34–35 of a work of mine upon the *arrangements for fecundation in anthocarpous plants* (Florence, 1867), and have been adopted by Severino Axell in his fine work *Om anordningarna för de fanerogama växternas befrutkning* (Stockholm, 1869) and by some others. That is why I permit myself to translate with such words the compound nouns *Wind-blüthen* and *Insect-blüthen*, used by the author, which cannot be literally translated.

the visits of insects should offer a much greater variety of floral forms than plants adapted to the wind.

These two propositions which are necessary consequences of the Darwinian doctrine are effectually confirmed by observation. for anemophilous flowers are not only less numerous than entomophilous,* but are also much less varied in their conformation.

The transfer of pollen by means of the wind demands that the anthers and stigmas be well exposed to the air, and it is also necessary for the pollen to be subtile and very light and dry, so as to be more easily carried by the air, and to be produced in enormous quantities so as to insure fixing upon the stigmas some one of its grains. Remarkable examples of such a disposition are afforded by the Cupuliferæ, Coniferæ, Graminaceæ, Juncaceæ and Plantaginaceæ.† If, for example, a bush of hazel in flower is shaken, or if

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* If we think of the immense number of individuals belonging to the essentially anemophilous families of the Coniferæ, Amentaceæ, Graminaceæ, Cyperaceæ and Juncaceæ, and of the great number of flowers which every individual of them usually bears, the statement that anemophilous flowers are less numerous than entomophilous is subject to dispute

At bottom, however, the principle maintained by Müller is most just: and the only change which occurs to me is to substantiate for his proposition this other; *anemophilous species are not only much less numerous, but also much less varied in the structure of their flowers than entomophilous species*: a most true and splendid generalization, which explains why in cold countries where the generation of insects is opposed by the climate, the whole of the vegetation is composed of anemophilous and gregarious plants (firs, birches, Graminaceæ and Cyperaceæ), and therefore desolately monotonous and poor in form; while in warm countries where myriads of insects abound, vegetation is most rich in diversity of forms and therefore composed of species not gregarious but entomophilous or ornithophilous.

† The genus Plantajo furnished me a most interesting subject of study, since by examining some of its species I saw how by gradual transitions an anemophilous species can change to an entomophilous.

Plantago lanceolata, as far as I could observe, develops in three forms. One of these has a stout and very high scape with whitish anthers which are quite broad and tremble in the wind, inhabits meadows and is exclusively anemophilous, as I have never seen it visited by insects. Another form is found upon hills, the stalk is not so high as in the first, and like it is essentially anemophilous. I saw, however, occasionally a species of Halictus light upon its spikes and try to gather the pollen; but the structure of the flower is so ill-adapted to such a purpose that the greater part of the pollen fell to the earth without being of use either to the insect or the plant. The third form is of small size, inhabits mountains, the spikes are very short, and the filaments shorter than in the others. In the pastures upon the Apennines of Chiavari I saw a great number of bees flying diligently from one spike to another, collecting pollen with perfect success and providing equally well for a promiscuous intercourse between the plants. There is, therefore, a form of *Plantago* perfectly intermediate between the anemophilous and entomophilous forms, and equally capable of being fecundated by the wind or bees.

Now if we suppose the filaments of this form to become rigid and colored, the pollen unctuous and sticky, and the anthers to lose their special tremulousness, we should reach the gradual metamorphosis of anemophilous into entomophilous characters, and witness the formation of an entomophilous from an anemophilous species. Exactly

we blow upon one of its mature catkins, we see at once small clouds of pollen emitted and carried away, and if immediately after we examine the surrounding stigmas we find very few which have not some granules of pollen attached to them. In this example, as a condition of the easy dispersion of the pollen by means of the wind, we have the excellent form of inflorescence of the male flowers arranged in catkins freely suspended in the air, and, as a condition of an inevitable intercourse between individuals, we find a separation of the sexes, which is a quite general phenomenon in anemophilous flowers. In other cases, for example in the Plantaginaceæ, the parts shaken by the wind are the anthers which hang suspended from long and very weak filaments, and the intercourse between individuals is obtained not by a separation of the sexes, but by a difference of time in the development of the sexual organs. In these plants, while the anthers are yet immature and enclosed within the floral envelope, the stigmas, perfectly mature, have already appeared in the form of long, plumose stalks; and only when the stigmas have passed maturity do the anthers appear. Such are the principal characteristic differences of anemophilous flowers.

The flowers fecundated by the intervention of insects are far more highly differentiated in the disposition of their parts. Yet here, too, some general conditions necessary to secure the visits of insects, and the transfer of pollen by their means can easily be determined. And in the first place, it is necessary that the insects should be able to distinguish such flowers at a distance. Now this can only obtain in three ways, either by means of the colors, or the odors, or both colors and odors at the same time. And this *a priori* deduction from the Darwinian doctrine is in harmony with the facts; for entomophilous flowers are either colored, or odorous, or colored and odorous at the same time. In like manner, odors and colors are *a priori* perfectly useless to anemophilous flowers, or those fecundated by the wind, and are not, therefore, properties which can be fixed by natural selection. With this, too, the reality corresponds perfectly, for anemophilous flowers have neither colors nor odors.

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what we here merely suppose, takes place in reality. The *Plantago media* is a Plantago which has become entomophilous; its stamens are of a beautiful rose color; the tremulousness of the anthers is lessened, the pollen has lost its volatility, and the plant is normally visited by *Bombus terrestris*, as I ascertained in the mountains above mentioned.

A second condition which is absolutely necessary to obtain a regular and indefectible visit of insects is, that the flowers furnish them some substance which is agreeable and of use to them. In the more simple cases, for example in Anemone and Clematis,* such a substance is the pollen which the insects feed upon, or gather as food for their larvæ. In other cases it is not only the pollen which is presented to them, but also honey, as in the Ranunculi, the Rosaceæ and many other plants. In still other cases the stamens withdraw themselves more or less from the depredatorial action of insects which then take from the flowers only honey. This takes place in the genera Salvia, Pedicularis, and Iris.†

*Not all the Anemoneæ nor all the Clematideæ are without honey. *A. coronaria*, *hortensis*, *paronina*, *nemorosa*, and *Hepatica* are without nectaries, or seemed to me to be so, but in *A. pratensis* and probably in all the forms of the subgenus Pulsatilla, the outer row of stamens show different stages of atrophy, and have anthers more or less abortive and changed into nectaries. As to Clematis, it is true that some of the species are without honey, at least none has yet been found in them; but in *C. Balearica* and some others, the more external filaments are dilated and transmuted into real introrse honey-bearing receptacles, which Bombi and Xylocopæ visit. Finally in *C. integrifolia*, although the outer stamens, which are hairy and diluted, have no nectar, the much narrower and glabrous inner ones have nectarifluous filaments.

It is very difficult to determine whether a flower has or has not honey. It is frequently found where least expected and secreted by entirely different organs. I have been frequently mistaken in the search. For instance, although I have had occasion for three or four years to study the flower of *Caltha palustris*, it is only a short time since I discovered that from each one of its carpels honey transudes through two small rhomboidal spaces in its external surface. The discovery was made while observing the deportment of a Halictus in one of the flowers. I noticed that it not only gathered the pollen, but sought something else, turning its proboscis towards the centre of the flower. Then, instructed by the insect, I examined the flower more closely and found that its nectaries secreted a very dense and white honey. It is an incontestable fact that, in this kind of search honey-bees show greater sagacity than we ourselves. The same, however, cannot be said of Diptera, which are in general of obtuse intelligence. And, in fact, all the flowers which are destined to be preferably visited and impollinated by Diptera (flesh-flies, Eristalidæ, Syrphidæ, etc.), secrete honey in broad and open nectaries, easily discovered.

It is singular how honey is secreted by the most different organs. Thus, in the single family of the Ranunculaceæ the honey is secreted, 1, by the reddish margins of the sepals in certain of the *Paoniæ*; 2, by the petals in Ranunculus, Myosurus, Trollius, Isopyrum, Helleborum, Nigella, Delphinium, Aconitum, Coptis; 3, by the abortive anthers in *Anemone pratensis*; 4, by the filaments in some Clematideæ; 5, by the carpels in the genus Caltha. So that in the Ranunculaceæ we have the singular example of all the floral organs, petals, sepals, stamens, and carpels, assuming and abandoning alternately the function of secreting honey for the advantage of insects.

†This does not accord with my observations. Our species of Salvia are visited almost exclusively by bees. When they thrust their heads into the fauces of the flower to suck the honey, the anthers, by means of a curious hinge movement, scatter the pollen upon their backs. Now the honey bees and Bombi collect this pollen carefully, brushing their backs with their legs from time to time. The same is true of Iris. I have frequently surprised a Bombus (I am uncertain whether a *B. hortorum* or *terrestris*) and *Xylocopa violacea* entering one of the three mouths of the flowers of this plant, and covering its back with pollen; after visiting two or three flowers it would

In much rarer instances, insects seek in the flowers neither pollen nor honey, but a different substance. Some Coleoptera which are of comparatively little importance in the fecundation of flowers, suck the tissues of the floral organs. In the case of a small orchid from Brazil, according to my brother Fritz, the lip becomes filled with a kind of flour. In other Brazilian flowers there are fleshy excrescences which the insects visiting those flowers gnaw.* A

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rest a short time in order to brush itself with its legs and collect the pollen there accumulated. I have elsewhere described the admirable mechanism of the flowers of Pedicularineæ, by means of which bees in thrusting the proboscis into the melliferous coralline tube, cause all the pollen to fall upon their backs, which without doubt they collect with great diligence.

Thus the flowers in question, far from having dispositions tending to withdraw pollen from insects, have admirable adaptations for furnishing it to them with great speed and abundance. Nor are the flowers of Salvia, Pedicularis and Iris alone in this, but almost all those belonging to the labiate or papilionaceous types, which are characterized principally by being always irregular and more or less horizontal or pendent.

The flowers of the labiate type have the honey-food in the lower part and the pollen-food in the upper, so that insects visiting such flowers get the pollen upon their backs. To this type belong nearly all the plants which Linnæus calls *didynamous*, that is to say, nearly all the Labiatæ, Personatæ, Acanthaceæ, Lobeliaceæ, etc.

The flowers of the papilionaceous type have the position of the food curiously inverted; for the pollen is at the lower part and the honey at the upper, so that insects visiting these plants cover the abdomen and not the back with pollen. A large part of the Leguminaceæ are of this type, which is also seen in some Polygalæ, Fumariaceæ, in the genus Collinsia among the Personatæ, and in the genus Hyptis among Labiatæ, etc.

In flowers of the labiate type the anthers are guarded above by one or more petals shaped like a helmet; in those of the papilionaceous type they are guarded below by one or more petals shaped like a keel. Müller's error, which is very excusable, comes from not having well interpreted the scope or function of this protection of the anthers, which instead of keeping pollen from insects rather favors giving them the whole. And what is the purpose of this protection? It is the very important one of protecting the pollen from atmospheric agents, especially rain.

And while upon this I think it worth while to call to notice the fact that the flowers of the labiate and papilionaceous types are, at least in Europe, exclusively designed for bees, flies being too stupid to discover where the pollen and honey are, and the Lepidoptera (diurnal), which sometimes visit them not being able to open the carina or galea and thus contribute to cross fecundation. These plants, therefore, belong to that numerous class which I call melittophilous.

*In the flowers of Serapias there is a large, dark-purple protuberance, which I conjecture is designed to be attacked by some insect specially active in fecundating this plant. But in eastern Liguria, where this plant and *S. cordigera* abound, I never succeeded in surprising insects upon its flowers nor in discovering pollen-masses displaced or stigmas fecundated. But my friend Luigi Ricca, the distinguished botanist, succeeded in western Liguria in surprising a bee on *S. longipetala* with its head loaded with pollen-masses; but he did not notice whether it gnawed the protuberance or not.

One of the magnolias, *Illicium religiosum*, as I recently observed, produces in the centre of its flowers a group of very juicy *pseudostigmatic* papillæ, which doubtless furnish food to some particular Cetoniæ; which I am the more disposed to believe, as I have seen *C. aurata*, *stictica* and others eagerly licking the stigmatic or circumstigmatic papillæ of *Magnolia grandiflora*, of which they are the real and peculiar fecundators.

In the same way the Ceteniæ, which are the normal fecundators of *Peonia montana*,

small bee, formerly noticed by Réaumur, the *Anthocopa papaveris*, cuts from the flower of the wild poppy pieces of the petal for lining the walls of its cells.

A third condition is a suitable conformation of the pollen granules and the stigmas. The pollen should be able to attach itself to the bodies of insects, and the stigmas should be able to detach it therefrom.

This affixing the pollen to the bodies of insects could not occur except by means of a spinose surface of the pollen granules, as is the case in the genera Malva and Taraxacum, or a light viscous coating as in most plants: or unless, as in the Orchidaceæ and the Asclepiadaceæ, there is a singular mechanism which attaches to the bodies of the insects the entire mass of pollen contained in the anther-lobes. Hence we see why we should not expect to find in entomophilous flowers the dry and smooth pollen of the anemophilous.*

Instead of plumose stigmas, fitted to collect pollen diffused in the air, and appropriate to anemophilous plants, we find the stigmas of entomophilous flowers smooth or papillose, but always more or less viscid.

All the many differences in colors, odors, pollen and honey, and in the structure of the pollen and the stigmas, which characterize entomophilous flowers, can be explained with entire ease if we think how infinitely varied is the mode in which the numerous phalanx of anthophilous insects can transfer pollen from one flower to another. Therefore we should not expect to find perfection reached in this or that individual flower, for we see that different plants, in their relations with insects occupy different grades of perfection, which is in entire accord with the Darwinian doc-

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apparently suck by preference the red, fleshy disk (the morphological nature of which is so much in controversy) which encloses its carpels.

*Sometimes in the best pronounced entomophilous plants there is found pollen perfectly smooth, pulverulent, and light. But in these cases it is easy to account for the phenomenon. There is for instance a floral type essentially melittophilous common to the genera Borago, Cyclamen, Galanthus, etc. The flowers droop, and the connivent anthers enclose the style, forming a pyramid. The bees grasp this pyramid and pressing upon it, sprinkle the breast with pollen. It is clear that if the pollen had not been smooth and pulverulent, its discharge would not have been effected and the floral arrangement in question would be of no use.

For the same reason the pollen of *Rhinanthus* is pulverulent, smooth and dry, as it has to be scattered upon the backs of bees.

Likewise in the family of Melastomaceæ, and the genera Solanum, Cassia, Erica and others, the pulverosity of the pollen is in evident relation with the dehiscence of the anthers, having pores at their summits.

trine. It has not yet been satisfactorily shown whether or not there is any plant subject to a perennial self fecundation (selbst befruchtung), that is to say, any plant with hermaphrodite flowers where the stigmas are constantly and exclusively fecundated by their own anthers. This seems the most simple case, and was probably at first general.*

However it may be with many plants, in the case of the Ranunculaceæ, Papaveraceæ and Cruciferæ, the visits of insects effect with greater facility the impollination of the stigmas with the pollen of their own flowers (*homoclinous or homogamous impollination*) than the transfer of pollen from one flower to another (*heteroclinous impollination*).

Among primordial and homogamous plants every slightest variation which might open a way to the possibility of the transfer of pollen constituted a signal advantage; and therefore the variations of color, secretions of honey and viscosity of pollen, became fixed in the flower by natural selection. In other and more numerous cases to these simple dispositions others more complicated were added, and of such a nature as not only to favor the eventuality of heteroclinous fecundation, but render it inevitable and necessary. The sexes, for example, began to separate themselves as individuals or distinct flowers, as in the genus Salix and the

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*Charles Darwin was the first to conjecture that primordial plants were essentially hermaphrodite or monoclinous, and that diclinous plants were later and had developed unisexual flowers in obedience to the grand principle of the division of physiological labor. Frederic Hildebrand (Die Geschlichter-Vertheilung bei den Pflanzen. Lips. 1867, p. 12–14), adopts the same opinion. In a work of mine (Atti della Soc. Ital. di Scienze nat. in Milano, vol. x, 1867, p. 275–277) I exposed summarily the reasons which caused me to embrace opinions diametrically opposite. Subsequently I collected a great number of data, all which confirmed me in my views. Severino Axell (on anordningarna för de fanerogama vaxternas befruktning. Stockholm, 1869, p. 89–93) strenuously defends my opinion to which he says he was led by a process of reasoning extremely like mine but entirely independent, since he heard of my work only after his own conclusions had been reached. This coincidence gives great weight to my argument, but as it is not a suitable place to develop it here, I will only mention that the families of plants received as primordial, for instance, the Coniferæ, Cycadeæ, and Amentaceæ are unisexual and anemophilous par excellence, while those which have experienced greater evolution and are more perfect, for instance, the Ranunculaceæ, Leguminosæ, Compositæ and the Corolliforæ in general, are eminently hermaphrodite and entomophilous.

Dioecious and monœcious plants form the primordial group (essentially anemophilous,; from these are then developed polygamous plants (intermediate between anemophilous and entomophilous), and from these again the hermaphrodite plants (essentially entomophilous).

This harmonizes with paleontological data; but this important generalization I reserve to develop elsewhere with a sufficient amount of facts and arguments.

Cucurbitaceæ. Here it is obvious that the transfer of pollen by means of insects is rendered absolutely indispensable. In other plants, as in *Cerastium arvense*, the Umbelliferæ and Compositæ, although both sexes are united in the same flower, yet they are not developed contemporaneously; wherefore it is equally necessary for insects to transfer the pollen from one flower to another. Finally in many other plants the flowers are formed and disposed in such a way that the transfer of pollen by the agency of insects is greatly favored and frequently even rendered necessary.

From among the great number of floral arrangements which render heteroclinous impollination necessary, and which have been brought to light by the researches of Darwin, Hildebrand, Delpino and my brother Fritz, I will mention two which not long since appeared sufficiently enigmatical, which enigma, however, has recently been solved by direct observation of the fecundating insects; I mean the floral arrangements of the Orchis of our meadows, and *Cypripedium Calceolus*.

Orchis Morio, *masculo*, *latifolia* and *maculata* have a spur in their flowers in the cavity of which no honey is found. This absence of honey is a phenomenon without parallel in the vegetable kingdom. Sprengel on that account called them plants with *false nectaries* (Scheinsaft pflanzen), imagining that the insects which visit them are deceived by the odors, colors and form of the spur into inserting their heads into the fauces of the flower with the expectation of finding honey. He was never able, however, to observe how the fecundating insects conduct themselves in the flowers of these Orchises. He observed, indeed, frequently, masses of pollen displaced and sticking upon the stigma, and occasionally came upon dead flies in the flowers, whence he concluded that flies are the fecundators of these plants. Nevertheless, the floral arrangement of the Orchises remained somewhat mysterious to him. "It is inconceivable to me," he says on page 404 of his work, "how it is that such flowers produce no honey, when, as it seems to me, it would be much better for them to produce it with a view to enticing flies to visit them repeatedly and fecundate them."

It is clear that Sprengel himself was conscious of not having completely deciphered the enigma. Darwin, too, as we read in his work on the Orchids, never succeeded in surprising insects in the field Orchis, although he had observed them diligently not less than twenty years. Nevertheless, he proceeds to expose in detail

the process of their fecundation, because his theory of natural selection, according to which only useful qualities can be fixed and preserved in living things, placed him in a condition to infer from simple inspection of the flowers, the details of the fecundative process.

As far as concerns the Orchis of our fields, Darwin had come to the conclusion that the insects visiting them might suck the honey enclosed between the inner and outer membranes of the spur, piercing the latter with their proboscis; that such an operation required the precise time necessary for the viscous stalks of the pollen-masses to attach themselves firmly upon the heads of the insects; and that the time occupied by the pollen-masses securely attached to the insects in becoming depressed upon their stalk so as to be able to rub against the stigma, corresponds nearly to the time employed by the insects in visiting one plant and passing to another. In this way, intercourse between two individuals would necessarily take place.

However, when we consider the immense number of such Orchids in the meadows, and reflect that insects have to perform several operations in order to fecundate them, it seems strange that they should never have been surprised at work by any one. Fortunately, I am able to fill up this gap and at the same time fully confirm Darwin's conclusions.

Towards the close of last spring I had taken a good many Bombi and some honey bees with several masses of pollen upon their heads, and I saw a *Bombus sylvarum* fly to the flowers of *Orchis Morio*, stick its proboscis into the spur and fly away with pollinaria upon its head. On another occasion, I saw at a distance a *Bombus lapidarius* fly to the flowers of *Orchis latifolia*; and I also saw a dipterous insect, *Volucella bombylans*, with the pollen-masses of *Orchis maculata* upon its head. However, during the spring I was not able to observe these insects closely enough to note exactly their movements and deportment.

But subsequently, on the sixth of this month (May, 1869) upon the heights of Stromberg, very abundant in Orchis, both I and my son Hermann were enabled with ease, and close at hand, to observe many Bombi at work. At a place full of *Orchis masculo* we saw a Bombus which appeared to be *B. terrestris* fly to the lowermost flower of a spike of this Orchis. It inserted its head into the flower, remaining about four seconds, and then withdrew it with

two pollen-masses attached. Ascending from the bottom towards the top, it visited the second and third flowers of the same spike. After withdrawing its head from the third flower, it stopped a short time and endeavored to brush off the pollen-masses with its legs, but without success. It then continued its visit, climbing up the spike, and visited a fourth flower. At this point I tried to catch it in the net, but failed, and it flew away. After standing a short time we saw a *Bombus hortorum* visit three or four flowers from base to summit of a spike of *Orchis mascula*, after which it flew to another individual of the same species, visiting its flowers in the same way. Upon examining the stigmas of this second individual we found pollen scattered upon them, and the anther lobes emptied of their pollen-masses. In the space of about two hours, which we spent in observing this fecundation of *Orchis mascula*, we noted two visits of *Bombus lapidarius* and one *Psithyrus campestris*. The *Bombus lapidarius* did not remain in the flowers longer than from two to three seconds. We captured the *Psithyrus* and one *Bombus lapidarius*. Both had a quantity of pollen-masses upon their heads, some of which were already depressed upon their respective stalks, and therefore in a condition to rub against and fecundate the stigmas, while others were yet erect and therefore not in a condition to effect fecundation. Of ninety-seven bees collected by us in this excursion, thirty-two had pollen-masses stuck upon their heads. Sometimes we observed that the bees succeeded in freeing themselves from some of the pollen-masses, either by tearing them off with their mandibles or brushing them off with their fore-legs. Possibly, it is in this way that sometimes in the flowers of Orchis, pollen-masses are found in greater or less proximity to **the stigma, out of place and, as it were, wasted.**

At least a good third, then, of the bees collected on the heights of Stromberg were engaged in the fecundation of Orchises, and we can obtain an approximate measure of their activity by the following figures. At seven o'clock, A. M., in a meadow containing several thousand individuals of *Orchis mascula*, I collected ten spikes which had one hundred and seven open flowers, only three of which had the stigma smeared with pollen, and one alone was without pollen-masses. Towards five o'clock, P. M., I collected from the same meadow ten other spikes having ninety-seven flowers open. Fourteen of these flowers had the stigmas smeared with pollen, two of which still preserved the pollen-masses in

place while the remaining twelve no longer had any. Two had a couple of pollen-masses stuck upon the edge of the stigma, and three were without any pollen-masses at all though the stigma was devoid of pollen. Thus at seven o'clock in the morning the fecundated flowers were in the ratio of two and one-half to one hundred, and at five o'clock in the evening the ratio had reached fourteen to one hundred.

Thus the conclusions of Darwin are fully confirmed by my observations. The bees must seek something in the spur of the flower or else they would not stop to visit them repeatedly. Since the honey is not free in the interior of the spur but is contained between its inner and outer membranes, the insects have to pierce this latter, which is very delicate and cannot offer the least difficulty.* Direct observation has shown that a stay of three or four sec-

*My studies thus far made upon field Orchis would lead me to different conclusions from those of Darwin and Müller. In the acts of the Italian Society of Natural Sciences of Milan (vol. 12, 1869, p. 129) I said: "this asserted deficiency of fecundation, together with the phenomenon of the absence of honey in many species of Orchis which have an enormous development of an *illusory* spur, *formerly* honey-bearing but now dry, produces the conviction that such Orchids are degenerate forms and more or less near extinction.

There is here a manifest example of imperfection or rather, organic degeneration, the pernicious effects of which are very obvious if we compare the scanty number of capsules in orchids, with the abundant fructification of *Spiranthes autumnalis*, *Loroglossum secundiflorum* and other Orchids which secrete a sweet fluid."

Darwin and Müller suppose that there is a secretion of nectar between the inner and outer membranes of the spur. Now, in all my observation, I never could see this honey. I indeed saw frequently, but not always, that the inside of the spur is vesicular, but when examined by the microscope I found that there is absolutely no trace of that glandulose tissue which is a constant characteristic of nectar-producing surfaces. Besides, reasons deduced from close analogy are against such a condition of things. Gymnadenia and Platanthera, which are closely related to them, have a spur entirely analogous to that of the Orchids, yet the honey they produce is not secreted in a vesicular hypodermis, but transudes in a normal manner.

I willingly admit that some liquid is frequently met with in such pores. In the vesicular parts of plants, e. g., in the summits of the inner petals of Dielytra, in the bladdery fruits of Colutea, Vesicaria, etc., drops of liquid are found, but these are only water of transpiration, or rather lymph, but never honey. It may happen that this lymph, which was found in abundance by Darwin in *Orchis pyramidalis* alone, really attracts *Acontia luctuosa* (one individual of which was found with its proboscis loaded with seven couples of pollen-masses), and other diurnal and nocturnal lepidoptera. But on the whole it seems improbable to me that the spurs, although lymphatic, yet not honey-bearing, of *Orchis morio*, *latifolia*, *maculata*, etc., should attract bees.

But bees, according to the positive observations of Müller, frequent and fecundate the flowers of Orchis. This fact signifies, according to my view, that they resort to them for some other purpose, which is to collect pollen which they find already prepared in a convenient form. It is more than probable that upon entering their hives loaded with bundles of pollen, they are soon freed by their companions from the annoyance they experience.

Sprengel calls the spur of Orchis a false nectary. Although in some plants I have

onds is sufficient to stick the pollen-masses firmly upon the heads of the insects, and any one can easily convince himself of the fact by introducing into the flower a sharpened pencil, and holding it for three or four seconds when, upon withdrawing it, pollen-masses will be found adhering to it. It will also be found that in about forty seconds after drawing it out, these masses will have completed that movement of declination by virtue of which they can come in contact with the stigma. Now, as a bee, from what we observed, does not remain on a given spike longer than twenty or twenty-two seconds, it is clear that it cannot fecundate it with its own pollen, but only with that of spikes previously visited.

On the 11th of May, 1869, in the neighborhood of Lippstadt near Overhagen, I repeatedly saw bees effecting the fecundation of *Orchis latifolia*, but I observed nothing new, or in any way different from what I noted in the case of *Orchis mascula*.

Towards the close of last year I published in the acts of this Society an observation made in May, 1867, upon the fecundation of Cypripedium, which was in many respects incomplete because made under unpropitious circumstances, although I succeeded with the aid of the Darwinian theory, in completely explaining the part the different floral organs play in securing the fecundative process. But on the 16th of May, 1868, in the same locality, I was able to make a greater number of observations, and confirm all my conclusions. This place which was of limited extent had only six flowers of Cypripedium. Passing and repassing in the examination of the slipper-like flowers peculiar to this plant, I found in one of them, which half a minute before was empty, an *Andrena pratensis* which by its violent agitation could be perceived at the distance of several feet. Visibly disquieted by its imprisonment it tried at least twenty times to climb up the walls of the slipper, but these are so contorted, and of such a shape, that after every attempt the Andrena slipped back again into the flower. Finally, it retired to the base of the flower and pushed its head into one of the two small apertures there; but this being too narrow, it attempted to scale the walls anew, and not succeeding, ran back

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come upon organs or parts of organs, which really merit this appellation, it does not seem to me applicable here. I ascribed to Orchids an illusory spur, once perhaps honey-bearing, but now dry, and I think that is the better view. It is in favor of this view that orchids, at least in eastern Liguria, are almost entirely passed over by insects, and offer an incredibly small number of transformed pollen-masses and fecundated ovaries.

again to the small aperture, and then again climbed up with no better success than before. Then, after a short pause, it ran with greater impetus to one of the small apertures (to the left) and using all its strength, at length succeeded in pressing down the lip and pushing its head, thorax, fore legs, and finally its whole body through this aperture, and so was again at liberty. In this passage, its right shoulder rubbed against the anther overhanging the aperture and carried away a good deal of the pollen.

The flower of Cypripedium. then, must be considered as a trap for Andrenas which enter it, allured by a sweet exhalation, and the minute drops of honey exuding from the apices of certain hairs in the lip. If an Andrena visits this snare during the warmer hours of the day, that is to say, when it possesses its maximum vital energy, it easily succeeds after a few minutes in freeing itself from its prison, but not without first getting some pollen upon its back which will fecundate the stigma of the next flower it visits. But if it is caught in the cool of the evening, it must perforce make up its mind to take lodgings there for the night, and be content to escape from its unwelcome quarters during the warm hours of the next day.*

If small Andrenas falling into this trap have not strength enough to push aside the lip so as to escape through the small apertures.

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*The structure of the flowers of *Cypripedium* relatively to the mode in which promiscuous intercourse is effected by means of insects, has been studied, in order of time, by Charles Darwin, Asa Gray, by myself, and by E. Müller.

Darwin (On the Contrivances, . . by which . . Orchids are fertilized by Insects) believed at first that the fecundation of the species of this genus took place by means of the proboscis of certain insects which, in being introduced by one of the two small holes of the sac, became covered with pollen which was then communicated to the stigma.

Gray soon after, from an examination of some American Cypripedia concluded that fecundation was effected by small insects entering the flower by the large opening, and leaving it covered with pollen by the small ones.

In 1866 I examined some exotic Cypripedia in Florence, and, though ignorant of Gray's observations, reached the same conclusion (On the arrangements for fecund. of anthoc., plants 1867, p. 20, 22).

The next year E. Müller (Beobacht. an West fälisch. Orchidera p. 1–6), established the truth of my conjectures, observing and describing the mode of action of certain andrenas in visiting and fertilizing the flowers of *C. Calceolus*.

In 1868 and 1869, having had occasion to study anew the flowers of some foreign Cypripedia (*C. barbatum* and others), I observed the manner in which large flies are imprisoned in them. It should be noted that not unfrequently in the Boboli botanical gardens the ovaries of Cypripedia ripen, without doubt, in consequence of the visits and imprisonment of these flies.

Ultimately Darwin (notes on the fertilization of Orchids, 1869, p. 16 and 17) cited the observations made on Cypripedium by Gray, myself, and Müller, fully admitting the results.

they die with hunger; and on the 17th of May, of this year (1869) I saw two dead individuals of *Andrena parvula* in the flowers of Cypripedium.

I here leave the first part of my subject, the application of the Darwinian doctrine to flowers, and pass to the second, which is the application of the same doctrine to the insects which visit the flowers.

As flowers are accommodated to the visits of insects, and as the meaning of the structure of flowers can only be comprehended by thoroughly knowing their entomological relations, so the insects which derive nutriment from flowers are accommodated to them, and the structure of their bodies cannot be well understood except in the relation of adaptation to flowers. And since, according to the Darwinian doctrine, the adaptations of insects to floral food can only be considered as characteristics slowly acquired by hereditary descent, we are necessarily led to distinguish inferior or primitive, and superior or posthumous forms. We are thus led to some indications of a genealogical tree of the insects which visit flowers.

These insects belong principally to three orders, the Hymenoptera, Diptera and Lepidoptera. The incentives, however, which urge them to visit flowers are different for each. The Lepidoptera suck honey exclusively; the Diptera devour pollen and are in the habit of sucking not only honey, but any sort of liquid; and, finally, the Hymenoptera which visit flowers, that is, bees, feed exclusively on honey and pollen, not only in their perfect state, but also as larvæ, so that they suck honey, eat pollen, and collect both for their young.

Of the three orders cited, that of Lepidoptera is the only one which is composed of families all of which are adapted to floral food, although only in the perfect state. Hence, it is that their buccal organs have a very uniform structure. The labrum and mandibles are entirely atrophied;* the maxillæ are transformed into two tubular [nearly], cylindrical and spirally twisted filaments which perform the function of a sucking tube; and at the base of these filaments are two rudimentary palpi. The inferior lip or labium is atrophied, and as a compensation its palpi are greatly developed.

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*Their rudiments are readily seen, except in certain silk-worm moths, in which the labrum is entirely atrophied. — EDS. NATURALIST.

If we turn from those Lepidoptera, which, endowed with a long proboscis, hover without alighting, and suck honey from the bottom of flowers with the longest tubes, and regard those which are of an inferior grade of adaptation, we find all possible gradations from a long proboscis to a rudimentary one, where the buccal parts are yet recognizable under the form of small fleshy papillæ equally unsuited either to bite or suck. According to the Darwinian doctrine, all Lepidoptera are derived from a single stock, and their characteristic spiral proboscis must have been formed gradually by slight and innumerable variations, which in the struggle for existence, were advantageous to those individuals in which they appeared, and were, therefore, able to accumulate and become fixed in their posterity in accordance with the laws of hereditary transmission. Therefore, as a necessary consequence of this doctrine, we should expect to find that the order Lepidoptera offers in its lowest stage this characteristic of a spiral proboscis, and possesses those fleshy protuberances or rudimentary buccal organs which we see to-day possessed by not a few of its representatives. This conjecture, strictly deduced from the Darwinian doctrine, accords wonderfully with the opinion of entomologists of great authority, who admit that there is the closest affinity between the Phryganeidæ and Lepidoptera; and the Phryganeidæ have the buccal organs precisely in that rudimentary state which we should pre-suppose appropriate to the primordial race or type of Lepidoptera. And, further, to consider this affinity of the Phryganeidæ with butterflies. Réaumur deduced it from general considerations upon the analogies of the insects; De Geer from the analogous form of the wings, and from the internal structure of the larvæ; Kirby from analogies in the buccal organs, and Westwood from the habits of the case-bearing larvæ of the genera *Psyche* and *Tinea*, from the analogous covering of the wings in the Phryganeidæ and some Papilios, and from the tibiæ analogously spinose in the two groups.

The expression, "*close affinity*," employed by these entomologists is changed and resolved, in the language of the Darwinian doctrine, into *close relationship*, and signifies that both Lepidoptera and Phryganeidæ proceed from a single stock, which, both in the internal structure of its larvæ and their habit of dragging a sheath about with them, in the venation and covering of the wings, the spinose character of the tibiæ, the buccal organs reduced to fleshy

protuberances, and in the long antennæ, would quite closely resemble the Phryganeidæ of to-day. The posterity of this stock separated into two parts. One of these continuing to live either in, or near the water, diverged little from the primitive customs, habits and forms, and came to constitute the group of Phryganeidæ. The other accustomed itself to suck the honey of flowers, withdrew itself little by little from the water, and, finding its new diet entirely acceptable, adapted itself to it completely, modifying the bucal organs, step by step, by successive variations always more convenient and more in harmony with its new mode of life, until in this way it gradually acquired a proboscis sufficiently long and dexterous to suck honey. It moreover, greatly developed its æsthetic sense of colors, at first in correspondence with the lively coloring of the flowers, and then in reference to sexual election. As soon as the hairy system of wings and body began to vary, which can happen the more easily the greater the surface of the hairs themselves becomes, until their complete conversion into variously tinted scales, the females would prefer those males which were adorned with the liveliest colors, and, vice versa, the males would select the most brilliantly adorned females.*

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* The relations of colors and odors which occur between flowers and their fertilizers, may to many appear a chimerical product of the imagination. But after a long series of observations I can assert that, however unexpected and surprising they may be, they are yet undeniable and real.

It is believed by many that the æsthetic sense belongs only to the human race. Nothing is more erroneous. The sense of music alone, however much it has been and perfected in birds through sexual selection, is beyond comparison more perfect in man. In the senses of taste and smell man is, by a singular coincidence, like bees and butterflies. Sweet things please our young not less than bees, and the ancient poets designated with the same word, nectar, the food of the gods and the honey of bees. By a no less singular coincidence the odors which allure bees and butterflies allure us too, and those which repel us repel bees. The graveolent flower of rue, which is so excessively disagreeable to us, although visited by flies, repels bees and Lepidoptera although it produces honey.

As to the æsthetic sense of colors and form, then, if we speak the plain truth, man is inferior to many living things.

Passing in review the most beautiful forms, and those adorned with the most attractive colors, we have on one side flowers, and on the other their fertilizers, that is, birds, flies, humming birds, Nectarineæ, lepidoptera, Bombylii, Syrphidæ and some Cetoniæ.

The most beautiful forms and brilliant tints in the world are without question those of the humming birds. They visit the most splendid and beautiful flowers on the earth, and the reason why the magnificent flowers of the tropical zone do not enter our climate is certainly correlative to the causes which exclude from temperate and cold countries the humming birds and gorgeous lepidoptera which are peculiar to warm regions.

But not all flowers are beautiful: there are some which have livid and repulsive

As to flies, it has been until now generally admitted that they are exclusively destined to fluid nutriment. But in the summer of 1867, I was somewhat surprised while observing in my garden an *Eristalis tenax* upon a flower of *Œnothera media*, to discover that it was eating the pollen. Resting upon its middle and hind legs, it thrust out its fleshy proboscis like an arm, seized a morsel of pollen with the two valves which terminate the proboscis, and tore it away from the anther. Since the pollen granules of Œnothera are tied together by elastic threads, that bit of pollen torn from the anther was attached to others by a band of threads, and the insect, in order to free its mouth from that inconvenient appendage began to use its fore-legs. Raising both together towards its mouth, it seized between them the cordon of threads, and rapidly rubbing them one against the other, much as we do in washing our hands, succeeded in cutting the threads and clearing them from its mouth and legs. Then it raised them again, and seized the two valves of the proboscis, thoroughly cleaning them of pollen, and the threads yet adhering to it; and in about three seconds this work of cleaning was complete. At the same time the valves of the proboscis, by rubbing against each other, had masticated the morsel of pollen, and had conveyed the single granules into the channel of the labium, whence they were pushed into the mouth. It had hardly finished cleaning its proboscis and eating the first mouthful of pollen, when it seized another portion and repeated each and all the operations I have described. It was so intent upon its meal, that I was able to observe it in the closest proximity without its manifesting the slightest fear.

The quantity of pollen which an Eristalis can devour in this way is surprising. Upon making a section of one and examining

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colors. Nor do all flowers emit a pleasant odor, since some have a fetid smell, or one like that of decaying animal matter.

All the flowers which have this (those, e. g., of Arum, Dracanculus, of the Stapeliæ, of some American Aristolochiæ, of the Rafflesiæ, Sapriæ, Brugmansiæ, Sapranthus, etc.) have without exception livid colors, and, like the skins of some serpents, are speckled with dark-purple and yellowish-black spots. Now all these flowers are fertilized exclusively by the flies which feed upon dead animals (*Sarcophaga carnaria*, *Musca vomitoria*, and the like).

The flowers of the Ceropegiæ, one *Aristolochia*, *Asarum*, and *Ambrosinia Bassii*, are fecundated exclusively by gnats (Phora, Ceratopogon, Cecydomya, Oscinis, etc.). All these have a generally livid tint speckled or striped with dark-purplish spots, and a putrid odor, for the most part like that of urine.

These few instances suffice to give an idea of the wonderful relations which occur between flowers and their fertilizing agents with reference to colors and odors.

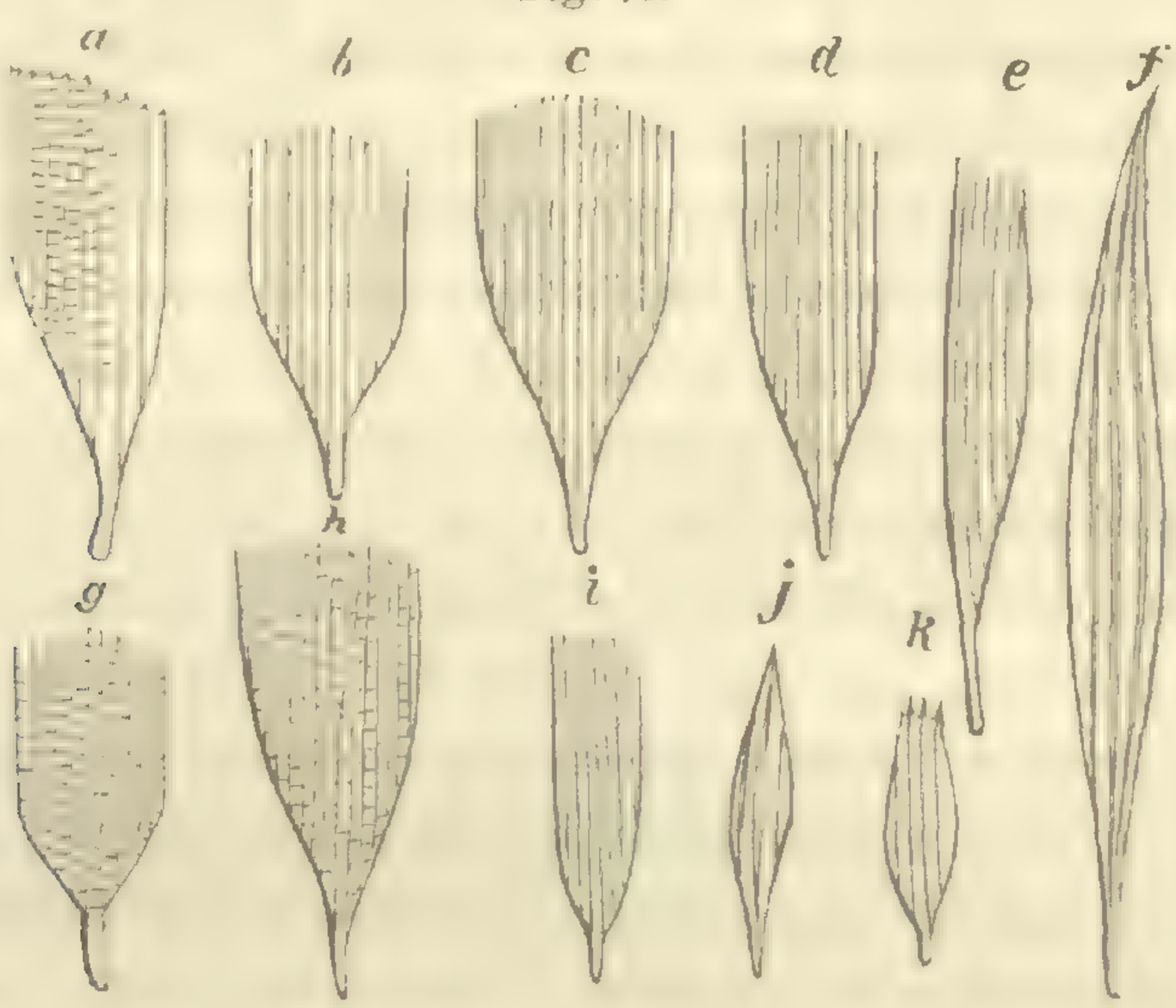
the stomach, it appeared very large and was full of a yellow substance which consisted of hundreds of thousands of pollen-grains. I have had since then many opportunities to observe this eating of pollen, not only in all the species of Eristalis, but also in the genera Rhingia, Syrphus, Volucella and Scatophaga. This chewing of pollen alternates with sucking honey if the flowers have any, and I am of the opinion that the singular structure of the proboscis of flies cannot be fully explained without taking into account its double function of sucking honey and eating pollen. In the Tipulariæ and also in those flies which do not eat pollen but live exclusively upon juices, for instance, Bombylius, the two valves of the proboscis serve no other purpose than to protect and guide the sucking tubes, but in the flies which devour pollen besides this function there is also that of grinding the pollen, for which they have special adaptations, for the margins of the two valves at the point of union are transversely dentate with fine and parallel bands of chitine. Probably the greater or less distance of these bands in different species is related to the different size of the pollen upon which they feed.

Since the proboscis of the Tipulariæ often possesses one simple function and has in accordance with that a very simple organization, we may consider these Tipulariæ as the most ancient branch of the stock from which Diptera are derived. A fact casually discovered by me and of which I find no mention hitherto, seems to me of great importance in the systematic disposition of this order. In the spring of 1868, while engaged in examining the head of a gnat, with a view to ascertain whether or not the valves of its proboscis had the transverse bands of chitine, I was surprised to discover that the proboscis and palpi were clothed with scales entirely like those of butterflies.

I find no mention of this important fact in the special works of Meigen and Schiner which are in my possession. Meigen simply points out that in Culex, Anopheles, and Corethra, scaly productions are observed on the venation of the wings, and he figures some of them which, however, being quite narrow and with two sharp points, have no analogy with real lepidopterous scales. The gnat-scales observed by me and figured accurately (fig. 73) closely resemble the most characteristic lepidopterous scales. They suddenly dilate from a short and narrow peduncle to a large scutiform surface which is traversed longitudinally

by a few parallel ridges between which, when more highly magnified, transverse wavy lines, very fine and numerous, are seen. The only difference which these scales present compared with those of butterflies is, that in the former the transverse lines are not so fine, so regular, nor so regularly distributed over the whole surface; also these lines are entirely wanting upon the scales of some species of Tipulariæ. Finally, while the real lepidopterous scales are always deeply crenate at their truncated extremity, the scales of gnats are not; and their truncated extremity terminates in a very fine margin, from which the points of the longitudinal ribs sometimes project.

Fig. 73.



Scales of two species of *Culex*.

a, *e*, Scales of the veins of the wings.
f, *f*, " " " margins of the wings.
i, *g*, " " " legs.
b, *c*, " " proboscis and palpi.
d, *k*, *h*, " " " of the second species of *Culex*.

These scales are partly dark and opaque, partly colored and transparent. It is in the latter that the transverse striæ frequently appear. All the figures are magnified 400 diameters.

I have examined several species of gnats and have found the proboscis, palpi, legs and abdomen clothed with scales of the same sort, while the thorax and the veins of the wings had forms intermediate between hairs and scales. I observed this in a magnificent Tipula from Brazil given to me by my brother Fritz. Besides this it had as a particular ornament a long tassel of scales upon its legs.

The presence of these scales upon the Tipulariæ shows that

there is a close relationship between them and Lepidoptera, a relationship which is further attested by the lepidopterous appearance of the genus Psychoda, the tipulaceous habits of Pterophorus, the similar venation of the wings in many Tipulariæ (Limnobia, Ctenophora,) and the Phryganeidæ, the aquatic habitat of the larvæ of the Tipulæ, and, finally the circumstance that it is far easier to deduce morphologically the proboscis of the Tipulæ from the buccal organs of the Phyganeidæ than from those of any other order of insects.

Therefore, according to my opinion, the stock or kindred common to the Diptera, Lepidoptera, and Phryganeidæ, in its manner of life, and the structure of its body would be very closely allied to the Phryganeidæ of to-day, living in water in the form of sheath-bearing larvæ, and in the perfect state remaining in the vicinity of the water. Its posterity divided at first into two branches, to wit, the *conservative* one *par excellence*, of the Phryganeidæ, which continuing in the same mode of life as its ancestors, has undergone very few variations; and the branch of those insects which suck the honey of flowers, which have gradually removed from their aquatic abode, have developed by natural selection the sense of colors, and acquired through sexual selection a squamose covering. This second branch again divided into two, one of which accustomed itself to feed exclusively upon the honey of flowers and produced Lepidoptera; while the other, less exclusive in its tastes adapted itself to imbibe all sorts of fluids as well as to pierce the more tender tissues, and produced the Tipulariæ. One part of these besides sucking different juices, grew accustomed to eating pollen and thus little by little the proboscis of the Tipulæ was transmuted by natural selection into that of flies equally well adapted to suck honey or eat pollen.

The Hymenoptera which visit flowers, the bees, being given exclusively to floral food not only in the perfect state but also while larvæ, present the greatest possible variety of adaptation. Starting from the mouth of the fossorial Hymenoptera adapted only to bite and provided with a very short tongue, we arrive, through numerous transitions, to the highly developed proboscis of the Anthophoræ and Bombi which can extrude their tongue to a length equal to that of their body, and then coiling it up, draw it back again into its cavity so as to give free play to the action of the mandibles. Furthermore, in different ways, according to the

different species, this or that part of the body has undergone special adaptations so as to be able to collect pollen with greater ease and in greater abundance. A sure criterion by which to comprehend these differences thoroughly as well as to estimate correctly the different grades of affinity between forms so varied, can be given only by the Darwinian doctrine. But we have no space to particularize.

We will conclude by discussing some objections which can be urged against the explanations of facts, and against the general principles advanced in this discourse.

It may be asked, what advantage can flowers and insects derive from having elongated respectively the melliferous tube and the proboscis instead of having them remain of a constant length? I answer that in order to comprehend the advantage of this elongation, it is necessary to consider in one view the benefits and the injuries which different tribes of insects bring to plants. The Lepidoptera are the only insects which, while aiding the plants by transferring pollen from one flower to another, do not cause injury by devouring the pollen. Therefore a plant which has modified its flowers so as to exclude bees and flies while admitting Lepidoptera, has obtained a signal advantage.

Suppose a plant develops a floral tube longer than usual so that the honey remains at a lower level; this variation will be an advantage for that tribe of insects which lives on honey alone and can therefore adapt itself more diligently to this variation. The advantage in this case is for the Lepidoptera and will last until the proboscis of certain bees and flies equals that of the Lepidoptera. When this equalization has been completed, a further elongation of the floral tube will be useful to the plant, which will immediately be followed by a corresponding elongation of the proboscis of the Lepidoptera, and so on. In this way, by means of the rivalry between the Lepidoptera, bees, and flies, the fact that the Lepidoptera do not consume pollen and can sooner adapt their proboscis to the variations of the flowers than their rivals coöperating, a gradual augmentation in the length of the tubes and spurs of flowers would become established, followed by a proportional elongation of the proboscis, concomitant in the Lepidoptera, later in bees and last of all in flies. It may be well to give in this place the measure of the longest proboscides of some of the Lepidoptera, bees and flies of our country.

Among flies the proboscis of *Bombylius discolor* is 10 millimetres long; that of *Rhingia rostrata* from 11 to 12 mm.; among bees that of *Bombus hortorum* is 21 mm., and that of *Anthophora pilipes* 25mm.; the proboscis of *Sphinx Elpinor* among the Lepidoptera is from 20 to 24 mm. long, that of *Sphinx pinastri* from 28 to 32 mm., and that of *Sphinx ligustri* from 37 to 42 mm. But the longest proboscis is that of *Sphinx convolvuli* which is from 70 to 80 mm. This exceptional size led me to infer that *Sphinx convolvuli* may have acquired its long proboscis by competition with the flies and bees with a long proboscis inhabiting warm climates. This conjecture is confirmed by information as to the geographical distribution of *Sphinx convolvuli* afforded me by Dr. Speyer.

In order to eliminate the visits of bees and flies which prey upon pollen and permit only those of Lepidoptera, a variation still more advantageous than the elongation of the melliferous tube is manifestly that of flowering at night. And this is precisely what many plants do, which keep their flowers closed during the day and open them in the evening when with the disappearance of the sun the activity of bees and flies is entirely destroyed. It is in the hours of the evening and night that the flowers of such plants by the brilliancy of their colors and the pungency of their odors attract sphinxes and other moths, showing in an eloquent way how advantageous to themselves is the preference they show for the visits of insects which are only useful to those of insects which are at the same time useful and hurtful. But it will be said; why cannot bees and flies as well as Lepidoptera adapt themselves *pari passu* to the noctifloral variations of plants? It is not difficult to see why. Lepidoptera feed only upon honey, and hence are obliged to follow *pari passu* the variations of the plants which nourish them with analogous variations on their part. Flies, however, do not live exclusively upon honey, but suck by instinct any sort of liquid, and bees after collecting honey and pollen have to make complicated manipulations in the hive. Whence it is plain why Lepidoptera only and not bees and flies as well, can acquire nocturnal habits, and adapt themselves to night-flowering plants.*

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*However ingenious and seductive may be the theory here developed by the author to explain the genesis of evening or nocturnal flowers, and of flowers with a long, honey-bearing tube, it nevertheless seems contradicted by a multitude of facts collected by me, and by arguments which I here briefly subjoin.

The whole theory of the author reposes upon the fact that Lepidoptera do not feed

There is yet a general objection which can be advanced against the application of the Darwinian doctrine to flowers and insects. Even conceding, it may be said, that this doctrine can be applied to all the phenomena of the organized world, and that in many points its *a priori* deductions are confirmed *a posteriori* by observation, it does not follow from that that it should be preferred to the teleological mode of view which explains every property of organisms as created with a view to the well-being of a given individual or of other individuals as well.

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upon the pollen, and that their visits are consequently of greater utility to plants than those of bees and flies.

If the theory is in harmony with truth the following phemonena would necessarily be verified.

First, the flowers fecundated exclusively by Lepidoptera, that is, evening or nocturnal flowers, as contrasted with flowers fecundated by bees or flies, would constantly manifest a considerable saving in the production of pollen. Let us see if this saving takes place in the conspicuous examples of night-flowering plants. *Mirabilis jalapa* and *M. longiflora* for every ovule to be fertilized offer not less than five anthers furnished with numerous pollen-grains. *Œnothera biennis*, furnished with eight large anthers, offers to the proboscis of the Lepidoptera festoons of pollen, the greater part of which is of use neither to the insects nor the plant. *Cereus grandiflorus* has an excessively large number of stamens and consequently of pollen. Striking a mean of these and other lepidopterophilous flowers and comparing it with a mean of melittophilous flowers it must be admitted that there is not the least appearance of pollen-saving in the former.

Secondly, the flowers with long tubes, or those fertilized *preferably* by Lepidoptera or Trochili, if the author's theory is true, would constantly harbor the anthers within the tube so as to withdraw them from the depredation of bees and flies. Now this is precisely what does not occur in the great majority of such flowers, the anthers of which protrude beyond the tube, evidently to make bees and flies, as well as Lepidoptera, contribute to the transfer of pollen. This form of flowers, which can be said to be absolutely wanting to the flora of Europe, is, however, frequent in tropical plants.

Thirdly, if the theory in question is true, plants with flowers exclusively lepidopterophilous would take, or would tend to take, the advantage over plants with exclusively melittophilous or myophilous flowers. But precisely the opposite of this is true, and, limiting myself to European flora, while not more than from ten to twenty species are exclusively lepidopterophilous (species of *Pancratium*, *Calystegia*, some Caryophyllaceæ, and the like), the exclusively myophilous species are numerous (almost all the Umbelliferæ, Rhammaceæ, Aristolochiaceæ, Euphorbiaceæ, Celastrineæ, etc.), and most numerous of all are those which are exclusively melittophilous, that is, all the Leguminosæ and the greater part of the Labiatæ, Personatæ, Borragineæ, Cynarocephalæ, Lactucæ, etc.

From all this we conclude that the theory of the author of the genesis of lepidopterophilous flowers, although ingenious, does not seem admissible. I am as profoundly pursuaded as Erm. Müller that both the possession of long, honey-bearing tubes, and the habit of flowering at night in plants, stand in a causal relation with the Lepidoptera and their proboscis; but not that the reason of this reciprocal adaptation only has to do with the greater or less depredation of pollen on the part of the insects; since it must be referred to other contingencies.

It would seem opportune to state the result of the studies I have made with a view to elucidate the genesis of lepidopterophilous flowers; but as this special theme is connected with the whole theory touching the genesis of anemophilous, ornithophilous, melittophilous, etc., flowers, I am constrained to refer to my other writings, as there is no space here to enlarge.

Without stopping to mention that every teleological explanation involves an absurdity inasmuch as it suppresses in the order of the phenomena the bond between cause and effect, I will here briefly adduce some facts which render the acceptance of the doctrine of final causes impossible. I have already touched upon the errors into which Sprengel fell in thinking that the arrangements in flowers were so disposed for the benefit of insects. Nor can a single example be adduced of a living being whose properties are advantageous to other species and not to its own.

The other supposition then, that every property of individuals has been created for their well-being, in the greater number of instances answers as well for the interpretation of phenomena as the Darwinian system. But there are cases in which it does not answer at all. The abortive stamens and the anthers without pollen in some flowers of Glechoma, Thymus, and other polygamous Labiatæ, the tibiæ of Apathus dilated like those of Bombus, although the former do not collect pollen, the retrorse teeth of the sting of bees which cause the death of those insects if they use it, are a few examples drawn from an inexhaustible mine of facts, all easily explained by the Darwinian doctrine, and inexplicable by the teleological.

All the numerous instances where the functions and conditions of life have been changed in such a way that many of the inherited properties become of no use or even injurious, offer an insoluble difficulty to the teleological doctrine, while they are in full harmony with the Darwinian theory.*

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*I must here, as always, declare myself a teleologist and vitalist. Now teleology and vitalism, far from being vanquished by the Darwinian doctrine, find in it their most solid support. What do teleology and vitalism mean? They mean that we believe that there is in all living things an innate, specific principle, intelligent, free and teleological. This principle is the hidden cause of the variability of organized beings, as well as the wonderful harmonies which have been established between one being and another.

Every man is conscious of proposing continually a determinate end for his actions and of seeking the best means for attaining it. Therefore, every man is free and teleological; and every man has the profoundest conviction of this fact, nor can all the sophisms of the materialists of the present day against human liberty stand against the verdict of consciousness. And if man is teleological and free, how can other living things, each in its proper sphere, which are united to him by a more or less remote relationship, not likewise be free?

Man and other living beings vary because they are free, and are free because, if they had not varied they could not have been free; if they had not been free, they could not have varied. Liberty and variability are inseparably conjoined. The different worlds, stones, and crystals obey fixed, indeclinable, mathematical laws. Therefore they do not vary. They are not free because they do not vary, and do not vary because they

A NEW SPECIES OF ERYTHRONIUM.

BY PROFESSOR ASA GRAY.

ORDINARILY it is hardly worth while to make a separate article for a single new species of plant, even when discovered in a district in which a new flowering plant is unexpected. But the species of *Erythronium* are so few, and the present one is so peculiar, and its habitat so closely bordering the region included in my Manual of the Botany of the Northern United States, that I need not apologize for bringing it at once to notice.

The specimens before me, accompanied by a colored drawing, are just received from Miss S. P. Darlington (a daughter of the late Dr. Darlington, long the Nestor of American botanists and one of the best of men), and were collected at Faribault, Minnesota, by Mrs. Mary B. Hedges, the teacher of Botany in St. Mary's Hall, a school of which Miss Darlington is Principal.

The flower is much smaller than that of any other known species, being barely half an inch long; and its color, a bright pink or rose, like that of the European *E. Dens-Canis*, reflects the meaning of the generic name (viz. red), which is lost to us in our two familiar Adder-tongues, one with yellow, the other with white, blossoms. The most singular peculiarity of the new species is found in the way in which the bulb propagates. In *E. Dens-Canis* new bulbs are produced directly from the side of the old one, on which they are sessile, so that the plant as it multiplies forms close clumps. In our *E. Americanum* long and slender offshoots, or subterranean runners, proceed from the base of the parent bulb and develop the new bulb at their distant apex. Our Western *E. albidum* does not differ in this respect. In the new species an offshoot springs from the ascending slender stem, or subterranean sheathed portion of the scape (which is commonly five or six inches long), remote from the parent bulb, usually about mid-way be-

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are not free. Invariability and necessity are inseparably united. Opposed to worlds, crystals, and all inanimate matter, which is neither free nor variable, there appears a phalanx of beings both free and variable. It is, then, perfectly logical to presuppose in these last a principle peculiar to them and *sui generis*, the animistic principle, and it is entirely illogical to deny it.

Thus we see how Teleology extends the hand to Darwinism, and both doctrines, illustrating and supplementing reciprocally, mutually support each other.

Fig. 74.



Erythronium propullans Gray.

tween it and the bases or apparent insertion of the pair of leaves: this lateral offshoot grows downward, sometimes lengthening as in the foregoing species, sometimes remaining short, and its apex dilates into the new bulb.

This peculiarity was noticed by Mrs. Hedges, the discoverer of this interesting plant, to whom great credit is due. Most lady botanists are content with what appears above the surface; but she went to the root of the matter at once. I learn that *E. albidum* abounds in the same locality. *E. Americanum* is also found in the region, but is scarce.

It is not easy to find or frame a specific name which will clearly express the most remarkable characteristic of this new species. But I will venture to name it

ERYTHRONIUM PROPULLANS.—E. scapo infra folia pullulante; foliis oblongo-lanceolatis acuminatis parum maculatis; perianthio roseo-purpureo (semipollicari), segmentis acutis basi luteo tinctis omnino planis (nec calloso-dentatis nec sulcatis); antheris oblongis; stylo fere equabili integerrimo; stigmate parvo vix tridentato; ovulis in loculis 4–6.

Scape bulbiferous from its sheathed portion below the developed leaves; these oblong-lanceolate, acuminate, slightly mottled; perianth rose-purple or pink (half an inch long); the segments acute, all with a yellow spot but plane at the base, the inner like the outer destitute of either groove or tooth-like appendages, but a little more narrowed at base; anthers merely oblong; style hardly at all narrowed downward, entire, the small stigma even barely three-lobed; ovules few (4–6) in each cell.

EXPLANATION OF FIGURE 74.

a. Flowering plant, just producing offset from the side of the slender stem or scape.
b. Lower part of a small plant out of flower, with slender, stolon-like offset enlarging at the apex into a bulb.
c. Lower part of a larger plant, with bulb formed without elongation of stalk.

REVIEWS.

GEOLOGICAL SURVEY OF ILLINOIS.* — This splendid volume is a fit successor to the three preceding, and in every way a credit to the great state that has so liberally provided means for Mr. Worthen, then to lay the results of his labors, and those of his efficient corps of assistants, before the world.

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*Vol. iv. Geology and Palæontology. A. H. Worthen, Director. Imperial 8vo, pp. 508, 31 Plates. By authority of the State of Illinois, 1870.

The geological survey of Illinois was inaugurated by vote of the Legislature in 1851, and was continued for several years without any very important results having been made public. Soon afterwards a strong opposition was made to the survey, but thanks to the stand taken by the Hon. Richard Yates, at the time Governor of the state, a bill discontinuing the survey was vetoed, and in 1858, Mr. Worthen was appointed by Governor Bissell as State Geologist, and from that date the survey has had the continued and liberal support of enlightened legislators, Mr. Worthen being thus enabled to furnish a series of volumes that will rank second only to those of the New York survey, which has been continued for so many years, and has embraced the kindred departments of Zoology and Botany. May we not hope that Illinois will also continue her survey until not only her geology and palæontology are thoroughly reported on, but her Zoology and Botany as well, and a State Museum established that will have within its walls a complete representation of the Natural History of the state. Alas that the building for such a museum was delayed a moment after Mr. Worthen had called attention to its necessity in his first report, for his fears have proved true, and the fine museum of geology and palæontology which had been brought together by the survey has been, since the publication of the last volume, subjected to the fate that sooner or later seems to be the destiny of all museums not placed in fire proof buildings.

The first volume of this survey was published in 1866 and contains a general account of the geology of the state.

The second volume, published in the same year, is devoted to the palæontology, and has fifty plates on which are figured several hundred species of fossils. Especially important is this volume to the student of the fossil fishes and plants of our Coal Measures, in which the strata in Illinois are most remarkably rich.

The third volume of the survey, published in 1868, contains a continuation of the detailed geology of portions of the state, and description of many more fossils, illustrated by twenty plates and many cuts.

The fourth volume, published late in 1870, contains first a continuation of the special geology of thirty-three of the counties in the state, by the Director of the survey and his assistants, Messrs. Bannister, Bradley and Green; and secondly, the continuation of the palæontology of the state, in two sections: first, the fishes by

Prof. J. S. Newberry and Mr. Worthen, second, the plants by Prof. L. Lesquereux.

In the 2d volume of the survey, Messrs. Newberry and Worthen described and figured one hundred and eighteen species of fossil fishes, and in this present volume they add descriptions and figures of thirty-two new species and four new genera, "embracing some of the most remarkable forms yet found in the Carboniferous System" while investigation is being continued on a mass of specimens that will probably "add at least fifty or sixty more species to the list," making a total of over two hundred species of fishes from the Carboniferous System alone, "showing that the western localities of Coal Measures and Lower Carboniferous limestone strata, are far more productive in this interesting group of fossils than any other portion of the earth's surface hitherto explored."

In Prof. Lesquereux's report on the fossil plants, after describing the species that have been discovered since the publication of the second volume of the survey, and giving a systematic table of two hundred and fifty-six species of fossil plants from the Coal Measures of Illinois, he states that the list of species "is more than double that given in the second volume, and that of the recently discovered species, seventy-nine are considered as new, and forty, though known already from Europe, had not been recognized before from our American Coal Measures."

Prof. Lesquereux, in concluding his report on the plants, gives a very interesting account of the "Mode of Preservation of Vegetable Remains in our American Coal Measures" which is of such general interest that we shall reprint it in full in the NATURALIST.

He also devotes a number of pages to "The Flora of the Carboniferous Measures of Illinois, considered in some of its affinities" and to "The Stratigraphical and Geographical Distribution of the Fossil Plants of the Coal Measures."

The thirty-one plates illustrating the palæontological portion of the volume are engraved in a very superior manner by the Western Engraving Company, from drawings made by Prof. Lesquereux, Prof. Newberry and Mr. C. K. Worthen, and the whole execution of the volume is most creditable in all its departments.

From the letter of the Director of the survey, transmitting the manuscript to the Governor for publication, we obtain the gratifying intelligence that the manuscript for the fifth volume is ready for the printer, and the plates for the engraver; and that the

materials for the sixth volume are being prepared for publication as rapidly as possible. These two volumes will include the reports on the remaining counties in the state, and will complete the survey in accordance with the plan hitherto pursued.

New Fossil Crustacea.*—Mr. H. Woodward, who has brought to the notice of naturalists so many crustacea of the older formations especially, describes and figures a new species of Scyllaridia (*S. Bellii*) from the London clay. The genus is allied to the modern Scyllarus, an ally of the Spiny lobster (*Palinurus*). Another interesting form, also figured, is allied to the fish louse, Æga. It is called the *Palæga Carteri*, and is from the Cretaceous formation.

Of the greatest interest, however, are the figures and descriptions of several species of *Cyclus* from the Carboniferous formation of Great Britain. These singular and puzzling forms are round, hemispherical, with the body trilobed, and with well marked segments and deep sutures between them. They are from two to five lines in length. Goldfuss originally figured one species as a trilobite (*Olenus serotinus*), and afterwards Münster referred it to Limulus; while Von Meyer believed it to be neither. Koninck, however, placed it among the aberrant trilobites near Agnostus. In 1868 Woodward said of it, "we must differ from M. de Koninck in referring this form to the Trilobita. If truly an adult, it must be placed near to Apus, with the other shield-bearing Phyllopoda; if a larval form, it may have been the early stage of Prestwichia or some other of the Coal Measures Limulidæ." In the present notice Mr. Woodward reiterates his opinion that "these forms may indeed be the larval stages of Prestwichia, Bellinurus, etc., the antetypes in Carboniferous times of the modern king crab."

In agreeing, so far as we can judge from the figures, with this view, we may say that Limulus sometime before hatching passes through a globular, hemispherical form, with deeply marked sutures, like those observed in several species of Cyclus. Thus the embryonic condition of the modern king crab, was, during the Carboniferous period, probably the mature, or at least larval (not embryonic) condition of the Cyclus. A study of these highly interesting forms will undoubtedly throw light on the affinities of both the king crabs and the trilobites, and indicate that they are

*New British Fossil Crustacea. Extracted from the Geological Magazine, London, 1870. Nos. 11 and 12. With two plates and wood-cuts. pp. 5 and 7.

more nearly related than naturalists have supposed. We trust palæontologists will be on the lookout for these fossils in our Coal Measures.

Age of the Mississippi Delta.*—In his "Principles of Geology," Sir Charles Lyell objected to Gen. Humphrey's view in his "Report on the Mississippi River, p. 99," "that this river is flowing through it [the delta region] in a channel belonging to a geological epoch antecedent to the present," stating that the bed of the river might belong to the delta formation. Prof. Hilgard, however, from a reëxamination of the borings made at the artesian well in New Orleans, states that the strata are of marine origin, containing numerous shells of probably quaternary age, so that at that time the mouth of the present river was an estuary. "A river doubtless emptied into the great estuary during the Champlain period of slow depression, but it was not the Mississippi river of to-day, which excavated its bed, partially into these very strata, and acquired its identity during the terrace epoch of elevation." The absence of drift wood, or its debris, "which meets the eye in every microscopic examination of the Mississippi delta deposits," is a "capital objection to the delta-deposit character of these strata."

Peabody Museum of American Archæology and Ethnology.†—Few people are aware of the value and interest of the collections brought together is this unique museum. Besides the collections already purchased in Europe and previously noticed in this journal, the well known Clement collection of remains from the Swiss Lake dwellings has been lately added.

"It contains, in all, eight hundred and sixty-five specimens. Of these, six hundred and eighty-seven, assigned to the age of stone, are chiefly from localities near Concise and St. Aubin, and were mostly collected by Dr. Clement himself. Of the remains of animals, wild or domesticated, there are those of the ox, hog, sheep, goat, dog, deer, cat, fox, lynx, bear, weasel and squirrel. Among the implements of stone are spear and arrow points, borers, chisels, axes and other kinds of cutting instruments. Many of the stone tools are still retained in their sockets made of the antler of

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*Report on the Geological Age of the Mississippi Delta. By Prof. E. W. Hilgard to Gen. A. A. Humphreys. Washington, 1870. 8vo, pp. 16.

†Third Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology. Boston, 1870. 8vo, pp. 15.

the deer, and a few of the axes are provided with handles restored after the original patterns, these last having been, in almost every instance, too much decomposed for preservation. There are one hundred and seventy-eight objects belonging to the Age of Bronze, consisting of fragments of pottery, various implements of bronze, such as axes, spear and arrow points, sword blades, fish hooks, pins of various dimensions, pendants and other personal ornaments."

Besides these have been added the collection of the Boston Marine Society, the Thorean collection, made chiefly about Concord, Mass., a collection of about a hundred objects of stone and pottery from Nicaragua, and a vast collection of Alaskan objects, mostly the work of coast Indians, known as Thlinkets, or more commonly as Kalooshes. "Nearly all the carvings in bone, horn and wood are of the most elaborate and skilfully wrought patterns." These carvings are of unusual interest in connection with the pre-historic carvings by the Reindeer Folk of the caves of France, of which there are specimens in this museum. Indeed, we now have in this country a remarkably full series of the pre-historic remains of Europe, and with the magnificent series of American remains, within the last two or three years placed on exhibition at the Smithsonian Institution, we have nearly as good materials as in Europe for the study of pre-historic man.

Prof. Wyman gives a brief account of his explorations in Florida, especially among the shell heaps. Among the bones, some of the tibiæ "were very much flattened from side to side, as has been observed to be the case with some from other parts of the United States, and in the Old World, from the caves of Dordogne and Gibraltar."

Peabody Academy of Science.*—The second and third annual reports contain an account of the dedication of the Museum in 1869. In an appendix to the reports of the Director, is a note by Mr. Hyatt on a cuttlefish (*Rossia palpebrosa* Owen?) found at Manchester, Mass., where this species has long been used for bait by fishermen. It has not before been met with except in the Arctic regions. The appendix also contains a "Catalogue of Batrachia and Reptilia obtained by J. A. McNiel in Nicaragua," in which Prof. Cope describes as new to science, a lizard, *Tretioscin-*

* Second and Third Annual Reports of the Trustees of the Peabody Academy of Science, for the years 1869 and 1870. Salem. 1871. 8vo, pp. 109.

cus lævicaudus, and a new genus and species of snakes, *Enulius murinus*. In the "Catalogue of Reptilia and Batrachia obtained by C. J. Maynard in Florida," Prof. Cope describes a new lizard, *Plistodon onocrepis* Cope, and a new salamander, *Manculus remifer*. Dr. Packard in a "List of Insects collected at Pebas, Equador, and presented by Prof. James Orton" describes as new *Attacus Amazonia*. Mr. Smith in the "List of the Crustacea collected by J. A. McNiel in Central America," describes a number of new crabs: *Leptopodia debilis*, *Ozius integer*, *Arenæus bidens*, *Gebia spinissima*, *Atya rivalis*, *A. tenella*, *Evatya* (n. g.) *crassa*, *Leander gracilis* and *Palæmon tenellus*.

Corals and Polyps of the West Coast of America.*—Of this elaborate work, with its careful and detailed descriptions and most excellent illustrations, we can only give the author's general results, both from want of space, as well as a knowledge of the subject. Two years ago Prof. Verrill called attention to the remarkable contrast between the assemblages of polyps found on the Atlantic and Pacific coasts of Central America, and the bearing of these facts upon the supposed former connection between the two oceans, across the Isthmus of Panama. He is now able to state that "the additional forms now presented make these contrasts still greater and more remarkable, and add greater force to the evidence then brought forward to show that no deep or extensive water connection, sufficient to modify the ocean currents, can have taken place since the existence of the species now living upon each coast."

"The polyps of Panama prove to be remarkably rich in sea fans (Gorgonacea), no less than forty-three species having been already obtained. Of these the genus Muricea appears here to attain to its greatest development, since fifteen species, besides several peculiar varieties, perhaps distinct, are in our collection from Panama Bay, and others from Acapulco and Peru, while from the West Indies there are but four well-ascertained species." "The occurrence of two peculiar, gigantic species of Pavonia, a genus

*Notes on Radiata in the Museum of Yale College. By A. E. Verrill. No. 6.—Review of the Corals and Polyps of the West Coast of America (with 6 plates). No. 7.—Geographical Distribution of the Polyps and Corals of the West Coast of America. No. 8.—Additional Observations on Echinoderms, chiefly from the Pacific Coast of America. No. 9.—The Echinoderm-fauna of the Gulf of California and Cape St. Lucas. (From the Transactions of the Connecticut Academy of Arts and Sciences. Vol. 1.) March 1871. 8vo, pp. 219.

of corals hitherto known only in the Indo-Pacific faunæ, is noteworthy, and also the presence of a peculiar new form of Dendrophyllia."

In the seventh part, on the geographical distribution of the polyps, lists of the species found in the five provinces, between and including the Arctic region and Panama, are given.

Economical Entomology in Canada.*—This subject is wisely taken in hand by the farmers and fruit raisers of Canada and the report on the insects injurious to the apple, grape, and plum, can not but be hailed with joy by those desirous of distinguishing these pests, of knowing their habits, and how to combat them. The information is prepared by those thoroughly acquainted with the subject, and the work is well illustrated, though not so well printed as desirable, a common failing of public documents on this continent. Mr. Saunders' report on the plum weevil, in the same pamphlet, contains an interesting account of the efforts made to capture the plum weevil in large numbers, by the offer of prizes. One person sent in twenty-two hundred and eighty weevils taken by jarring twenty plum trees, ten English cherry and thirty peach trees, between the 24th of May and the 19th of June!

NATURAL HISTORY MISCELLANY.

BOTANY.

Darlingtonia Californica.—It is now more than sixteen years since that distinguished botanist, M. Alphonse De Candolle, published in the Bibliothèque de Genève some remarks on the genus Darlingtonia, a translation of which appeared in a horticultural journal of Philadelphia.

M. De Candolle states that the figure of the plant exhibits a character not mentioned by me in the description, and which is very remarkable if it be real; that is, if it be not an error of the

*First Annual Report on the Noxious Insects of the Province of Ontario. Prepared for the Agricultural and Arts and Fruit Growers' Associations of Ontario, on behalf of the Entomological Society of Canada. By Rev. C. J. S. Bethune, William Saunders and E. B. Reed. Toronto, 1871. 8vo, pp. 66.

draughtsman. The five cells of the ovary are represented as *alternate* with the sepals; but in Sarracenia, which he had seen living. the cells of the ovary are opposite the sepals. The artist who executed the drawing is the well known Mr. Isaac Sprague, who made all the illustrations for Dr. Gray's Genera of the Plants of the United States, and in that work the cells of Sarracenia are correctly represented as opposite the sepals. M. De Candolle asks, "Has he committed an error in the plate of the Darlingtonia? Considering his usual accuracy, I doubt it. On the other hand, it is difficult to believe in contrary symmetries in genera so closely allied. I have discovered a similar fact in the family of Campanulaceæ, and it has enabled me to establish several genera, which are, besides, indicated by their external appearance. The thing, then, is not without a parallel, though it is very rare, and should be well examined before being admitted. I would, therefore, point out to American botanists, and particularly to M. Torrey, the great importance of verifying fig. 1 of Sprague's plate."

In making the details of the original drawing, Mr. Sprague had at his disposal only a single flower of a dried specimen, and it was not until recently that I have been able to test, in a satisfactory manner, the accuracy of his analysis. It is known to most of our botanists, that after waiting many years to see the plant in a living state, we have, through the kindness of the brothers Messrs. Henry, who reside near where it grows abundantly in California, and by the liberality and prompt action of Messrs. Wells, Fargo & Co.'s Express, received fresh, living specimens, several of which have flowered. I am now able to state that Mr. Sprague has shown "his usual accuracy" in all the details of his drawing. The cells of the ovary are *alternate* with the sepals. Indeed, I have found scarcely anything to add or alter, now that we have the living plant for comparison.

The theoretical structure of the flower of Darlingtonia, we think, accords with what is actually the case. The stamens are in a single series, and are mostly about fifteen in number. If we assume that they represent only five, each by collateral chorisis increased to three, they will form a verticil alternating with the petals, so that they will necessarily alternate with the carpels also. In Sarracenia the stamens are in a double series, and probably, as in Darlingtonia, multiplied by chorisis; the two verticils alternating

with each other, so that the carpels, in this view, will be opposite the sepals.—J. Torrey, *in Bulletin of the Torrey Botanical Club.*

A Monstrosity in Anemone patens.—While on a recent botanizing tour in the Rocky Mountains, I found a flower of *Anemone patens, var. Nuttalliana*, in which all the numerous pistils are thoroughly transformed into organs resembling petals, so as to give the flower the appearance of being perfectly double.

The five petal-like sepals, and also the stamens, are present in their normal state. The transformed pistils are somewhat longer than the sepals, but of the same pale purple color. The outermost, or those next the stamens, are three parted, as if to represent the leaves of the plant, while the central ones are entire, like the sepals. The root which produced this beautiful anomaly, bore three other scapes, each with a flower perfectly normal.

The specimen I have carefully preserved, as a most interesting instance of a wild flower becoming double without the aid of cultivation. But why were not the other flowers which grew from the same root also double?—Edward L. Greene, *Golden City, Colorado.*

[Why not? *Quien sabe?* By the way, full double *Thalictrum anemonoides* is found now and then in perfectly wild plants, and sometimes in *Anemone nemorosa.*—Eds.]

Ajuga reptans L.—I have detected this plant growing abundantly in a field in Saco, Maine, where it appears to be well established. It resembles *Brunella vulgaris* so closely in its habit, that I think it may have been overlooked elsewhere. It has been before (1851) found near Montreal, but not, so far as I can learn, in the United States.—G. L. Goodale.

ZOOLOGY.

The Humming Bird.—In the month of June, 1870, we discovered a Ruby-throated humming bird building its nest near and a few feet below our chamber window. We observed carefully the building of the nest, the period of incubation and the time that the young left the nest. On the 14th of June we first saw the bird building the nest on top of a horizontal branch of a pear tree; the branch was about three-quarters of an inch in diameter under the nest. The bird built up the side farthest from the house first,

and built one-half of the circle its full height; the last half of the nest she built in one day with the exception of finishing the outside with lichens. June 16th she laid the first egg and was busy at work all day covering the outside of the nest with lichens, and was one week longer finishing the outside of the nest. June 17th she sat on the nest all day; on the 18th the second egg was laid and was larger than the first egg. On the morning of the 3d of July both of the eggs were in the nest and at noon there were two young birds; this makes the period of incubation fifteen days from the time the last egg was laid. July 10th, we examined the nest, and found but one young bird; it had a little down on it, but no feathers. July 13th, I examined the young bird and found it covered with pin feathers. On the 15th it picked its feathers and had quite a long bill. The 19th, after being fed it stood up in the nest and made its wings move rapidly, as though it was trying to fly. On the 23d of July the bird left the nest, which made twenty days that it remained in the nest. We did not see a male humming bird near the nest at any time, but a neighbor's cat caught and killed two or three male birds, and it may be that it caught the mate to our bird. The old and young birds remained in the garden until late in the autumn and were quite tame; the young bird would allow me to walk within four feet of it and examine it. You will see by this that both the period of incubation and the time that the young bird remained in the nest are longer than given by Audubon and Samuels.— LABURTON JOHNSON, *Bradford, Mass.*

POSITION OF THE BRACHIOPODS.—At the meeting of the Boston Society of Natural History held March 15, Prof. Edward S. Morse referred to the communication of Mr. Wm. H. Dall, "On the Relations of the Brachiopoda" read at the preceding meeting.

Prof. Hyatt said his objections to Prof. Morse's classification of the Brachiopoda had heretofore rested wholly upon the presumed affinities of the Polyzoa and Ascidia. He had been led by the similarities of the adult animals of the two groups to partially follow Prof. Allman in his opinion that these two groups were closely related. In a paper on the Fresh Water Polyzoa (Proceedings Essex Institute, vol. iv.) he had compared them, but had at the same time shown that the differences were much greater between the Polyzoa and Ascidia than between the former and the Brachiopods. Thus, there is no muscular system in the Ascidia which

can compare in any sense with that of the Polyzoa; and in transforming the Polyzoon into an Ascidian, Prof. Allman is obliged to violate this obvious difference, as well as to effect many changes which are not consistent with their organization. The nearer affinity of the Polyzoa and Brachiopoda is hardly questionable since the investigations of Koraleusky, who has shown us that the young Ascidians are apparently more like young vertebrata than they are like the young of the Polyzoa. The importance and value of the resemblances existing between the adult Polyzoon and the adult Ascidian, so far as they may be supposed to indicate any close affinity or community of origin are thus doubly denied by the differences of form and structure, both in the adults and in the larvæ.

The Ascidians are also likely to be removed by these new discoveries, not only entirely away from the Polyzoa, but to an equal or greater distance from all the rest of the Mollusca; and even if we could in the face of embryology still maintain our comparison between the two structures, we should be contrasting the Polyzoa, not with a typical Mollusk but with an animal whose own position is very uncertain. I can think of no fundamental molluscan characteristics, either in the Brachiopods or Polyzoa, which ally them with the Lamellibranchs (clams), except those which join them still more closely to the Ascidians. Therefore it seems clear, that if we separate the Ascidians from the Lamellibranchs, which they so closely resemble in their general adult characteristics, on account of their different developments, we must also, in turn, remove the Polyzoa from the Ascidians, and should logically regard the similarities of the two as analogies arising in different structures, and not as affinities derived from some common ancestor. Thus cut off from its quondam molluscan allies our Polyzoon has but one refuge; its development points concisely to a vermian ancestor, and to this source we must relegate both it and its nearest ally, the Brachiopod.

Prof. Morse called attention to the fact that Koraleusky, Hæckel, Darwin and others had pointed out the relationship apparently seen in the embryo of certain Tunicates, and the typical idea of the vertebrate embryo. Without expressing an opinion for or against this view, it was interesting to remark that many eminent naturalists had seen reason to include the Tunicates with the Vermes; and in the supposed relation, on the other hand, of the Tu-

nicates with the Vertebrates, it was interesting to recall two prominent features of the Vermes that are likewise prominent characters of the Vertebrates, namely: hairs or setæ secreted by follicles, and genitals in pairs, with infundibuliform orifices, suspended freely in the perivisceral cavity.

A Zoologist on the Pacific Coast.—Dr. S. Kneeland gave an account at the same meeting of a trip which he made in 1870. by sea, from San Francisco to Panama, and presented a few specimens which he had collected. He described the climate, the general appearance of the coast, and incidents of the voyage, and referred to the habits of some of the sea birds and of the flying-fish. Large petrels (*Puffinus cinereus*) he said, began to appear and followed us on the second day out. On alighting in the water, which they often do, they put forward their webbed feet, checking their headway in this manner, backing water as it were with the wings spread, before settling on the surface. They came round and near the steamer in considerable numbers, but never alighted on it as the booby of the Atlantic does. On account of the great length of their wings and the shortness of their legs, they cannot rise, like the gulls, directly from the water, but are obliged to run along the surface like the smaller petrels, beating the water with their feet until sufficiently elevated to use their wings.

Flying-fish also began to appear, but neither so numerous nor so large as in the Southern Atlantic. The ventrals were expanded just like the pectorals in the act of flight, the former being much the smaller. They rose out of a perfectly smooth sea, showing that they are not mere skippers from the top of one wave to another; they could be seen to change their course, as well as to rise and fall, not unfrequently touching the longer, lower lobe of the tail to the surface, and again rising, as if they used the tail as a powerful spring. While the ventrals may act chiefly as a parachute, it seems as if the pectorals performed, by their almost imperceptible but rapid vibrations, the function of true flight. Another reason which led him to think they perform a true flight is the way in which they reënter the water. After reaching the end of their aërial course, they drop into the water with a splash instead of making a gradual and gentle descent, like the flying-squirrel, flying-dragon, and other vertebrates with mem-

branes acting as parachutes. The drying of the flying membrane in the air would prevent the small but numerous motions necessary for true flight, and the animal, therefore, suddenly drops when the membrane becomes stiff. He could not see how the drying of the pectorals would effect their action as parachutes.

At the same time there were seen small Portuguese men-of-war (*Physalia*) no larger than an olive, and without the purple reflections of the larger ones so often met in the Atlantic. Whether these were the young, or full-grown individuals, he did not know. He saw none larger than these, and they were not numerous.

As he approached the coast off the Gulf of California the petrels disappeared and were replaced in an hour or two by white gulls, about the size of Bonaparte's gull, but either entirely white or with a very slight lavender-blue tinge on the back and wings. These had an entirely different way of alighting and rising from the water: they did not push forward their feet to arrest their course, but circled round like pigeons until their headway was stopped, then quietly settled upon the water immediately folding their wings. They also rose directly from the surface without running along as the larger winged petrels did.

Migrations of Moths.—Our readers are familiar with migrations of butterflies, and now we see noticed in "Nature" the migration in "amazing numbers" of *Urania Leilus*, which mimic butterflies not only in their size, and disposition and colors of their scales, but also in this habit of swarming, which we do not remember to have seen noticed in other moths. This Urania was seen flying in swarms across the Isthmus of Panama, and also by another person near Para, Pernambuco, and Rio Janeiro. "From an early hour in the morning until nearly dark these insects passed along the shore in amazing numbers, but most numerously in the evening. It was very seldom that one was seen in the opposite direction."

The Urania is scarcely, as "Nature" suggests, "something between a skipper [Hesperia] and a hawk moth," but a true Geometer. A careful examination of the structure of the moth shows us that it is nearly allied to Chœrodes and Urapteryx. To this position Guenèe has also assigned it.

Rapid Growth of the Pickerel (*Esox reticulatus*).—This fish, like all bad characters, makes a worse show the more he is studied. Dr. E. L. Sturtevant investigated their powers of eating, in the

following manner. He put two young pickerel, about five inches long, in a trough with a great quantity of little minnows of about one inch in length; and these two pickerel ate one hundred and twenty-eight minnows the first day; one hundred and thirty-two the second; and one hundred and fifty the third! and *they increased one inch in length in forty-eight hours!* They were mere machines for the assimilation of other organisms!—*Fifth Report of Mass. Commissioners of Inland Fisheries*, 1871.

Ticks in the Ear.—I can tell a tale about a tick in *my* ear (see Naturalist, May, p. 176). In Cuba I was lost in the woods. I slept one night on the ground. A day or two thereafter feeling a curious buzzing in my ear I lay down on the opposite side and filled the ear with water. It was not very long before the tick loosened its hold and was taken out. I know nothing of the species but suppose it was the common horse or cattle tick of that island.—C. Wright.

The Star-nosed Mole.—In January, 1869, I noticed mole tracks and burrows in the snow in Niles, Michigan, and soon saw the star-nosed mole making similar tracks and burrows. He was apparently as lively as if it had been summer. Is it common for this animal to be abroad thus in the winter?—Sanborn Tenney.

White Spotted Muskrat.—I have a muskrat skin that has a narrow white spot upon the back, between two and three inches long; also two patches of white upon the head. There was also white about the mouth.—W. C. Fish.

GEOLOGY.

Discovery of Mastodon Remains at Mott's Corners near Ithaca, N. Y.—A few days ago a son of Mr. J. P. Allen, of Mott's Corners, in digging a ditch to drain a small peat bog, discovered two teeth of Mastodon. With more than ordinary good sense, he immediately stopped digging and the specimens were carried to Cornell University. A party consisting of Mr. Cornell, Pres. White, Dr. Wilder, Prof. Brown, a student and myself visited the spot and made further excavations which furnished only fragments of bones. Since then other parties have secured three more teeth and a considerable quantity of broken bones.

The locality is situated in the deep valley of Six Mile Creek, excavated in Chemung rocks. The bottom of this valley has been

filled up with a great thickness of drift, through which the creek has cut here and there down to or into the solid rock. At the mastodon locality the stream met with a little knob of Chemung rocks which appears to have formed at one time an island, but the creek afterward cut its way through the rock to a lower level on the left side and the channel on the opposite side was deserted. Springs, one of which is said to be salt, have kept this deserted channel wet and a bed of peat has formed which once supported some large trees. The layer of peat varies from a few inches to two feet or more and is full of sticks, pine knots, bark, etc., more or less decayed. Beneath this is a layer of variable thickness, rarely more than a few inches, composed of clay mixed with pebbles and pieces of shale. In this were found small fragments of bones and teeth, the former in a very decayed condition showing that the skeleton had been completely broken up and scattered. The whole rests on a bed of blue arenaceous clay with large pebbles and fragments of rock of all kinds, in fact, a modified drift. In most cases the bones were merely scattered over the surface of this bed between it and the peat. The teeth are in very good condition and not at all waterworn. The animal probably became mired near the spot. The skeleton, exposed to the action of the elements, went to pieces, and the fragments were scattered, partly by water action and partly through the agency of wild animals.—Ch. Fred. Hartt, *Cornell University, May 25th*, 1871.

The Discovery of a Skull of a Musk-ox in Utah.—The skull referred to in the "Salt Lake Tribune" this morning, is quite different from the skull of a buffalo. The long, heavy, drooping horns mark it as the skull of a musk-ox—an animal now found only within, or near, the arctic regions. It is an exceedingly interesting relic to the geologist as an aid in reading the ancient history of this valley. The skull, which is in a good state of preservation, was imbedded about eight feet below the surface in a layer of coarse, stratified gravel, with layers of sand and finer gravel above and below it.

Much of the work of filling the valley had been accomplished before this relic was deposited, but it found its resting place long before the work was completed, and long before Salt Lake wore water lines in the mountains above the "benches." Musk-oxen and the foot-prints of glaciers left on the quartz rocks of some of these canyons, suggest a former climate quite unlike that which

now makes the valley such a fruitful garden.—P. A. Chadbourne, May 16, 1871. *From the Salt Lake Tribune.*

Fossil Walrus.—At a meeting of the New York Lyceum of Natural History, held during last autumn, Prof. Newberry, the President, exhibited the anterior portion of the cranium of a walrus which had been found during the summer at Long Branch by a gentleman whose foot struck against it while bathing. It was strongly silicified, but exhibited no appreciable difference from modern specimens. The precise age of this fossil could not, of course, be ascertained, although it is well known that its range was formerly much south of its present habitat. It is not unfrequently brought down on floating ice off the coast of Newfoundland; and although Labrador is at present the southern limit of its residence, it was once very abundant in the Gulf of St. Lawrence, and its remains have been found in the shell-heaps of the Bay of Fundy. It is probable that the specimen exhibited by Prof. Newberry is a relic of the glacial period, although it was suggested that it might have been of the tertiary age, which probably cannot be verified. Other specimens of similar character are recorded as having been found on Martha's Vineyard; in Monmouth Co., New Jersey; and in Accomac Co., Virginia.

The Pterodactyl in America.—Prof. Marsh states in the American Journal of Science and Arts, that the Yale College party obtained in addition to the cretaceous fossils already spoken of, several specimens which indicate a huge flying reptile, which he names *Pteroductylus Owenii*. The bones discovered "indicate an expanse of wings not less than twenty feet." The remains were found by Prof. Marsh in the upper cretaceous formation of Western Kansas. This is the first occurrence of the Pterodactyl in America.

MICROSCOPY.

Monochromatic Illumination.—Whenever I want to make out some of the minutest details of any organism, or to get over any difficult test, and I see that my microscope, after all due preparation, and with the best prospect of light, fails to answer my expectation, I refer, as a last resource, to my prism, and get from it a colored sunbeam. Blue or green are the colors which I prefer; they are the most suitable for the purpose.

The elimination of every, even the slightest, chromatic aberration obtained by this means increases, in my opinion, the defining and penetrating power of the microscope, and enlarges its dominion on the field of observation. Different other means have been now and then suggested, such as an alcohol light saturated with chlorine of iodine, or a light passed through a stratum of cupreo-ammoniacal solution, or even through a glass of cobalt; all these lights may be very useful and for some special purpose even preferable to any other, as Dr. Woodward observed, speaking of photography; but for direct observations with the microscope, the effects obtained by them are by no means to be compared with the marvellous results of a mono-chromatic illumination. And I do not think it absolutely necessary for this purpose to have recourse to a beam of the *sun*, which in many countries less favored than Italy is not rarely a mere desideratum, and very often a dim, cloudy thing. A brilliant luminous point of electric light — a light obtained from oxhydrogenic flame — acting upon lime, magnesium, or zirconium, perhaps also the magnesium-wire lamp, may supply the deficiency of the sunbeam. Each of these simply white lights decomposed through a prism, will give a mono-chromatic illumination sufficient to reveal the best structural details, which up to this day have baffled the keenest researches of the student.—Count Castracane, *Monthly Microscopical Journal*.

ANTHROPOLOGY.

Supposed Indian Corn Huskers.—In the museum of the Smithsonian Institution are several Indian stone implements like that noticed on p. 16 of the present volume of this journal, which are said to bear a striking resemblance to iron corn huskers now in use in the West.—Eds.

NOTES.

At the Manchester Literary and Philosophical Society, Mr. Boyd Dawkins exhibited a number of casts in plaster of Paris of various objects of natural history, and explained the process by which any one can make them for himself. The material of the

mould is artists' modeling-wax, which is a composition akin to that used by dentists; and, as it becomes soft and plastic by the application of heat, though in a cold state it is perfectly rigid, it may be applied to the most delicate object without injury. As it takes the most minute markings and striations of the original to which it is applied, the microscopic structure of the surface of the original is faithfully reproduced in the cast. This method is briefly this: 1. Cover the object to be cast with a thin powder of steatite or French chalk, which prevents the adhesion of the wax. 2. After the wax has become soft, either from immersion in warm water, or from exposure to the direct heat of the fire, apply it to the original, being careful to press it into the little cavities. Then carefully cut off the edges of the wax all round, if the undercutting of the object necessitates the mould being in two or more pieces, and let the wax cool with the object in it, until it is sufficiently hard to bear the repetition of the operation on the uncovered portion of the object. The steatite prevents the one piece of the mould sticking to the other. The original ought to be taken out of the mould before the latter becomes perfectly cold and rigid, as in that case it is very difficult to extract. 3. Then pour in plaster of Paris, after having wetted the moulds to prevent bubbles of air lurking in the small interstices; and, if the mould be in two pieces, it is generally convenient to fill them with plaster separately before putting them together. 4. Then dry the plaster casts either wholly or partially. 5. Paint the casts in water-colors, which must be fainter than those of the original, because the next process adds to their intensity. The delicate shades of color in the original will be marked in the cast by the different quantity of the same color, which is taken up by the different textures of the cast. 6. After drying the cast, steep it in hard paraffine. The ordinary paraffine candles, which can be obtained from any grocer, will serve the purpose. 7. Cool, and polish the cast by hand with steatite. The result of this process is said to be far better than that obtained by any other.— *The Manufacturer and Builder.*

The American Museum of Natural History held an exhibition of its collections in the Arsenal building, in the Central Park, to invited guests, April 27th. This Association was incorporated some two years since, and has made excellent progress in establishing a museum. The cases are said to contain nearly one thou-

sand mammals, ten thousand birds, and two thousand fishes and reptiles. There are also nearly four hundred mounted skeletons of the various orders. The insects number more than ten thousand, and shells about that number. Also a few geological specimens of no great value. There are no mineral collections as yet. The insects were presented by Baron Osten Sacken, R. A. Witthaus, and Coleman T. Robinson. The shells are the gift of Albert S. Bickmore and William A. Haines. The remainder of the collections was obtained by purchase in this country and Europe. The Department of Public Parks, under the authority granted by the last Legislature, will commence in the autumn the erection of a permanent building in Manhattan Square, for this collection. The cost of the new building will not exceed five hundred thousand dollars.—*American Chemist.*

Prof. Baird, of the Smithsonian Institution, who was last spring appointed by the President and confirmed by the Senate as United States Commissioner of Fish and Fisheries, will visit the coast of New England during the coming summer, making his head quarters at Wood's Hole. The act of Congress under which the Commissioner is appointed makes it his duty to prosecute investigations with a view of ascertaining whether any and what diminution in the number of valuable fishes has taken place, and if so, to what causes the same is due. He is also to report to Congress whether any and what protective prohibitory or precautionary measures should be adopted in the premises.

We understand that Prof. Baird will dredge extensively both at the surface and at the bottom, and the investigations will be of great interest to naturalists, several of whom will join him in his explorations.

The Providence Franklin Society celebrated its semi-centennial anniversary on May 9th. This society has been more active in the past than of late years, but seems now to show unusual activity. Several scientists of eminence have been active members, and we trust a new life and energy will be infused into its present working staff.

Silk worm eggs from Japan, to the amount of one hundred and thirty-five thousand cards, costing in that country six hundred and seventy-five thousand dollars, lately arrived in San Francisco. —*American Chemist.*

We are sorry to learn that the Government of Nova Scotia, in resorting to the retrenchment system, has withdrawn the small annual grant heretofore made to the Institute of Natural Science, the only scientific society that colony possesses; and, moreover, one which for the past eight years has struggled to maintain a position creditable to itself and the country in which it is established. Surely the trouble and expense of publishing, setting aside the gratuitous mental labor of those members who have furnished the interesting papers which together form the eight annual parts, comprising two volumes of over one thousand pages, should have been considered by the authorities of the colony before they acted in such an illiberal spirit. We trust, nevertheless, to see the Institute still progress in its career of usefulness. —*Nature.*

Prof. Agassiz has accepted an invitation extended to him by the Coast Survey Bureau to take passage on the iron coast survey steamer, which has just been built near Wilmington, Del., and which sails for the Pacific coast in September next. The expedition will take deep sea soundings all the way, and extensive collections of specimens will be made for the Museum of Comparative Zoology at Cambridge.

Secretary Boutwell has written to the Secretaries of State and Navy asking that naval and other officers may be instructed to afford such courtesy and assistance to the exploring party as may be desirable.

We learn that Count Pourtales of the Coast Survey and Rev. Dr. Hill will accompany the expedition.

The Legislature of Arkansas has passed a bill providing for a geological survey, and making an appropriation of fifteen thousand dollars for beginning the work. The position of chief geologist, salary two thousand eight hundred dollars per annum, was tendered to Prof. Edward Orton, of Antioch College, one of the assistant geologists on the Ohio survey, but has been declined by him.—*American Chemist.*

The President of the Geological Society of Glasgow thinks the phosphate deposits of South Carolina are of Eocene Tertiary age. This is quite a mistake, as they are of Quaternary age. The bones he refers to were washed out of Eocene strata, but they are

associated with Quaternary mammals such as the tapir, horse, mastodon, mammoth, megatherium, dinotherium, etc.

The Maryland Academy of Sciences held its annual meeting in May, electing Rev. Dr. J. G. Morris, President, and Rev. E. A. Dalrymple, Corresponding Secretary, with the usual officers. This society holds field meetings, and otherwise shows considerable activity.

The State Geological Rooms at Springfield, Illinois, were burned on the twenty-second of February, and the state collections were greatly damaged by water and hasty removal.

The Record of Entomology for the year 1870 is now published. The design of this useful annual is to collect from various periodicals and transactions of societies, the titles of articles and notices of new discoveries in entomology, thus giving a record of the progress of American entomology each year. In this way the isolated descriptions of new species, and notes about the habits of insects are indicated so that the working entomologist is greatly aided in collecting the materials for study. It also gives foreign entomologists a summary of what has been done in this country, and thus brings the working entomologists of both hemispheres into closer relations. The work is advertised in the present number.

ANSWERS TO CORRESPONDENTS.

S. J., Hudson, Mass. — The plant you send is the *Habenaria virescens*. It belongs to the Orchis family and is not uncommon in wet places where the skunk cabbage grows. — J. L. R.

C. G. A., Augusta, Me. — The specimens you send from the pine tree of about sixty feet in height are pronounced by Prof. Gray to be unquestionably from the *Pinus Banksiana* as you supposed. Your Orland tree is remarkable for its height.

S. S. C., — Speaking of the enemies of the oyster a correspondent writes: — "Along the tidal rivers and sounds of East Florida are vast beds of oysters, many of which are seen when the tide falls to have been opened and the animal removed. It was difficult to understand by what agency this was done. Inquiring of an intelligent native pilot and fisherman, I was told that the Sheepshead and Drum, fishes whose principal food consists of crustacea and mollusks, are able with their strong jaws and pavement-like teeth to crush the shells of the oyster sufficiently to extract the animal. Moreover, the Conch (Turbo), Does not our correspondent mean the strombus? which shell-fish is very common on these coasts, inserts its hard and horny operculum (which well represents an oyster knife), between the shells, pries them open, and sucks out the oyster with a fleshy tube, or proboscis. This Conch, which is from six to ten inches long, puts out a foot, upon which it can travel along the bottom. It walks to the oyster bed, deliberately pries open the oyster, and takes him raw on the half shell; a remarkable performance indeed, for a Gasteropod." We submitted this communication to an eminent naturalist, who has spent much time exploring in Florida, who replies as follows: — "Gasteropods do not open oysters with their opercula. The Turbo in fact is a vegetable feeder. The oysters are killed by frost in severe 'northers,' and when the animal decomposes, the shells, of course, open by the elasticity of the cartilage. No fish has teeth strong enough to crush oyster shells; they frequent the beds for the smaller shells and crustacea which harbor there."

BOOKS RECEIVED.

First Annual Report on the Injurious and Beneficial Insects of Massachusetts. By A. S. Packard, jr., Entomologist to the State Board of Agriculture. Boston, 1871. 8vo, pp. 31. 24 figures.

Canadian Naturalist and Quarterly Journal of Science. Vol. 5, No. 3. Sept., 1870. (April, 1871.) Montreal.

Proceedings and Communications of the Essex Institute. Vol. 6. Part 2. 1868-71 (March, 1871). [Concluding the work.] Salem.

Annual Report of the Board of Supervisors of the Louisiana State University for 1870. New Orleans, 1871. 8vo, pp. 271. [Contains 2d Annual Report of the Topographical Survey of La., by Col. S. H. Lockett, pp. 55; 2d Annual Report of the Geological Survey of La., by F. V. Hopkins, M. D., pp. 35 and map; Report of Botanical Survey of Southern and Central La., by Prof. A. Featherman, pp. 131; and a list of the shells.]

Museum Godeffroy. Catalogue IV. Hamburg, 1869. pp. 139.

On the Physics of Arctic Ice, as Explanatory of the Glacial Remains in Scotland. By Robert Brown. 8vo, pp. 31. London, 1871.

Descriptions of some new or little-known species of Oaks from North-west America. By Robert Brown. 8vo, pp. 8. London, 1871.

Bulletin of Museum of Comparative Zoology. Vol. 2, No. 5. Appendix to the Preliminary Report (Bulletin. No. 9, Vol. I.) on the Echini collected by L. F. de Pourtales. By Alexander Agassiz. pp. 3. April, 1871. Cambridge.

Memoirs Boston Society of Natural History. Vol. 2, No. 1. January [May], 1871. Contains Historical Notes on the Earthquakes of New England, 1638-1869, by Wm. T. Brigham.

The Discovery of the Force which in the beginning put all the Heavens and the Earth in Motion. By Jacob Ennis. 8vo, pp. 23. Cambridge, 1871.

Annales Academici. 1865, 1866. 4to. Lugduni-Batavorum, 1870.

Denkschrift auf C. E. Hermann von Meyer, von C. A. Zittel. 4to, pp. 50. Munchen, 1870.

Memoirs de la Societe de Physique et d'Histoire Naturelle de Geneve. Tome xix, 1st part, 1867. Tome xx, 2d part, 1870. 4to. Geneve.

Sitzungsberichte der k. k. Akademie der Wissenschaften zu Munchen. Jahrgang, 1870. Band II. 8vo. Munchen, 1870.

Journal of the American Geographical and Statistical Society. Vol. 2, Nos. 1, 2; 1860 and 1870. 8vo. New York.

Journal of the Queckett Microscopical Club. April. London.

The Profession of the Mechanical or Dynamical Engineer. An Inaugural Address by W. P. Trowbridge. 8vo pamph. Philadelphia, 1871.

Anæsthetics. By E. R. Squibb, M. D. pamph. 8vo. New York, 1871.

Notes on Radiata in the Museum of Yale College. No. 6.—Review of the Corals and Polyps of the West Coast of America (with 6 plates). No. 7.—Geographical Distribution of the Polyps and Corals of the West Coast of America. No. 8.—Additional Observations on Echinoderms, chiefly from the Pacific Coast of America. No. 9.—The Echinoderm-fauna of the Gulf of California and Cape St. Lucas. By Prof. A. E. Verrill. 2 pamphs. 8vo. [From the Trans. Conn. Acad. Arts and Sci. Vol. 1, 1868-71.]

On the Geology of the Eastern Uintah Mountains. By Prof. O. C. Marsh. 8vo, pp. 8. Meh., 1871.

Notice of a Fossil Forest in the Tertiary of California. By Prof. O. C. Marsh. 8vo, pp. 4. Apr., 1871.

Description of Some New Fossil Serpents from the Tertiary of Wyoming. By Prof. O. C. Marsh. 8vo, pp. 7. May, 1871.

Æsthetic Culture in the Troy Female Seminary. By Mrs. John H. Willard, and *Plan for Improving Female Education.* By Mrs. Emma Willard. 8vo, pp. 32. Troy.

Amazonian Drift. By Prof. C. F. Hartt. 8vo, pp. 3. April, 1871.

Report on the Action of Cochituate Water upon Lead Pipes. By W. R. Nichols. 8vo, pp. 27. Boston, 1871.

Notes relating to the Physical Geography and Geology of, and the distribution of Terrestrial Mollusca in, certain of the West India Islands. By Thomas Bland. 8vo, pp. 8. March, 1871.

Notes on Chalcidiæ. Part I.—Eurytomidæ. By Francis Walker. 8vo, pp. 17. London, 1871.

A New Genus and Species of Chalcidites. By F. Walker. 8vo, pp. 2. London, 1865.

Notes on Chalcididæ and Description of a new species of Megastigmus. By F. Walker. 1869.

Genres des Poissons de la faune de Cuba appartenant a la famille Percidæ. Par Felipe Poey. 8vo, pp. 79 and plate. New York. [From Ann. Lyc. Nat. His. Vol. x.] 1871.

Arrangement of the Families of Mollusks prepared for the Smithsonian Institution. By Theo. Gill. 8vo, [S. I. Miscel. Coll.] pp. 49. 1871.

Annals of the Lyceum of Natural History of New York. Vol. x. Nos. 1-3. Feb.-March, 1871.

On the Aymara Indians of Bolivia and Peru. By David Forbes. 8vo pamph., pp. 113. 7 Plates. London, 1870. (Communicated to the Ethnological Society of London, 1870. Contains also a discussion of the subject by Mr. Squier and others.)

Geological Survey of Canada. Report of Progress from 1866 to 1869, accompanied by Geological and Topographical Maps. Alfred R. C. Selwyn, Director. 8vo, pp. 475. Montreal. 1870.

Conchological Memoranda, No. VI. Preliminary Descriptions of New Species from the West Coast of America. By R. E. C. Stearns. May 18, 1871. 1 p. 8vo.

Notes on the Chalcidiæ. Part I.—Eurytomidæ. By Francis Walker. 8vo pamph., pp. 17. Cuts. London, 1871.

Third Annual Report on the Noxious, Beneficial, and other Insects of the State of Missouri. By Charles V. Riley, State Entomologist. 8vo pamph., pp. 175, 273 cuts. State Document, 1871.

On the Influence of the Blue Color of the Sky in Developing Animal and Vegetable Life, as illustrated in the Experiments of Gen. A. J. Pleasonton. Philadelphia, 1871. 8vo pamph., pp. 24.

American Journal of Conchology. Vol. 6, Part 4. (June.)

Archiv fur Anthropologie. Vierter Band, 1870. 4to. Braunschweig, 1871.

Feuille des Jeunes Naturalistes. No. 7. May 1, 1871. Dornach.

Catalogue, etc. Columbia College. 1871.

Bowdoin Scientific Review. Nos. for May.

American Journal of Microscopy. Vol. 1, No. 1.

Journal of the Franklin Institute. May, June.

American Journal of Science and Arts. June.

Land and Water. Nos. for May.

The Academy. Nos. for May and June.

American Bee Journal. May, June.

Bulletin of the Torrey Botanical Club. April, May.

Le Naturaliste Canadien. April, May.

Nature. Nos. for May and June.

The Field. Nos. for June.

Science Gossip. June.

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THE STUDY OF MINUTE FUNGI.

BY DR. J. S. BILLINGS, U.S.A.

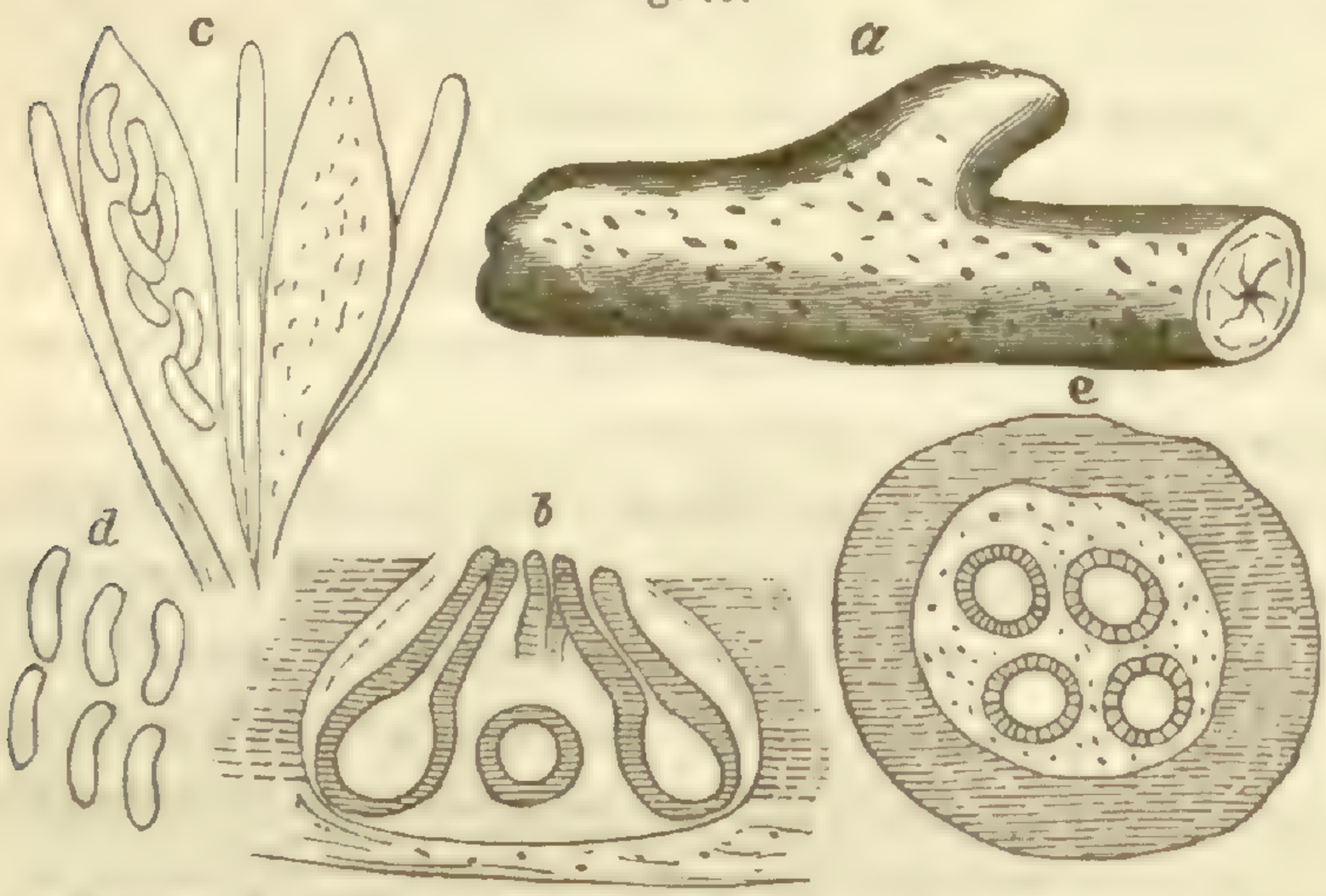
There are probably a number of microscopists, or, perhaps it would be better to say, possessors of microscopes in this country, who would gladly turn their attention to the minute Fungi, if they only knew how to begin, or could obtain any one book or treatise which would furnish the necessary guidance. As there is no such book in existence, the literature of Mycology being confused and scattered in the highest degree, it may be that a few words of advice as to the best mode of study of this subject will be of some interest.

As a text for my remarks, I will take one of the commonest of the minute Fungi, which can be found everywhere and at all times of year, namely, *Valsa stellulata* Fr. The Valsæ form a genus of the great order Sphæriacei, which in their various states comprise the majority of the black specks or dots which will be found upon almost all decaying wood, and dead twigs, leaves, and herbaceous stems. To obtain specimens, you need only step into the yard and examine minutely a few twigs, pieces of old board, or dead stems of flowers or weeds, on some of which you will be certain to find little black, shot-like bodies, varying in size, from that of a large pin's head to a mere point hardly perceptible to the naked eye, while half an hour's stroll in the woods, and an examination of two or three decaying stumps or logs, and some of the

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dead branches lying about, and especially an overhauling of one of the little piles of drift wood about the roots of some tree on the bank of a creek, will furnish you material for a year's work, if properly used. On one or more of the branches you have picked up you will find a portion thickly dotted with black spots, which, under a hand magnifier will be seen to be little black bodies, closely united and bursting through the bark. These are really the ends of as many tubes, which are the necks of globular, oval or retort-shaped flasks buried in the bark or wood beneath. By slicing off with a sharp knife, thin horizontal sections of the bark, through one or two of these little pustules, you will be able to see these flasks in situ very distinctly. Probably they will appear black and empty with thick walls.

Fig. 75.



a, Valsa on a fragment of branch, natural size. *b*, perpendicular section. *c*, Asci and paryphyses. *d*, spores. *e*, horizontal section of conceptaculum and perithecia.

With the point of a knife pick out one or two of these flasks, put them on a glass slide with a drop of water, and a rather thick cover, and crush them out flat by pressure. Examination of the object thus prepared, with a power of about two hundred and fifty diameters, will show that the contents of the flasks are little colorless delicate sacs, in each of which are eight minute colorless, curved, sausage shaped spores.

The little sacs are called thecæ, or more usually asci, the flask which encloses them being called the perithecium. And the Sphæriacei are Fungi in which the spores are contained in asci (ascomycetes) and the asci are produced in perithecia, which are more or less globose, at first entirely closed, at length opening by a neck (ostiole), or pierced by a small hole or pore at the summit. If each perithecium is by itself, or solitary, not imbedded in a crust or stroma, but either on, or in the bark or wood, it is called a simple or true Sphæria.

If the perithecia are associated in little clusters of from two to twenty, imbedded in the bark or wood, with long necks which converge to form a bundle or disc which pierces the bark, it is a *Valsa*. If the perithecia are buried in a brown or black carbonaceous mass or stroma, which grows like a cushion *on* the bark, the necks of the perithecia being short and not converging, it belongs to the genus *Hypoxylon*. If this stroma is more developed, growing up like a miniature club from one to four inches high, black or brown, corky or brittle, with the perithecia immersed in it at the upper part, it forms the genus *Xylaria*. If this club or stalk be fleshy, white or red it is a *Cordyceps*. This genus for the most part grows up from dead caterpillars or insects, giving rise to the newspaper stories of the vegetable bug.

Let us now return to our Valsa. Having determined that it is a Valsa, we next wish to know its specific name. And, just at this point is where the great difficulty in the study of mycology commences, where the student is most apt to be discouraged and demoralized, and where a little assistance is most needed. To determine the species of a Valsa we must first ascertain whether the perithecia are in a special stroma, and next whether this stroma has a distinct limiting wall or conceptaculum.

If there is a black, ventricose conceptaculum, pyriform or conoidal in shape, the apex being upwards, with the perithecia scattered through the stroma, and their long converging necks bursting through the conceptaculum, and then through the bark, it belongs to the subdivision *Circumscriptæ*. Slicing across one of the pustules of our Valsa, and examining the cut surface we see a black ring; the cut edge of the conceptaculum, within which is a spongy mass, the stroma, in which are the perithecia. Of the *Valsæ circumscriptæ*, about forty species have been described by mycologists. To decide which of these species you have before you, you next examine the spores. About a dozen species have spores like those described above, namely, colorless curved rods. Your next step, then, is to ascertain accurately the length of the spores before you. And by "accurately" I mean that you should determine their length to within the $\frac{1}{1000}$ of an inch. The easiest way to do this, is by means of an eye-piece micrometer, but if you have not this you must rule a scale on a card by aid of your stage micrometer and camera lucida.

On a line across one end of the card, mark off the length of

three or four one-thousandths of an inch as they appear through the camera. At each of these points draw a line perpendicular to the base. The most convenient length for these lines is $2\frac{1}{2}$ inches. Now divide these lines into ten equal parts, by lines ruled parallel to the base line, and then draw a line diagonally from one of the $\frac{1}{1000}$ inch marks on the base line to the next $\frac{1}{1000}$ inch mark in the tenth line above. You will thus have constructed a diagonal scale which will measure to the ten-thousandth of an inch. To use it, you lay it on the stage beside the object, and view it with one eye and the object with the other. You will with a very little practice see the object projected on the card and can read off its length at once.

On measuring the spores of your specimen, you find that they are .0004 of an inch long. The spores of all the species in this division of the Valsæ are shorter than this, with the exception of *Valsa stellulata* Fr. Fr. stands for Fries, a great Swedish mycologist who named and described this species and this is his description.

"*S. stellulata.*—Subrotunda, immersa, stromata albo circumscripto, ostiolis ovato globosis, brevibus radiato stellatis" . . . The "Systema Mycologicum" of Fries from which the above description is taken, was published in 1822, and, of course, at that time there was no microscope at his command by which he could define the fruit. The first description of the spores of this species was given by De Notaris, in 1853, in the Memoirs of the Academy of Science in Turin.

But the mere giving a name to our fungus, or finding out what name somebody else has given to it, amounts to very little, except as giving the same sort of mental exercise and amusement, as the putting together a puzzle of any kind would do. What we want to know, is, how did the Valsa get there under the bark? What is its life history, and what is its use or purpose, if it has any? And the first question of all to occur to you, if you have become a little impatient of the very minute points by which one of the so-called species differs from another is, how do you know that these points indicate specific differences? In other words why do you practically assert that the fungus with spores exactly like, but with spores the one ten-thousandth of an inch shorter than another fungus, may not be merely a stunted specimen of the latter? To the latter query I must reply, that at present we have no satis-

factory basis on which to discriminate species in the minute Fungi, and this is true even as regards some genera, and it is with a faint hope that some of my readers will aid in establishing such a basis that I have called their attention to this subject. The practical test of a good species is, that it will produce its like, subject to variations which are usually limited in degree. Now this test has not been applied to any of the species of Valsa, nor, indeed, to any of the Sphæriacei; and the observer who will take a specimen of *Valsa stellulata* or of any other species, and propagate it, watching its development under varying conditions of place, moisture and temperature, and honestly and accurately report the results, will do more to advance our knowledge of these plants than if he had collected and ticketed a thousand or two of them. This field is almost entirely unexplored, and I know of no reported results of culture of any of the Sphæriacei. All that has been done has been in a few cases to observe the succession of forms and to conclude on the principle of "post hoc ergo propter hoc" that these forms necessarily belong to the same plant.

That some of the minute Fungi in the various stages of their development assume different forms—so much so that these forms have been classed under different orders and classes, there is no doubt—but in very few cases have these various stages been made out with anything like precision. The Brothers Tulasne, in the second volume of their great work, the "Selecta Fungorum Carpologia," attempt to specify the various stages and forms of the Sphæriacei—and upon these to base a new system of classification. Splendid as is their work, it will very soon be manifest to any one who attempts to make use of it to classify species which they have not named—and although the book is a thick quarto, it does not refer to one-tenth part of the forms known—that it will afford him little or no assistance.

The attempt at a physiological classification of these organisms is as yet premature, the mere morphological classification being still so very incomplete, that it is impossible from published descriptions to identify much more than half of the minute Fungi which have been described, while a vast number have been collected and named which have never been described at all. I do not, therefore, recommend the microscopist who proposes to undertake this study, to try to do more at first than to recognize genera, and I furthermore advise him to confine his work for a

time to half a dozen species which he can get named for him by some one who has the necessary facilities for so doing in the shape of identified specimens. For instance, having ascertained that he has a specimen of *Valsa stellulata*, let him first see whether he can get the spores to germinate. First, he may try them with a little water on some form of growing slide, the simplest form of which is to take the slide with the spores on it covered with a piece of thin glass just as he has been examining it under the microscope, and laying it across a narrow dish of water (a soap dish or toothbrush dish is just the thing) let two or three threads lead from the water to the edge of the thin glass cover. The growing slides of Hoffman, De Bary, Dr. Maddox, and those described by Dr. Curtis and the author in their report on Fungi in connection with the Texas cattle fever, are all good and useful. The spores should be tried not only in water, but in fluids which will afford them some nutriment, such as juice of fruits or plants, Pasteur's fluid, or on such media as a slice of potato, blotting paper soaked in lemon juice, etc., etc.

But the most essential, and what will prove to be the most interesting, experiments will be the culture of the fungus in its native habitat, viz., on, or in the small branches of the tree on which it is found. Cut off a small branch of oak and cut it into lengths, say a foot long. Examine these carefully to make sure that the bark is smooth and unbroken, and then on half a dozen of these pieces plant your Valsa by placing it both on and under the bark at marked points. Plant the same Valsa in like manner on similar pieces of branches from other trees, for instance, elm, beech, and blackberry or green-brier (Smilax) or on the grape-vine. For purposes of comparison, keep half a dozen similar pieces of each kind of wood without planting anything on them. Now place your pieces of wood, two of them in a miniature hot-bed, two of them under glass over water, and two of them simply on the ground in the open air, where they will not be disturbed. Observe that wherever you put a planted specimen, you must put an unplanted branch of the same wood under the same circumstances.

Having planted this new kind of garden you have to watch for results. If the theories of Tulasne are correct you ought to find, preceding the true Valsa, little perithecia which however will contain no asci, but minute colorless bodies embedded in a sort of

gelatine which have an active swarming motion when placed in water, and which he calls spermatia; these he says will not germinate, but I advise you to try for yourself. These bodies are usually referred to the genus Cytispora or Naemaspora, belonging to a totally different order of Fungi, the Sphaeronemei of the Coniomycetes. You will probably also find various moulds appearing on the sticks, some of which are very curious, and have received very long and hard names, and your experience will differ from mine if you do not find a number of forms which you will not expect and which will puzzle you very much. Note and draw them all, and combine your results in a paper for the NATURALIST, which shall give the life history of the particular Hypoxylon, Diatrype, Valsa or Sphaeria, with which you have experimented.

The field is very wide, and the experiments of one man must be checked by those of another to get our knowledge of the subject established upon a satisfactory basis.

I feel sure that any one who gets fairly started in this field of investigation will find it infinitely more amusing, interesting and satisfactory than looking at specimens purchased ready mounted and labelled.

There is another, and the usual mode of studying this subject, namely, the collecting all the specimens you can get and having ascertained their specific names put them in an herbarium. This kind of work very few can have the necessary facilities for doing, for it is absolutely necessary to have access to authentic specimens and good libraries to obtain valuable and satisfactory results. It is work which must be done by somebody, but it involves a good deal of uninteresting labor, and is not at present so desirable as the mode of investigation which I have indicated.

THE TOAD AS AN ENTOMOLOGIST.

BY A. S. RITCHIE.

THE principal object of the following notes on the toad as a collector of beetles, is to show how useful some of the lower animals are to man in his search after knowledge. Before entering on the

subject, a few remarks on the habits of the toad may not be uninteresting.

From the earliest accounts relating to this creature it has always been looked upon by the people as ugly, hideous, and venomous, while even supernatural powers have been attributed to it. Thus an old author says: "If the toad burrowed near the root of a tree every one who ate a leaf of that tree would die, and if he only handled it, would be struck with sudden cramps." Some of the antidotes recommended for toad venom are the following: Black hellebore, powdered crabs, the blood of the sea-tortoise mixed with wine, the stalks of dogs' tongues, the powder of the right horn of a hart, cummin, the vermet of a hare, the quintessence of treacle and the oil of a scorpion, mixed and taken *ad libitum*.

Even in those days when these elaborate prescriptions were invented some good was acknowledged to exist in the toad. The "toad-stone" is alluded to by Shakespere in the passage:

> **"Sweet are the uses of adversity,**
> **Which like a toad, ugly and venomous,**
> **Wears yet a precious jewel in its head."**

During the middle ages the stone found in the head of this reptile was popularly believed to be possessed of the power of giving warning of the presence of poisons. Fenton, writing in the year 1569, says: "There is to be found in the heads of old and great toads a stone they call borax or stelon. This worn in a ring gives a forewarning against venom." Another recommendation the toad had in those days was "its power as a styptic." Supposing any one to fall down and knock his nose against a stone, he could instantly stop the bleeding if he only had in his pocket a toad that had been pierced through with a piece of wood and dried in the shade or smoke. All he had to do was to hold the dried toad in his hand and the bleeding would immediately cease. The reason for this effect is, "that horror and fear constrained the blood to run into its proper place, for fear of a beast so contrary to nature."

In our day, however, the properties of this animal are better understood, although to a great extent it is still held to be venomous by the people, and generally killed wherever it is found.

Recent investigations go to prove that an acrid secretion covers the body of the toad, which is the cause of sore mouths in dogs attacking it. One of the great uses of the toad is its propensity

for destroying insects injurious to vegetation. Our gardeners ought to introduce them into their gardens and cultivate the acquaintance of these creatures, their little trouble in so doing would be amply compensated.

The toad is of a retiring disposition, loving dark corners and shady places. It has a slow, jumping motion, and is of a very timid disposition. Numerous instances might be cited of pet toads, and of their becoming quite tame.

The toad differs in some respects from the nearly related frog. The structure of the mouth is, however, nearly the same; the tongue is attached by the root, as it were, to the base and front of the mouth, the tip being reversed and pointing down the throat when the animal is at rest.

The moment it sees an insect its eyes brighten and sparkle, the toes twitch and quicker than the eye can follow, the tongue is thrown out, the insect transfixed, and withdrawn into the mouth.

Unlike the frog, the toad does not spring after its prey, but remains seated. Having kept frogs in the aquarium, I have noticed that they will spring two or three times their own length from the moss to catch a fly on the glass, using their tongue, as it were, on the jump. They seldom miss their mark. As far as my experience goes, neither of these animals will eat anything without life or motion. I have, however, often deceived a frog by moving a dead fly in the sight of the creature, which it always took readily.

Many stories have been told of toads in rocks, and reasons have been given by authors as to the way in which they became so embedded. My subject has, however, nothing to do with these "old great toads," but to one of our own day and generation. After this digression, I shall now introduce my friend, the toad, in his capacity as a collector of beetles.

The true naturalist, in the pursuit of his study, is a very teachable individual; he never refuses assistance from any one, whatever his station in life is, or however meagre his knowledge of the science may be. The many ways he uses the animal creation to advance his knowledge in the particular branch of study, may be illustrated as follows:—

The conchologist wearies for the pleasant days of summer, to take a trip to the sea-side, with his dredges and lines, his bottles and store boxes, where he adds to his collection many interesting and perhaps new forms of molluscan life.

A trip to the sea-side is not always easily obtained; but the naturalist may be seen in the markets buying the several species of flat fish, such as flounders and other species which live and feed at the bottom of the sea. Knowing them to be good collectors, he takes advantage of this fact to procure many and sometimes rare species, and thus adds to his cabinet, without the trouble of dredging for them.

The entomologist, likewise, has recourse to different methods to obtain the objects of his interesting study. The following is one of many:

Starting at six o'clock one morning, in the summer of 1864, for a walk to our beautiful mountain to collect insects, provided with the requisite apparatus, a wide-mouthed bottle, with spirits, for beetles, and a small flat box, lined with cork, for butterflies, etc., my success was particularly good. The first captures were eleven specimens of carrion beetles, comprising three species, viz., *Silpha peltata*, *Silpha marginalis* and *Silpha inæqualis*. These were obtained from the body of a dead hawk-owl (*Surnia ulula*). Having secured them in the bottle, and while walking leisurely along, I noticed a toad (*Bufo Americanus*) sitting contentedly at the root of a basswood tree (*Tilia Americana*). Having never made use of my dingy friend as an insect collector, although aware of his propensity that way, my mind was made up to press him into the service—but how? He must be dead first. As he sat looking at me with his beautiful eyes (for although his appearance is not very prepossessing, still those beautiful, bright, yet languid eyes go a great way to improve his appearance), I had certain qualms of conscience about taking his life; still it was in the cause of entomology, and for the furtherance of science his life was sacrificed. Now he was dead; how was I to proceed? I had cut up and dissected many insects as well as birds; but to cut up a toad, and before breakfast—"there's the rub"—that grey, warty toad, no beautiful eyes now. One slash of the knife through the skin, another through the walls of the stomach, and the poor creature's breakfast was exposed.

I was a little disappointed at first, as one or two common forms of beetles presented themselves, that might have been obtained without sacrificing the poor animal; still, I reasoned as he had been up nearly, or perhaps all night, collecting, and I had not, he must have taken some species not in my collection. Having

scraped the contents of his stomach into my bottle of spirits. I started home, resolved to see what the insects were before breakfast.

I spread them out on a sheet of blotting-paper and counted them, the result being as follows, naming them for the benefit of my entomological friends, who have not made use of the toad as a collector of insects:—

There were thirteen perfect specimens, viz.,—

	No. of Specimens.
Cymindis pilosa, rare,	one.
Platynus cupripennis, common,	two.
Bembidium quadrimaculatum, uncommon.	one.
Cercoyn, undetermined,	three.
Tachyporus jocosus, common,	one.
Pæderus littorarius, rare,	one.
Ips faciatus, common,	three.
Ips sanguinolentus, common,	one.

Besides these, there was one elytron each of Hippodamia and of Brachycantha; also vestiges of legs and wings of other insects.

I have killed several toads since, with similar results: one, I may mention, had the stomach filled with a species of *Chrysomelidæ*, *Doryphora trimaculata*, amounting to eleven specimens. He had evidently come across a colony of that insect, and made a hearty breakfast. I may state that this insect was in great abundance, during 1864, on the Island of Montreal. The same may be said of last summer, 1868; taking them by the score on the Mountain, also along the river at Hochelaga.

The earlier you go out in the morning the better; before sunrise, if possible, ere the process of digestion has gone too far.

Birds are also very useful as collectors of insects, as may be seen by the following from one of the daily papers, being only one of many thousand examples:—

Birds The Farmer's Friends.—An intelligent farmer boy in Illinois observed a small flock of quails, commencing at one side of a cornfield, taking about five rows regularly through the field, scratching and picking around every hill, then returning and taking another five rows, until thinking they were pulling up the corn, he shot one and then examined the field. On the ground they had been over, he found but one stalk of corn disturbed, but in the quail's crop he found one cut worm, twenty-one striped vine bugs, over a hundred chintz bugs that he could distinctly count, and a mass apparently consisting of hundreds of chintz bugs, but not one kernel of corn. During the past five years the quails in that vicinity have been decreasing, and the chintz bug increasing.

It will thus be seen, from what has been said regarding the habits of those humble animals, toads and birds, what great ser-

vices they render to man in the economy of nature, and will, it is hoped, tend to show that it is the duty of all, especially of agriculturists, to preserve such valuable animals.—*Canadian Naturalist and Geologist.*

FRESH WATER SKETCHES.*

BY PROFESSOR L. W. BAILEY.

It must not be inferred, from the title above given, that it is the purpose of the author, in the following "Sketches" to impose upon the readers of the NATURALIST, either a temperance tract, or a treatise on hydropathy, a fisher's manual, or even a guide to the lakes. The disciples of Isaac Walton will find that like Buller, I have tabooed the whole subject of angling, "and all its endless botheration about baskets and rods, and reels and tackle—salmon-trout. sea-trout, perch, pike, etc.,"—nor must the tourist look here for descriptions of the picturesque, the beautiful, and the grand, as displayed in the scenery of our unrivalled rivers, lakes and cataracts. My object, on the contrary, is to allude but slightly, if at all, to the charms of our inland aquatic scenery, or even to such objects of natural history, as may meet the eye of every observer, but rather to present, in a familiar way, some account of the minute, but marvellous wonders, which may be found by the aid of the microscope in every pool, pond, lake or river in our country. As the sketches in question have not the formality of a scientific treatise, and are divested to a considerable degree of technical language, I hope they may find some readers among those who might be repelled by a more pretending title or a more ponderous theme. If they serve to recall to the accomplished microscopist, some of the pleasures which have often "lent a

*The idea of these sketches was first suggested by some manuscript notes, left among the papers of my father, the late Prof. J. W. Bailey, of West Point, and which had been written with a view to the preparation of a small volume, similar in its general character to "the Sea-side Book" of Harvey, but relating exclusively to the more minute and microscopic forms to be met with in ordinary fresh waters. A few pages only of this work having been completed, and the present writer not being in a position to carry out the intention originally entertained, he has, in the following pages, embodied a portion of the notes in question, in a modified form, with the results of such observations as he has himself been able to make upon the subjects alluded to.—L. W. B.

charmed loneliness" to my own pursuits, or if they shall succeed in awakening in any that curiosity and desire for more intimate knowledge, which can only be gratified by original research, I shall feel that I have not misapplied that labor to which I have been urged by

> "That fond desire which dwells in human breasts,
> When pleased, their pleasures to extend to those
> Of kindred tastes."

I. THE POND AND ITS FLOWERING PLANTS.

> "What loved little islands, twice seen in the lake
> Can the wild water-lily restore?"—CAMPBELL.

Is there any New Englander, any Northerner, to whom these words do not recall some favorite haunt of his youth, some of those beautiful and bright sheets of liquid crystal, which are so profusely scattered over the northern portions of our country, lending beauty to many a landscape, which, without these ornaments, would be dull and uninteresting? All who remember such scenes, will agree that what the lakes are to the landscape, the lilies are to the lake, adding a charm which we never fail to miss when they are not present. Without them there is always felt a loneliness, a want of animation and cheerfulness, the cause of which we may not be conscious of, but the contrast to which is at once perceived if we chance to find a pond

> "Where in the midst, upon her throne of green
> Sits the large lily, as the water's queen."—CRABBE.

We then feel that she it is who apparently lends life and light to all around, and we can but acknowledge that she well deserves her aquatic throne.

In company with this queen of the waters, there is usually found a bright bevy of maids of honor well worthy to grace her court. The delicate little Floating Heart (*Limnanthemum lacunosum*), the curious Water-shield (*Brasenia peltata* Pursh) the purple and yellow *Utricularia* are among her train; while the coarse but curious Yellow Lily (*Naphar advena* Ait), the slender Pipewort (*Eriocaulon septangulare*), the white Arrow-head (*Sagittaria variabilis*) and the purple Pickerel-weed (*Pontederia cordata* L.) stand as sentinels around. But, as I have said, it is not my intention to dwell upon those charms of lake scenery which must be obvious to every observer. Let us then turn not unlovingly from

what he who runs may read, and armed with the microscope seek out new sources of pleasure in its wonderful revelations.

The plants to which reference has been made, though in themselves far from being microscopic, afford many points of interest to the microscopical botanist. In the Nymphæa, Nuphar and Limnanthemum, for example, are presented vessels of an unusual form, marked like the ordinary dotted ducts so common among land plants, but singularly branched in a manner quite unlike what is usually met with in the latter. These vessels may be easily seen in a thin slice of the stems of the leaf or flower, or they may be obtained completely isolated by letting portions of the plant macerate in a glass of water for a few days in summer, until partial decomposition has taken place, when the vessels in question may be easily picked out with the point of a needle and examined by themselves. In the pure limpid jelly which invests the younger parts of the Water-shield (*Brasenia peltata*) is another object which cannot fail to attract the attention of the botanical student. If this be examined under the microscope, it will be found that the plant is not surrounded, as it appears to the naked eye, by a mass of homogeneous unorganized jelly, but that it is covered with minute hairs, each one of which is the axis of a cylindrical mass of jelly excreted by itself. In the Pickerel-weed (*Pontederia cordata*) an interesting subject of study may be found in the slender crystals (*raphides*) contained within the large ellipsoidal cells, of which this plant contains such great numbers, both the crystals and the cells being much like those which have been called "Biforines" and which occur in Calla, Arum and other plants of the natural family *Araceæ*. The true *biforines* when separated from the other tissues in water, rapidly discharge the crystals from one or both ends of the cells, and often with such force as to drive the cells backwards like a rocket, but this action is apparently wanting in the crystalline bundles of Pontederia. The diaphragms or thin plates of cellular tissue, met with in the stem and petioles of this plant will also be found to afford very beautiful objects for the microscope.

The Water Lobelia (*L. Dortmanna*) is an interesting plant, easily recognized by its naked stem flowering above water, while its base is surrounded by a bunch of radical leaves reduced to mere petioles. This plant, like all of its tribe, has a milky juice, and the latex vessels in which it circulates may be found in the

leaves, and be isolated with great ease by the method of maceration and partial decomposition above mentioned. A better plant for exhibiting this peculiar form of vegetable tissue can scarcely be found.

Among the most interesting of the aquatic plants are the Duck-weeds (species of *Lemna*) some of which are the smallest of all flowering plants, and yet possess every essential organ. The leaf and stem are confounded while the root is reduced to one or more capillary fibres, in the centre of which minute spiral vessels may be detected. On the surface of the pond, are *stomates* or breathing-pores of the usual form, and among its cells may be found starch globules and a few cylindrical and stellate groups of crystals. The flowers are the simplest possible, consisting of two staminate and one pistillate flower, supported by a scale-like spathe, and with no trace of any other floral envelope. The male flowers have but one stamen and one of these flowers always comes to maturity, and discharges its pollen in advance of the other. The pollen, when received upon the stigma, develops pollen-tubes as in other plants. In short, no structure or function of the larger plants is wanting in these dwarfs of Flora's kingdom. The Duck-weed is one of the plants which often form "the green mantle of the standing pool," which is often considered as the evidence of impurity, but which, like all growing vegetation in such situations, by absorbing nitrogenized matters and evolving oxygen serves to purify and sweeten the water. Any one may convince himself of this important agency of growing plants by putting a little decaying organic matter in two vessels of water, one of which has growing plants immersed in it, and the other has not. The last will be putrid and offensive in a few days, while the former may be kept for months in a pure condition. The Lemna may be easily kept in a glass of water with a little pond mud at the bottom, and may be thus watched in all its stages of development. It will be found that it has the singular habit of hibernating. On the approach of cold weather, it will be seen to sink to the bottom of the vessel where it will remain all winter, but will rise again to float on the surface as soon as it feels the warmth of the vernal sun.

Let us now quit the surface of our pond, and, looking below, see what we can find in its "green and glassy gulfs." True to our plan of only attending to the microscopic, I shall not stop to de-

scribe the various interesting submerged plants which will naturally attract the attention. The beautiful feathery *Myriophyllum* and *Naias*, the interesting *Ceratophyllum*, the submerged leaves of the white and yellow Ranunculus (*N. aquatilis* and *N. Purshii*) reduced to a mass of branching vessels, with a mere trace of parenchyma; the various species of Potamogeton, the Hippuris, etc., etc., will all prove of great interest to the botanical student, but we will at present attend to those plants only which afford good views of the motion of the sap.

Among the best plants for studying this circulation are those of the *Chara* family, a group of plants formerly included among the Algæ, but now regarded as occupying a separate and somewhat higher position. They are very common in ponds, streams and ditches in all parts of our country, and may easily be recognized by their leafless stems and branches composed of long joints which are scarcely larger around than a common knitting-needle. Each of these joints is a single cell, within the walls of which are seen minute green particles, arranged in parallel lines, which go obliquely around the joint, leaving at one place a narrow colorless band. It does not need a very high magnifying power to see in these tubes a most beautiful display of the phenomena of circulation. The fluid may be seen

> "in fluent dance
> and lively fermentation mounting"

along one side of the colorless band, and proceeding along the whole length of the joint until it reaches the extremity, where it turns down on the other side of the same band. The large starch globules and other masses which are borne along by the current. enable us to follow its course and even to measure its velocity.

A very full account of the observations made on the circulation in *Chara* and *Nitella*, by Amici, Slack, Varley, Dutrochet and others, will be found in Hassal's Fresh Water Algæ. p. 78. These plants may be kept in glass vases without any trouble and will prove of great interest to the microscopist not only for the phenomena of circulation but also for the curious structure of their organs of reproduction. These organs are known by the name of the nucule and the granule, the former being considered by some authors as the female and the latter as the male flower. The nucule consists of a globular body surrounded by fine spirally-twisted

tubes which closely envelop it. It contains numerous starch globules and is capable of germination. These nucules when ripe are quite hard and not being readily decomposed are often met with in a fossil state in fresh-water deposits. Lamarck mistook them for the shell of a mollusc and called them *Gyrogonites*. The granule differs much from the nucule. Its exterior presents a number of triangular plates with radiating cells and indented edges. Each one of these plates supports in its interior a cluster of flat articulated threads, in each joint of which is coiled up a spiral elated filament. Upon the bursting of the globule, these filaments (*spermatozoids*) escape into the water, where their wonderfully active movements have led to their being looked upon as true animalcules. They are, however, merely agents in the fertilization of the germ-cell, and are analogous to the singular bodies discovered by **Meyen in the antheridia of mosses.**

The Nitella (Chara) presents such curious phenomena that it is certainly worth the trouble of keeping it, and nothing is easier than to effect this. Each cell of the plant seems to have its own independent life, so that if any portion of the plant be thrown into a glass of water with a little pond mud, it will continue to grow and flourish. "I have sometimes known it in winter to separate at its joints, so as to give a number of completely isolated cells, each one of which continued alive all winter, displaying the ordinary circulation, and in the spring developing **a whorl of new joints."** *

Another plant also easy of cultivation is the Water-tape (*Vallisneria spiralis* L.) which shows the circulation not less beautifully than does the Nitella. This plant grows in immense quantities on the flats in the Hudson River, and sometimes to such an extent as to afford a serious obstacle to the passage of a boat. Its singular mode of fecundation is thus described by Dr. Gray in his excellent "Botany of the Northern States." † The staminate flowers being confined to the bottom of the water, by the shortness of the scape, the flower-buds themselves spontaneously break away from their short pedicels and float on the surface, where they expand and shed their pollen around the fertile flowers which are raised to the surface at this time; fertilization being thus accomplished, the thread-form fertile scapes coil spirally, and draw the ovary

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* J. W. Bailey. † p. 463.

under the water to ripen." It is to these phenomena that the fanciful Darwin alludes in the following lines —

> "As dash the waves on India's breezy strand
> Her flushed cheek pressed upon her lily hand
> Vallisner sits, upturns her tearful eyes
> Calls her lost lover and upbraids the skies."
>
> —LOVES OF THE PLANTS.

In future "sketches" we shall endeavor to obtain some further glimpses at the marvels of *pond-life*.

NOTE.—The circulation of the fluids may be seen in many land as well as water plants. The currents in the moniliform hairs on the anthers of the common Spiderwort (*Tradescantia Virginica*) are well known to microscopists, and, indeed, it has been ascertained that the hairs of most plants in some stage of their growth exhibit similar phenomena. Among our native land plants few exhibit a finer display of these phenomena than may be seen in the young hairs on the fruit of the Enchanter's Nightshade (*Circæa Lutetiana* L.). Currents bearing along large albuminous? masses and much resembling those in Chara will be found in all the young hairs around the base of the flower and fruit of this plant. Currents more like those of *Tradescantia* may be seen in the hairs within the corolla of the common Foxglove of the gardens. Lindley states that the large cells of the rhizoma of the Scouring Rush (*Equisetum*) show very distinct currents, and the writer has seen beautiful displays of these phenomena in the cells of the root of the common Asparagus.

MODE OF PRESERVATION OF VEGETABLE REMAINS IN OUR AMERICAN COAL MEASURES.*

BY LEO LESQUEREUX.

REMAINS OF PLANTS IN COAL.—It has been erroneously asserted that the coal itself does not contain any recognizable vegetable remains, it being merely a mass of bitumen, independent of any of the plants which are found in the shales overlaying or underlaying it. Our bituminous coal is generally a compound of supposed layers of crystalline matter, about one-eighth of an inch in thickness, separated by a thin coat of pulverulent coal, or mineral charcoal, which is a mere compound of cellular tissue and of vessels of plants.†

* From the Fourth volume of the Geological Survey of Illinois. A. H. Worthen, Director. 1870.

† This fact is easily ascertained by microscopical examination. Prof. J. W. Dawson, of Montreal, has closely examined this charcoal, and published, as results of his interesting researches, numerous forms of vessels of plants. The same kind of researches had been already pursued by Prof. Goppert, who had recognized, in this pulverulent coal, remains of plants of every family hitherto known to occur fossil in the coal. (Quar. Geol. Jour., vol. 5, mem., p. 17.)

Generally, this agglomeration of broken tissue preserves some outline by which the genera, even the species to which the remains belong, can be recognized at first sight: leaflets of ferns, stems of Calamites, bark of Stigmaria, Lepidodendron, etc. But besides this, the coal itself, though more rarely, is marked with distinct prints of the plants of which it is a compound. This case is especially observable in a kind of hard, laminated, flint coal, obtained in Mercer county by Mr. H. A. Green, which bears on the horizontal surface of its crystalline lamellæ, however thin they may be cut, the outline and nervation of leaves and branches of ferns, and other vegetables of the coal; and these are so distinctly marked, that the most delicate parts are as easily identified as **those of plants preserved in shales.**

The great abundance of these remains show that the whole mass of this coal, which is true coal and burns freely, is a compound of them. In the cannel coal which has been formed under water from more decomposed vegetables, the forms are more rarely recognizable. Yet the cannel coal of Breckenridge, Ky., is marked through its whole mass by stems and leaves of Stigmaria and Lepidodendron, rendered distinct by infiltration of sulphuret of iron. Even in the anthracite coal of Penn., whose matter has been subjected to heat and fused to cohesion after the transformation of vegetable matter into coal, one can easily discover an abundance of remains of plants whose genera and even species are sometimes recognizable. These facts, which cannot be overlooked, may be taken into account in examining new theories in relation **to the formation of coal.**

Vegetable Remains Preserved in Shale.—It is in the clay or silicious shale that the fragments of plants of the coal epoch have been more generally preserved. When a bed of vegetable matter heaped for the formation of a coal has begun to cease its growth, its top indicates a greater scarcity of vegetable remains, mixed with a larger proportion of earthy or clayey matter. The coal then becomes a less homogeneous mass, easily separating in layers of heaped fragments of vegetable and foreign matter. By and by, the vegetation becoming scarcer by superabundance of water upon the surface of the bogs, the clay is more thickly deposited, and the vegetable remains, more rare and scattered, are more distinct, and more easily recognizable. When preserved in that

way, the plants or their fragments have been first slowly decomposed and softened by humidity, and then more or less flattened by compression. All the naturalists who have examined the coal formations are well acquainted with the appearance of the remains found in shale, and sometimes admirably preserved. Generally, the woody tissue of the plant has been destroyed, and the surface of the stems and branches only are preserved in a thin coat of coaly matter, bearing impressions of scars of the bark, etc. For the leaves, the coaly matter represents the whole substance, and for the ferns, especially, it preserves the exact form of the vegetable, and is marked by the impression of veins and veinlets, mostly distinct to their last divisions. Some leaves of a coriaceous texture have their epidermis hardened by mineralization, and separable from the shale like a transparent pellicle. It can then be easily examined under the microscope, and all the details of structure recognized. It is especially the case with our *Dictyopteris rubella* of Murphysborough, as also with the leaves of *Whittlesea elegans* Newb., of Ohio. Sometimes the leaves of *Neuropteris hirsuta* have been heaped and compressed together in such quantity, that the pinnules are separable from each other as a carbonaceous cuticle, preserving traces of the primitive organism.

The shales, according to the amount of vegetable matter mixed in them, and the depth at which they have been formed under water, are of a more or less dark color; whitish or yellowish when of fresh water origin, and with few remains of plants; black and generally more homogeneous when formed in deep water, and having for a larger proportion of their compound, broken remains of organized beings. In this case the remains are either animal or vegetable mixed together, both fragments of molluscs and fishes with fragments of plants recognizable on the same piece of shale, or mere remains of animals, or only plants. These various appearances are easily explained in considering the phenomena accompanying the formation of the coal strata, from deposits analogous to those of our existing peat bogs. For the surface of these bogs, even in our time, shows the same differences in the superposed deposits, according to the depth and chemical compounds of the water by which they become covered, either by casual inundation in the interior of the land, or by slow immersion near the borders of lakes or sea shores. Even where the coal and shales, from the amount of remains of fishes which they contain, appear to have

been formed in water of a certain depth, the matter always bears evident traces of its origin from land vegetation, and never from marine plants. The lower part of a bed of coal, worked near the mouth of Yellow creek, Ohio, is a kind of cannel coal, or very bituminous compact shale, full of the remains of fishes, whose entire skeletons vary in length from one inch to one foot. Yet this shale has an abundance of the remains of land plants mixed in its compound. The same case is observable in Kentucky — for example, at Airdrie, on Green river, where the upper coal (No. 11 of the Kentucky section) is overlaid by a bituminous laminated shale, containing teeth of large fishes with trunks of Sigillaria, Lepidodendron, etc., and branches and leaves of ferns. Those who have examined our immersed peat bogs along the shores of New Jersey, have seen in activity a formation of the same kind, where logs of large trees are fished from a depth of ten or fifteen feet, out of beds of peat submerged in water deep enough to feed a variety of fishes; while here and there, small islands, half floating fragments of wood or heaps of mud, are covered with a luxuriant growth of ferns, reeds, or bushes, which throw their debris to the surface, to be conveyed to the bottom and there mixed in the bed of mud, an incipient shale, with animal remains.

Among the various metamorphoses to which remains of plants have been subjected in the shale by compression, decomposition and other chemical and mechanical agencies, one peculiar phenomenon is worth noticing here. In the shale covering the bed of anthracite of Rhode Island, the whole carbonaceous matter of the plants has been destroyed by heat, and the mere skeleton of the leaves and other remains is marked upon the shale as a more or less distinct mould, often covered by a whitish incrustation of selenite. In this process of fusion, the vegetable fragments have been distorted in such a way that they often present an appearance far different from that of the species to which they belong. For example, in some branches of ferns, the leaflets have been, on one side of the pinnæ, extended to double their original length, and narrowed in proportion, while on the other side they have been relatively contracted and widened. Without an examination of the shale at Newport, it would be difficult to account for such a metamorphosis. At this locality, the shales present along the shore a series of low undulations, resembling slightly elevated waves; and there one can see that, in the state of fusion of the

whole mass, the remains of plants, following the force of upheaval, have been, at peculiar places, drawn upwards and therefore elongated on one side, and of course drawn on the other towards the rachis. It is peculiar that the rachis and stems do not show any appearance of flexure and of deformation, and it is remarkable also that the same phenomenon of dimorphism is not observable on the plants found in the shale of the anthracite basin of Pennsylvania, where the flexures of the veins of coal are often abrupt, and where traces of tortion are frequently seen upon fragments of the combustible mineral. This deformation of vegetable remains may give an idea of the difficulties encountered by the palæontologist in studying, as he has to do, mere fragments of plants in their fossil state. Not only do these remains generally insufficiently represent the whole vegetable, but often they are deformed by various forces and influences, to which they are subjected in the process of mineralization.

Vegetable Remains Preserved in Ferruginous Concretions. — As far as we know, from the specimens abundantly found in Illinois, the mode of preservation of fossil plants in concretions is somewhat different from what it is in argillaceous shale. These concretions are found, especially in the shale of Grundy county, irregularly scattered from top to bottom of the strata, in the form of oval, more or less elongated, generally slightly flattened concretions. They appear to have been formed by superposition of concentric layers of slowly deposited carbonate of iron or ferruginous clay around central nuclei, which are most commonly parts of plants, bones of fishes or the remains of insects and crustacea. Their size and form vary according to that of the body around which the deposit has been made. Some small leaflets of ferns are found in nodules which are not larger than a walnut; pieces of calamites are inclosed in cylindrical concretions varying in length from two inches to one foot or more; pinnæ of ferns or of Asterophyllites have been discovered in flattened concretions measuring about one square foot and only two inches thick, their form agreeing more or less with that of the body around which they have originated, though always showing an oval or round outline, by superposition of concentric layers. It is not yet clear whether the flattening of some of the specimens is the result of compression. Generally, the nodules which have cylindrical pieces of stems, or

nutlets for nuclei, are round or exactly oval, while they are flattened for pieces of ferns, in proportion to the breadth of the fragments which they have entombed.

The origin of these concretions has been explained in admitting a general tendency of some mineral bodies to *concentrate around centres, whether solidifying from fusion, solution, or vapors.** This explanation may be satisfactory in regard to other kinds of concretions, but from their peculiar position, their form and size, varying according to the nature and outline of the bodies which they contain, the nodules of Mazon creek rather seem to be the work of infusoria or *Bacillaria* concentrating molecules of iron around some centres, as it now happens in the formation of the bog iron ore, or in other deposits, in springs or pools, whose waters contain a solution of iron. This supposition appears confirmed by the manner in which the bodies in concretions have been preserved and selected for preservation. Though generally mere fragments, their integrity is complete, and yet some of them are of very soft texture. The pinnæ or leaflets of ferns are always found in them in a flattened position, their axis or rachis extending through the centre of the elongated nodule, with the divisions on both sides; the surface of the pinnules, slightly swollen, as when in their living state, is marked by recognizable hairs or fruit dots, with distinct veins and veinlets, and their appendages, like the scales, are seen in the various modifications which they present in living specimens; for example, long, straight, flat, diverging, on primary rachis, and becoming shorter, ruffled and curled on their upper divisions. The small organs of plants appear, therefore, in a better state of preservation than in the shales. With small animals like crustaceans, scorpions, insects of a fleshy and very delicate texture, the preservation of form is still more remarkable. They are found entombed in the middle of the nodules just as if they were in life, or as if they had been transformed into stone while still living. The fruits or nutlets are not flattened. By the section of the nodules, which generally break into two equal halves by hard strokes upon their edges, the middle and internal part of the fruit is exposed to view, while the outside surface is immersed in the stone. The numerous cones also of Lepidodendron found in these concretions are equally well preserved, either whole or in part, by horizontal cross sections. Some specimens not only

*Dana's Manual of Geology, p. 626.

show distinctly the petioels of the sporanges and the blades in their natural position, but even sporanges with their seeds have been found in them, without perceptible alteration. In the cross section of these Lepidostrobi the sporange cells form a central row, which is surrounded by the blades in the form of a star.

Peculiar species of plants and animals, or their fragments, seem to have been selected as the nuclei of these nodules. They contain, for example, an abundance of leaflets of various species of *Neuropteris*, especially *N. hirsuta*, of *Alethopteris Serlii*, of *Pecopteris villosa*, *P. abbreviata*, *Hymenophyllites Clarkii*, *Annularia longifolia*, *Stigmarioides*, etc., which are either rare or have not yet been found in the shale at Morris, while these shales are rich in the remains of *Odontopteris Schlotheimii*, *Alethopteris crosa*, *Clodendron*, *Carpolithes multistriatus*, scarcely or not at all preserved in concretions. As the bank of shale bordering the bed of Mazon creek has not yet been opened, these differences may result from geographical distribution. Yet, as the animals and plants of soft texture, like the species of the genus Sigillarioides, have not yet been found in the shale of our American Coal Measures, it is evident that these remains have been generally destroyed by maceration, and only escaped total destruction by their entombment in these nodules. The same can be remarked on the remains of small animals. The remains of fishes found in these concretions are merely bones, scales and coprolites; while of molluses, they have afforded only some agglomerations or very small shells.

Vegetable Remains Preserved by Mineralization or True Petrifaction.—This kind of fossilization is performed by slow infiltration of mineral matter into the substance of the vegetable, when in a soft state of decomposition. The phenomenon is produced either by a total destruction of the vegetable substance, for which sand, clay or oxyd of iron is substituted by infiltration, or by a slow, still unexplained mineralization of the vegetable substance, by silex or lime. By the first process, the whole texture of the vegetable is destroyed, except the surface, preserved as in a mould, which shows the original outline of the vegetable, and bears the cicatrices of the bark and other external characters, which often render it recognizable. These moulds, generally covered by a coat of coaly matter, are rarely flattened by compression, and mostly represent trunks or branches of large size, some-

times fruits of a hard consistence, rarely branches and leaves of ferns. They abound in the sandstone beds of our Coal Measures, and some of our new species of Lepidodendron and of Sigillaria have been described from specimens of this kind. In the second case of petrification, on the contrary, the surface or outside of the vegetables is generally obliterated, as if it had been more or less decayed while subjected to mineralization, while the internal structure is preserved in its minutest details, and so distinctly, that it can be studied under the microscope when lamellæ of the fossils are detached, and polished thin enough to become transparent. Specimens of wood fossilized in this way, though often remarked in the Carboniferous formations of Europe, and very common in the more recent formations of this continent, have rarely been found in our Coal Measures, and none as yet have been obtained, except from Southern Ohio and Northern Kentucky. Both these processes of fossilization have acted upon vegetables already separated from their support, and more or less decayed, or upon trees still standing or still living, when they were surrounded by the mineral substances which caused their petrification. Though not quite as abundant as prostrated fossil trunks, petrified standing trees are not unfrequently obtained from the sandstone of our Coal Measures. Near New Harmony, Ind., some petrified trees, varying in size from six to twelve inches in diameter, have been obtained from a sandy shale, and transferred to his museum in their standing position, and with their roots attached to the trunks, by my lamented friend, D. D. Owen. Though entirely metamorphosed into sandstone, their mould preserves remarkably well the scars of the point of attachment of the leaves, the wrinkles of the bark, etc., and show the gradual variations which modify the form of the cicatrices in passing from the stem to the roots. True petrified forests have been observed in banks of sandstone of the Coal Measures of Pennsylvania and of Kentucky. This phenomenon should, therefore, demand but a passing notice, if it did not give rise to some discussions concerning the mode and cause of dislocation or fracture of these fossil trees, and also concerning the causes and agents of their petrification.

Fossil trees, except when observed in their standing position, still half inclosed and sustained in the matter in which they have been originally buried, are always found in pieces or broken. This is observable as well in the fossil wood of the Carboniferous

measures as in that so abundantly found in more recent formations; for example, in the Cretaceous and Tertiary beds of our continent. The fracture of the pieces is of two kinds: either irregular, in various directions, like the breaking of mineral substances produced by hard strokes, or horizontal, as if by a kind of cleavage, the separate pieces forming disks or regular cylinders of various lengths. Generally, in both cases the fractured surface is clean, smooth, distinctly angular, and showing that in most cases, at least, the breaking of the trunks has been effected after the fossilization. Prof. Goppert, who has visited the fossilized forests of Egypt, south of Cairo, and has published the result of his researches,* has found there the trunks subjected to a kind of multiple fracture, produced at various times and in various ways: some of the trunks having their fractured surfaces obliterated as if by decay, others showing on their fragments, still closely approached to each other, evidence of recent separation. He therefore explains their fracture as due to mere atmospheric influences, especially to sudden changes of temperature, which are not rare in those regions. This explanation could be admitted for the irregular fragments of silicified wood, found in connection with our recent formations, and which, in some countries — in Arkansas and Mississippi, for example — are in some places strewn upon the ground in profusion. Agglomerations of silex are rarely homogeneous or regularly compact throughout. They are interspersed with fissures or soft veins which, when penetrated by water, expand under the influence of frost, and determine fractures in various directions. But fossil wood broken in that way is rarely found in our Carboniferous measures. Generally, the fossil trees of this formation, when separated from the mineral substances in which they were originally imbedded and petrified, show the fracture by horizontal divisions, as by cleavage, and when in a standing position, and taken out of the matter which surrounds them, they separate in disks of various lengths, and can thus be taken out in pieces, which superposed afterwards rebuild the whole trunk, without marks of any other mode of disconnection, but horizontal through fissures. In that way the different parts of the trees mentioned above, as found by Dr. D. D. Owen, have been taken out of the sandstone separately and replaced in their order

* Der Versteinerte Wald bei Cairo, &c.; Acad der Wiss. zu Wien, vol. 23, 1856.

of superposition, to rebuild the vegetable in its original position. At Carbondale, in Pennsylvania, a true forest of Calamites has been crossed in the opening of an inclined tunnel through a bank of sandstone to a bed of coal underlying it. The fragments of petrified stems taken out of this passage are in such abundance that they have been used for the construction of a kind of gangway for running the coal cars out of the mines. These fragments, nearly without exception, are mere disks, varying in length from one to four inches, without relation to the size or diameter of the stems, which measure from three to six inches; the differences in the length of the sections being as marked for the large as for the small stems. All these fragments represent only as far, at least, as I could determine from the examination of hundreds of specimens, two species of *Calamites*, *C. Suckowii* and *C. approximatus* Brgt. The walls of the tunnel are adorned by a number of these trees, still in their standing position and half imbedded in the sandstone. Though these stems are continuous, they show, at various and irregular distances, horizontal fractures where they break or are dislocated at their separation from the surrounding sandstone. Some of these trunks of Calamites, which in their natural state were evidently hollow, have been abruptly folded or crushed, like hollow cylinders in bending under their own weight, or by some external force; but even at the point of inclination or tortion of these stems, the fracture is horizontal or perpendicular to their erect position. At Paintsville, Johnson county, Kentucky, the bottom of the river, which at some places has been cleanly washed, is marked, as in a kind of irregular mosaic work, by the broken tops of large trunks of Sigillaria, still in their original standing position, all horizontally fractured. One of these trunks measures twenty-two inches in diameter. The same peculiar kind of horizontal fracture is generally observable on the silicified trunks so abundantly found in some parts of Southern Ohio, especially in the bed of Shade river, near Athens. They are, most of them, pieces of stems of fern trees (Psaronius), varying in diameter from three to twelve inches, broken in disks from two to fourteen inches long. A few of these pieces of silicified wood are irregularly broken and disfigured on the outside by maceration; but generally they preserve their cylindrical form, and when of some length show here and there, at various distances, horizontal splits, uninterrupted all around the trunk, where a dis-

ruption is easily produced by a hard stroke. From the great bed of sandstone overlying the Pittsburg coal, near Greensburg, I have received, from Rev. W. D. Moore, large specimens of fossil wood, most of them long, irregularly broken, much decayed pieces, evidently representing sections of trunks broken lengthwise. These were found in various positions in the sandstone, and were mostly broken before they were imbedded in it. But among them there is one which bears, attached to a short stem, three diverging branches of its roots, a proof that it has been buried in its original standing position; and this one has its top horizontally broken and flat.

From these data and a number of others, which it is useless to mention, being all of the same kind, and bearing the same evidence, it appears that the fracture of the fossil wood is of two kinds: irregular, for trunks fossilized after prostration or in a decaying state, as they are generally found in our Tertiary and Cretaceous strata; and horizontal, by splits perpendicular to the natural direction of the stems and the roots. If the cause of fracture in the first case is, without doubt, essentially due to atmospheric agency, that of the second, which has acted upon the vegetable while it was still subjected to the process of petrification, is certainly different, and can be explained, I think, by the difference of density of both the surrounding mineral matter and the imbedded vegetable. Evidently, all the stems in the process of fossilization have been subjected to a softening process of their whole mass. The outside pressure of the surrounding mineral matter must have been felt, and can have acted only in one way, that is, vertically, as it happens in the forcing of a body of less density out of water; and the result of that action cannot but have been a tendency to dislocation, and therefore to splitting of the trunks in a horizontal direction. It might be supposed, perhaps, that a gradual accumulation of sand or other mineral matter around standing trees, in burying them, has formed layers of different density, whose action may have produced, in the fossil vegetable, zones of petrification also varying in density, tending, therefore, to cleave from each other, and horizontally separable. But the roots of fossilized trees which tend downwards in an inclined direction, or even are nearly horizontal, should be split in an inclined plane and not perpendicularly to their axis, as they are, at least, on all the roots of standing trees which I have had opportunity to examine. Moreover, the silicified stems which have been

noticed above as marked by horizontal splits, are of the same compound in their whole length.

The silicified wood of the Coal Measures of Ohio, as that also of more recent formations of our continent, furnish us some valuable data for the examination of another vexed question: concerning their mode of fossilization, or rather the origin of the silica which has produced their transformation. Two opinions, above all, have been advanced on this subject. Prof. Goppert thinks that the process of petrification has been very slow, of long duration, and that to explain it, it is not necessary to suppose that the water in which the vegetable substance has been transformed, was richer in silica than it may be now in its normal state. Prof. Schimper, on the contrary, asserts that the water in which wood has been silicified should have been of a higher temperature, more abundantly saturated with silica, and therefore, he concludes that the kind of mineralization has happened in a much shorter time than is generally supposed, and by volcanic agency, as is now the case in the vicinity of the Geysers of Iceland.* To sustain this assertion, the celebrated professor says: that the progress of the fossilizing process should have been rapid enough to reach the whole substance of the wood before its decomposition by putrefaction. But the woody tissue, when entombed and protected against atmospheric influence, is unalterable for a considerable period of time, and slowly passes, by emerecausis, into coal. It is, therefore, conceivable, that in the first stage of this slow burning, when the whole vegetable has been reduced to a soft matter, it may be penetrated by mineral fluids which, by crystallization, transform it into stone. In the valley of Locle, Switzerland, large prostrate trunks, more than fifty feet long, were discovered some years ago in a bed of sandy clay of the upper Tertiary. These trees, most of them Dicotyledonous, had their bark still in a good state of preservation, their woody tissue admirably preserved, and looked, indeed, as if they had been recently buried. Yet their wood was soft enough to be cut through with the knife without effort, like butter. Beds of lignites, in Germany, where the emerecausis is in a more advanced stage, contain large trunks of wood, softened in the same degree, and already blackened. In that state, the woody tissues are easily impregnated by dissolved mineral sub-

*Traite de Pal. Veget., p. 38 and 39.

stances. But to omit theoretical discussion and merely consider facts observable around us, it is evident that our silicified wood, as well in our Coal Measures as in the more recent formations, is found in connection with strata which show no trace of volcanic agency. The silicified trunks of Southern Ohio have been washed out by the creeks from the Mahoning sandstone. The area covered by this formation, and over which the trunks are found in greater or smaller quantity, extends from Athens southward, to the Ohio river, and in Virginia, as far up the great Kenawha river as Charleston, or about one hundred miles in a direct line. There is no trace of any volcanic agency in that country. No disturbance of any kind is observable in the strata, which have their normal, slightly marked dip to the eastward; nor does the sandstone itself indicate, in its appearance, by a variation of its compounds or of its density, any trace of metamorphism. At Gallipolis, near the mouth of the great Kenawha, a number of fossilized trunks, still buried in the sandstone, are seen protruding from the bank, in which they have been petrified in a prostrate position. As these trees have been examined already by other geologists, and mentioned as indicating a peculiar direction of the current, by which they have been brought and deposited, a short account of them here may not be uninteresting. There are five of them, from four to fifteen inches in diameter, their length unknown, lying, two in a southeastern direction, one due east, and the two others due south. The part seen out of the sandstone is much decayed, the outer surface, where it is preserved, is covered by a coat of coal varying in thickness from one-half to one-fourth of an inch. What is most remarkable, and bears directly on the question of their petrification, is that they appear to have been transformed into stone by different substances, showing a different kind of mineralization. In one of these trees the internal texture has been destroyed, and the woody tissue is replaced by a hard calcareous sandstone or clay, separating in layers of about one-fourth of an inch in thickness. A second is a compound of small crystals of iron flint, its interior being perforated lengthwise by a number of irregularly placed cylindrical apertures, filled with small iron crystals, forming regular stars of more than twenty rays. A third, of which I have obtained large pieces, it being of smaller size, four inches in diameter, is transformed into a compact, opaque, black silex, which does not pre-

serve any trace of organic structure. * As these trees, of course, have been petrified where they are found now, it would appear as if different mineral substances, held in solution in the water, had acted upon the woody tissue in different ways, according to its nature. In any case, it is evident that the petrification has been performed in various ways, by the slow action of the liquids penetrating the sand, and not by the uniform crystallization of silica as it is now produced in the hot springs of volcanic origin. This is more evident, in considering silicified wood of our more recent formations. Neither in the plains of Kansas and Nebraska, nor in Eastern Arkansas, nor in Mississippi and Ohio, where fossilized wood is found generally associated with a ferruginous argillaceous sandstone, is there any trace of volcanic agency. There is merely an evident relation of this kind of fossilization with the deposition of iron. In Ohio and Virginia, that part of the Mahoning sandstone containing silicified trunks, borders, and perhaps overlays in part, the area where the richest and most numerous beds of iron ore have been deposited. In the recent formations, the fossilized wood is generally associated with the red or ferruginous clay. Even in the small area occupied by our Post Tertiary formation at Barlow, Ohio, disks of silicified fossil wood of dicotyledonous species are found in a bed of red ferruginous clay, associated with species of shells of the genus Anodonta, entirely transformed into a compact mass of oxyd of iron.

SYSTEMATIC ZOOLOGY AND NOMENCLATURE.

BY ALEXANDER AGASSIZ.

THE first requisite for the accurate discussion of any subject is an appropriate nomenclature. The great influence Linnæus exerted upon the progress of Zoology is due to the universal acceptance of the binomial system as a most concise and convenient method, a tool admirably adapted to bring order into the chaos of names of

*It is marked by inflated articulations, like a species of Anarthrocanna, Gopp., and is as yet the only specimen found in our Coal Measures which might be compared to the trunks seen by Prof. Brongniart in the coal mines of St. Etienne, France, and compared to Bamboos, from their inflated articulations. (Lyell. Manuel, 4th ed., p. 319.)

immmerable animals and plants previously known in each country simply by their vernacular names. In the hands of Linnæus it was the expression of vast erudition, the statement of the affinities of animals and plants, the formula for the classification of the organic world as he understood it. In the hands of his followers and disciples it has become too often the end instead of the means; and, in the last years, the laws requisite for the establishment of the correct name of an animal, or of a plant, have become often as difficult to establish as the most intricate legal question. The greater part of recent systematic works are, of necessity?, filled with pages of synonymy, for the most part taken at second hand, which have been handed down for years with all the errors of quotations. It certainly is an absolute necessity that the units with which zoologists work should be well defined. But has synonymy, as now understood, the value which has been given to it? The history of the present confused condition of nomenclature is an interesting one; it is the attempt to show by the binomial system, not only the correct name of any animal, but, at the same time, give a short historical sketch of the changes the name has undergone. The name of an animal or plant, is that binomial combination which it has first received, let us say *A b* from Linnæus; [*A* (generic) *b* (specific)]. Subsequent changes, such as the transfer of this to a different genus, *B* by Cuvier, are simple matters of registration, a part of the *history of the science*, showing what Cuvier thought of the affinities of the species named *A b* by Linnæus. When then we speak of this species as *B b* Cuvier, we are recording his views as an investigator, and this does not lessen whatever credit there may be in the original description of *A b* by Linnæus. If afterwards Blainville comes and says that Cuvier should have referred *A b* to the genus *C* of Latreille and quotes this species hereafter as *C b* Blainville, he is only recording his opinion and so on through indefinite time. Changes which the progress of science render necessary in the position of *A b* of Linnæus are, or should be quoted under the authority of the author who proposes them as expressing the actual condition of our knowledge of the affinities of the species *A b* of Linnæus. Unfortunately the writing of the authority after such a change is often considered as an honor by naturalists, and much valuable time is lost in ransacking old books to find out incorrect combinations, which are subsequently corrected with great flourish of trumpets.

as if this process advanced our knowledge of the affinities of the animals under discussion. No naturalist ignores wilfully what others have already done before him; it is generally from absolute impossibility to obtain the desired information, and if the question of nomenclature were generally regarded simply as a matter of registration; it would help to rid our systematic treatises of a mass of useless lumber. *

But systematic Zoology used as it should be, as the connecting link between all the branches of sciences forming the great whole of Zoology has a totally different meaning. It becomes an epitome of years of study, the concise expression of the thoughts of the writer on the affinities of the animals he is discussing. Systematic zoologists have until lately laid claim to be recognized exclusively as zoologists, we should remember, now at least, that Physiology, Comparative Anatomy, Morphology, Embryology, Palæontology, Histology, Psychology and Geographical Distribution are as much a part of Zoology as the mere questions of classification and nomenclature. Great as have been the benefits derived by following the principles of Linnæus we must nowadays return to old Aristotle and take him for our guide. The Aristotelian view of the whole knowledge of the life of an animal is the true conception of what Zoology should be. The convergence towards this broad base of Zoology, by workers in the different fields mentioned above, shows the necessity of some element in common to express the variable quantities constantly obtained from a closer and more accurate examination of nature. This element systematic Zoology furnishes, it gives us the quantities to make our equations. and when it takes this broad form is no longer a mere dry collection of meaningless names, but becomes our interpretation of nature. The facility with which, in a new country, unknown animals can be described and the notoriety thus readily obtained, is a strong incentive to go on with descriptive work, not that I would, as is frequently done, deny all value to systematic Zoology, but it

* The rules of nomenclature generally adopted are by no means satisfactory. The exceptions constantly taken to their application only increase the confusion, and the attempts made by the British Association to recommend a set of rules for the guidance of Naturalists have not been successful. The recent revision of these rules shows how impossible it is to lay down general instructions intended to be retrospective and prospective; to apply them to times of which the scientific spirit was so totally different from our own. All that we can with any justice demand is that the original name by which a species was first baptized, should be recognized to the exclusion of all others, if it is possible to determine this name with accuracy.

should not be forgotten that the true purpose of systematic work must be to increase our knowledge of the relationship of animals of any special group already known, and serve in some way as a connecting link in the chain of the various branches of Zoology. We have our memoirs of systematic Zoology, of Psychology, of Palæontology, of Comparative Anatomy, of Histology, etc., treating of their respective sciences as isolated departments and strongly biassed by the characteristics of the sciences from which they originated. Comparative Anatomy, and Physiology as well as Histology, are the children of Human Anatomy, and this, in its turn, was gradually developed from the needs of medicine. Embryology and Palæontology, though so intimately connected, are rarely treated together, the latter being considered to belong, by birthright, to Geology. Psychology is but now becoming emancipated from speculative Philosophy. We have, however, no recent memoir on Zoology in the Aristotelian sense: the sciences forming the branches of Aristotelian Zoology stand upon separate pedestals. They have grown up independently of one another, yet they all converge towards a common point, each an important part in the life history of every animal, and the common link which is to unite them all is (when rightly understood) systematic Zoology.

Working in this spirit, systematic Zoology helps us in our attempts to understand the laws of nature: these must remain unintelligible to him who is busy with naming and classifying materials, reducing his science to an art, merely accumulating facts to be stored in museums, forming as it were a library of nature. To him its books will be inaccessible and its laws as inexplicable as are the laws of the motions of the planets to one who has no knowledge of the existence of gravitation.

WHAT I FOUND AT HAMPTON BEACH.

BY PROF. J. W. CHICKERING, JR.

About fifty miles northeast from Boston, on the coast of New Hampshire, juts out into the ocean the bold headland known as Boar's Head, perhaps half a mile long, a quarter of a mile wide.

and rising by a gentle slope to the height of perhaps a hundred feet, where its abrupt sides are washed by the waves; a mass of drift with alternate layers of gravel and water-worn stones of various sizes, gradually wasting away under the encroachments of wind and tide; the old fishermen telling of the time, when many rods farther out, they used to see

"The Head of the Boar,
Toss the foam, from his tusks of stone."

To the north, a long, sloping, sandy beach stretches away in a sweeping curve to Little Boar's Head, three miles distant, and to the south a similar beach curves around for two miles to the banks of Hampton River, and those Rivermouth Rocks, whereof Whittier sings. On beyond, lies Salisbury Beach, and farther on, low down in the horizon, appears the blue outline of Cape Ann.

At the northern end, the beach is covered with huge boulders as far as a granite ledge lying midway between high and low water mark, hollowed into caves and recesses and surrounded with little pools full of life and beauty. From this point a hard, smooth and level beach stretches away for a mile, till, approaching the rocks and the river, it is by cross currents rippled and furrowed, affording a fine opportunity to study the effects of tidal and wave action. Back of this, rise a number of sand hills, fifteen or twenty feet high, raised into fantastic shapes by the wind, from which, when the west wind blows, the fine white sand drifts across the beach like snow in winter. Back of these hills, are marshes, interlaced by a network of small streams and ditches, attractive both to the sportsman and the naturalist.

Suppose on a pleasant morning in July we rise with the sun and start on a voyage of discovery. The smooth, shining beach is half covered with the advancing or retreating tide, and with our eyes wide open, we walk down the sand. Our attention is soon attracted by a number of curious tracks, sometimes circling around the small pools found in the hollows surrounding every large rock; sometimes leading for many rods in a straight line towards the water. Let us follow one to its termination.

If in the sand, digging a few inches turns out a little crab (*Cancer Sayi?*) who if set at liberty, either writes his curious hieroglyphics as he retreats along the sand, or more probably commences at once to bury himself again with marvellous rapidity. The size of the animal will be found to vary the appearance of his

track. If it terminates in a pool, a close examination will detect a little depression in the bottom, with a slight but constant motion, and a stick will reveal his crabship quietly twiddling his thumbs, and greatly averse to being disturbed. They are largely used as bait for Blue-fish, not often hereabouts for food. They require careful handling as their claws have a savage nip.

A different track, finer and broader, leads to the deep burrow of a most unsightly worm, perhaps a foot long, with myriads of legs.

Yet another to a large, slow moving *Natica heros*, taking his morning walk, his huge foot and distended mantle causing doubt whether they can all be contained in the shell; another still discovers the beautiful little *Natica triseriata*.

Nearing the water, lines of sea-weed mixed with larger or smaller shells, mark the receding waves. After storms, immense heaps are thrown up, and collectors may obtain beautiful specimens of sea-mosses, the Irish moss (*Chondrus esculentus*) being quite abundant.

Large and fine specimens of the mussel (*Modiola modiolus*) are found attached to the roots of the Devil's apron, Laminaria, which is often seen twenty feet in length, with specimens of Saxicava, and now and then a Chiton.

On the beach are scattered, often thickly, the large shells of *Cyprina Islandica*, and *Mactra giganteа*, or hen clam, often used as milk skimmers, and occasionally perfect specimens of the beautiful little *Machæra costata*. The common sun-fish or jelly-fish, *Aurelia aurita*, is very abundant, and the larger, darker-colored *Cyanea Postelsii* is not rare.

But it is in the little pools, upon and around the ledge of rocks at the northern end of the beach, that the lover of nature will be most richly repaid for careful search. Sometimes they are overhung by the arched rocks, forming deep and dark recesses, sometimes in the full light of the sun, revealing the minutest objects upon the bottom.

Delicate sea-weeds of various colors, with minute coralline growths, encrusting the rocks, cover the floor of these pools with a carpet of richest tapestry. Swimming about, may be seen various smaller fish, here finding a safe retreat from the voracity of their bigger relatives, while the crabs are sidling about in their awkward yet nimble way, and now and then a dark-green lobster glides about, skilfully eluding any attempt to capture him, while

the little sand-fleas leap in all directions, like so many grasshoppers.

The rocks are covered, in every direction, by an encrustation of barnacles, *Balanus ovularis* and *elongatus*, whose tentacles waving to and fro in the water, were supposed by the ancients to be the feathers of the young barnacle geese; and creeping about may be found in great abundance the common cockle, *Purpura lapillus*, in all varieties of color, white, yellow, slate, banded, and often prominently marked by its lines of growth. The writer has one specimen, pure white, heterostrophed, the only one he has ever seen among thousands.

The animal is carnivorous, and may often be seen boring his way through some other shell, making those round holes often seen in dead shells, and then at his leisure sucking out the unfortunate inhabitant, so that it seems poetical justice, when he in his turn has his shell summarily cracked, that he may be used as bait for the cunner or sea-perch, with which the coast abounds.

The three species of Littorina, *L. rudis*, *L. tenebrosa*, *L. palliata*, are seen travelling on all sides, and of all colors, white, black, red, yellow.

Tumbling over each other in eager haste, are various dead shells, each tenanted by a hermit crab, Eupagurus, having no covering for the posterior portion of his body, and so seeking protection in some empty shell, brandishing his claws at the entrance most fiercely, but often overcome and driven out by some stronger relative attracted by the superior accommodations of his tenement. Here also may be found a stranger lately arrived upon our shores, but which has been for several years working its way south, from Halifax, whither it seems to have been imported from Europe, *Littorina litorea*, the common periwinkle. The shell is black, and very thick, and the animal may yet become of commercial value, as in England, where everything edible is used for food, one London firm sells annually seventy thousand bushels of this mollusk.

Looking closely into the miniature caverns worn in the rocks by the action of the waves, we see great numbers of the star-fish or five-finger, *Asterias vulgaris*, of every variety of size and color, and may with interest study their slow locomotion as they put in action their myriads of suckers, on the under side of the body. The sea-egg, *Echinus granulatus*, is found in company, moving its long spines and sending out hundreds of thread-like suckers be-

tween them, by which it draws itself along. The sea-anemone, *Metridium marginatum*, occurs here, and with a little care in the search, may be seen expanding its yellowish, leathery disk into ocean flowers of great beauty and varied hues. Small sponges are not uncommon. The eggs of various fishes, as the square, black, leathery cases of the skate with their four long spines, are not uncommon, and to the careful observer, every hour reveals some new form of life, or discovers interesting and curious habits of forms already familiar.

In the ocean are found in abundance the cod, the haddock, the pollock, the hake, the mackerel, the cunner or sea-perch, the flounder, the dog-fish, the fisherman's special enemy, driving away all other fish, and even eating from the hooks fish already caught on the trawl, the sculpin, that marvel of ugliness, and more rarely the skate, the cusk, the blue-fish, and occasionally the huge, misshapen, abbreviated, sluggish, worthless, shorter sun-fish, *Orthagoriscus mola*, looking as if it might be one of Darwin's developments, that had not yet attained to a tail.

In the marshes back of the beach, all sorts of water-fowl abound, and the hunter's gun is often heard.

The flora of this locality also, is full of interest, especially to one unfamiliar with the curious forms of the spiny *Salsola Kali*, the thick, apparently leafless stems of *Salicornia herbacea*, and the cheerful colors of the beach pea, *Lathyrus maritimus*, flowering at intervals all through the season. All these and many others are found growing in the pure, white, dry sand, apparently incapable of furnishing either moisture or nourishment to any sort of vegetation.

To the lover of nature, accustomed only to the verdure and beauty of inland woods and fields, or the majesty of mountain scenery, a residence of a few days or weeks at Hampton Beach could hardly fail to bring much of novelty and constant interest, while the cool sea-breeze, and the glorious surf-bath, bring back vigor to the wearied frame, and the everlasting diapason of old Ocean, thundering against his rocky shores, can hardly fail to fill even the undevout mind with thoughts of the great and good Maker of all this beauty.

HABITS OF THE BLACK BASS.

BY S. T. TISDALE.

I WILL now give some account of the growth and habits of this fish, derived from twenty years' experience and observation. After stocking a pond no fishing should be permitted for five or six years. This gives ample time for a large increase, after which the observing angler may class them as to size with some accuracy. In waters adapted to their growth they will increase as rapidly as perch. In six years after being spawned they will reach three pounds, and gradually increase to the maximum size, which may be set at five to six pounds, at the rate of about half a pound a year. Very many fish from two to three and a half pounds, have been taken from the ponds stocked in 1850 to 1852, and but few, comparatively, of five to six pounds. One of seven and a half pounds was taken late in May, 1864, which I had placed in a new pond, two years previous, then weighing three and a half pounds; but it was a female fish, from which I took a *sack of spawn weighing two pounds*. Another of equal length taken from another pond in June, after it had spawned, weighed five and three-quarters pounds. This would indicate a growth of one pound a year after reaching three and a half pounds, food being abundant. I cite these as facts, with some doubt as to their general application. The absence of more large fish may result from free fishing, and the greediness of the larger growth of fish to take the angler's tempting bait. It is noteworthy that the largest fish yet taken appear to be those which were transplanted. They spawn in May, and appear to occupy their spawning beds for nearly two months, being found thereon late in April, disappearing in June. Large, clean places are scooped out in four to eight feet depth of water, verging on the shore of the pond, and some four to ten feet diameter. These beds are made on sandy or gravelly bottom, are distinctly visible with fish thereon, from a boat as it passes over or near them. The trunk of a sunken tree, a shelving rock, or beside a lone rock, or bed of rocks, or other hiding place, is a favorite location for a spawning bed. They lie in one or more couples over their beds, and here for the period of incubation they keep watch

and ward with constant fidelity. Around their beds may be seen perch, suckers, eels and catfish in plenty, ready to devour a portion of the ova. The bass are constantly at war with these voracious depredators, driving them off from moment to moment, "under the current of a heady fight." Young bass are not seen in large numbers like the herring and some other fresh-water fish swimming near the surface a prey to their enemies.

In embryo life they seem to come in a moment! From close observation in a small pond where I placed several fish in April and May, and where I could daily watch their movements, beds were made by several pairs, over which the female hovered continually. Here they remained until the 24th of June. Every hour I watched them without any evidence of young fry. In the afternoon of this day, after an hour's absence, I returned and discovered several hundreds of minute young bass hovering at the surface of the water, while the parent fish was moving around her bed as usual. These young fish were darting about with activity —about three-eighths of an inch long, looking like black motes in the water. For three or four days they kept in this position, and then scattered about the edge of the pond among the grass, a few being thus seen for some two or three weeks, when all sight of them was lost till September, at which time a few only were discovered of about two inches in length, with the tail marked with a cross-bar.

The above refers to the *first* show of life from one bed. On the 28th of June two other beds in the same manner developed their young. Most of these died or were devoured by the old fish. The precise time these fish spawn, or the duration of their spawning season, I have not yet fully discovered. I incline to the opinion that a period of two to four weeks passes before all their ova are deposited, and that they are hidden by them in the sand, in or around their beds, receiving impregnation from time to time from the male fish. The act of emitting their spawn I have never seen; and repeated efforts to express it from these fish in May, when supposed to be ripe, for the purpose of artificial impregnation, proved abortive. The ova of this fish are small, about one-fourth the size of salmon or trout spawn, very compactly laid in a film-covered sac, and apparently difficult to escape through any artificial process. Further experiments beyond doubt will effect this. One fish is generally on guard at the bed, seemingly quite docile.

and if alarmed moves from it a few feet, but soon returns. This probably is the female exercising her maternal care of the young. The young fish begin to be visible in June and July close in shore among the gravel, pebbles or grass, darting with some activity, and near the surface, for the double purpose of food and protection. They are marked with a small black stripe across the tail, distinctly visible through their first summer; after the first year this disappears, and they assume the general character of this fish, varying according to season, water and food. They are about an inch long when they first disport themselves, and reach about three inches in five months.

They are caught by trolling with an artificial bait in imitation of a fish like a minnow, or a fly, the murderous spoon, or a strip of perch or pickerel, or any other fish, with line extended twenty-five to two hundred feet — or, by still fishing from a boat, with minnow, worm, or other bait, and from the shore with a rod-line at long cast. When hooked they plunge deep, and then come with velocity to the surface, breaching some two to four feet out of water, repeating this several times with a shaking motion, as if to shake the hook from their mouth. Their capture affords unequalled attraction to the angler. Often two will strike at once, if bait and fly, with long leader, are used. They are hardy, tenacious of life, and will live a long time out of water. They can be transported in a barrel half-filled with water in cool weather, fifty miles by rail, by once changing the water, say twenty of medium size, with entire safety; and in warm weather ice must be used to *cool*, not *chill*, the water (say to a temperature of fifty-five to sixty degrees). In this manner they can be carried to England with proper care, especially the smaller fish. They do not feed much at large in winter, as it is rare to catch them through the ice, and the belief is that they will not bite at this season, as a general rule. Indeed, this is the result of present experiments, as those wintered in a small artificial pond recently, show that they go into winter quarters by December, where they select some lone deep place, near or under the shelter of rocks or roots, and remain in a torpid state till spring, emerging to all appearance in fine, active, vigorous condition. They feed much on flies in summer, and the calm surface of the lake is often agitated with their breaking for this purpose. They range wide in quest of food, often driving small fish ashore. In August, September and October, they are in

the best condition for the table, and a baked black bass of four to five pounds, in September, with every appropriate condiment, is a rich dish, which all who taste will fully appreciate. — *Fifth Report of the Massachusetts Commissioners of Fisheries*, 1871.

REVIEWS.

Progress of American Ornithology. — Mr. Allen's* latest, and in all respects his most valuable, memoir embraces several distinct essays, for which the Mammals† and Winter Birds of Florida seem to furnish merely the occasion, and are, at any rate, overshadowed by the importance of the general questions discussed. He has worked long and faithfully upon a subject of broad interest, and his labors will receive attention, no less from those who differ from him, than those whom he convinces. Standing squarely opposed to the great majority of ornithologists, his arguments must be refuted, or his position endorsed. In our present character of unwilling critic, we endeavor to speak in the same earnest spirit of inquiry that tempers Mr. Allen's page; and may possibly succeed in showing how trivial is the real point at issue between Mr. Allen and those of us from whom he appears to differ so widely.

Mr. Allen's lists and field notes, which result from several months investigation, are collated with Mr. Maynard's and Mr. Boardman's, and "may be considered as equivalent collectively to the labors of a single observer constantly in the field for at least four or five winters." (p. 161.) They are properly prefaced with a sketch of the physical features of the country, from which

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* On the Mammals and Winter Birds of East Florida, with an examination of certain Assumed Specific Characters in Birds, and a sketch of the Bird Faunæ of Eastern North America. By J. A. Allen. *Bulletin of the Museum of Comparative Zoölogy*, Vol. II. No. 3. pp. 161–451. pls. xvi.–xxii.

† The list of Mammals comprises thirty-five species, among them the *Trichechus manatus*, "still quite common in the Indian River," and a large list, probably one of the West Indian *Mysticetidæ* new to our fauna, but unfortunately not identified. Here as elsewhere, the writer's extreme views are conspicuous in the general treatment of facts, and technical distinctions. In the case of "*Virginianus*" we may observe that even those who might assent to the absence of any grizzly from the huge area of Northern Europe, would not admit *U. Americanus* to be a mere synonym

we gather two interesting points. The irregularity which Audubon noticed in the pairing and breeding of some resident species, corresponds to the gradual and protracted development of the vegetation; the mildness of the winter causing an almost perennial verdure, and four weeks in February and March being required to accomplish the work of one in May at the North. The other fact, of diminished vivacity of the birds during the breeding season is of similar significance. "In spring, at the North, the woods . . are vocal with bird-music; but in Florida no such outburst of song marks the vernal season; . . the songs of some are much abbreviated, and so different from what they are at the North as to be sometimes scarcely recognizable." (p. 166.)

The list of birds, considered as simply such, shows the same care and fidelity that mark all Mr. Allen's papers, and supplies a special desideratum. Our local lists of the Atlantic coast may now be considered nearly complete, and they collectively afford a very perfect ornithological map from Labrador to Florida. To the one hundred and eighty-three species here given either as permanent residents or winter visitors — these two classes being carefully discriminated — a few perhaps will be hereafter added, but certainly not may remain unnoticed. We do not observe any name previously unrecorded, or, at least, not to have been anticipated from the known range of habitat. Aside from the critical dissertations, and the tables of measurements, that the list contains — neither of which are essential to its integrity, and which, therefore, we shall presently notice in another connection — its chief value rests upon the copious and accurate field-notes, which are always reliable, and generally represent important items of information. The extensive lists of synonyms, however interesting as indices of the writer's peculiar views, or valuable as bibliographical compilations, are nevertheless, we regret to think, of little consequence in some respects, and in others positively injurious. Some of them must tend, we feel sure, to bring Mr. Allen's general work into disrepute. When, for instance, we see (p. 300) *Chordeiles Texensis* given as a synonym of *C. popetue*, it is certain, that however truthful the author may be in the general tenor of his way, he sometimes exceeds the utmost limits of propriety. One who wields so free a lance as Mr. Allen's, should be sure his own vizor is well down: and a blunder like this looks still worse from its inconsistency. For, in another place (p. 355),

he does us the honor (his endorsement in such a case is an honor) to recognize our *Pelidna Americana* — a bird that cannot stand a moment upon Mr. Allen's platform; and in one or two other instances — that of *Graculus Floridanus*, for example, unquestionably a southern form of *G. dilophus* — he is similarly untrue to his principles.

Among the critical discussions that we mentioned just now, is a highly satisfactory elucidation of the several interesting modifications in size, form and color that result from climatic and other physical influences upon the birds. The decrease in stature, coincident with lowering of latitude, was perhaps already sufficiently known; but the other points needed the excellent exposition they receive at Mr. Allen's hands. He shows a singular tendency to increase in the size of the bill of Floridan birds. This corresponds exactly to the remarkable elongation of the tail of many southwestern forms; and his explanation — greater activity of peripheral circulation — is doubtless as applicable to one as to the other. The third characteristic of Floridan forms is an intensity of coloration, as compared with Northern broods of the same species. This is well illustrated in the Quail, and several other species, particularly the curious little *Pipilo* in which the white markings of the wings and tail are at a minimum, though the iris, singularly enough, is white instead of red.* It would be difficult to over-estimate the importance that attaches to this admirable elucidation of the peculiarities that collectively distinguish the Floridan birds. Interesting in itself, additional value is gained in its affording data for a similar exhibit of the relationships of the birds of the Lower Rio Grande and Colorado rivers. Numerous forms from these regions, as well as from the peculiar Cape St. Lucas locality, can be better interpreted now that we have analyzed that portion of the Eastern Province lying within corresponding degrees of latitude: and many that have been named as positive specific forms, and taken to be such, may prove merely indices of geographical variation occurring in strict accordance with laws that Mr. Allen

* PIPILO ALLENI, *nob* = *P. erythrophthalmo* similis, sed minor; alis caudaque minus albo-plagiatis; et iridibus albis. This interesting "form," which we believe remains unnamed, we have great pleasure in dedicating to our esteemed friend

An anonymous writer of some pleasant articles on our birds in Appleton's Journal (iv, p. 385 seqq.) says: "The 'Chewink' is perhaps the most curious instance of change in the color of the iris, which with the summer dress is red, and with the winter, white — the change taking place sometimes first in one eye, and then in the other, during the process of the autumn moulting." This, if so, is new to us.

has demonstrated. In some cases indeed, Floridan forms furnish exactly intermediate links, as when the Floridan *Thryothorus* grades from *Ludovicianus* proper into *Berlandieri;* and again there are cases, like that of the Quail, where the Floridan form, although unnamed, is as different from average Northern samples as *O. Texanus* is. Promulgation of data so pertinent to the general question of variation in feral animals is a service of great moment to ornithology, and Mr. Allen's careful handling of the subject elevates his "Winter Birds of East Florida" to a place that no mere annotated catalogue, however good, could claim.

Still keeping away from the main issue, we will note certain discussions, some relevant and others not so, that the Floridan list affords. Bartram's somewhat celebrated "Sacred Vulture" certainly needed the overhauling it gets; Mr. Allen finds it a myth, based upon *Sarcorhamphus papa*, with a dash of *Polyborus tharus*, and an infusion of Bartram's imagination; which is pretty much as was to have been expected. The origin of the domestic turkey is handled at some length. After fusing *M. Mexicana* with *M. gallopavo*, Mr. Allen attempts to refute LeConte's and Baird's theories, arguing that the domestic bird was reimported from Europe, whither it was originally carried from Mexico. Among other discussions, are those upon the species of *Cathartes*, *Buteo*, *Parus*, *Passerculus*, *Quiscalus* and *Turdus*, in which the writer pleads for a much less number of species than are usually admitted, and presents some astonishing lists of synonyms. We have no other objection to these disquisitions, than that they lead to nothing tangible, for they seem to us to be merely a recapitulation of what was before known of the close resemblance, and wide limits of variation, of the species in question; the *opinion* that Mr. Allen offers of their specific identity being, of course, a foregone conclusion from his premises. It seems to us unnecessary for Mr. Allen to raise the *Hylocichla* question for the third time, merely to repeat, with some expansion, the remarks that appeared in his "Birds of Massachusetts" and "Birds of Iowa"; no good can result, we conceive, from rehearsal of items already the common property of ornithologists, or from reiteration of individual opinion.

The many extensive and elaborate tables of measurements that enrich the "Winter Birds of Florida," and show not only the discrepancy in size between Floridan and Northern birds, but also the

variations in each of these, may be regarded as collateral with, or supplementary to, Mr. Allen's highly interesting and suggestive "Examination of Certain Assumed Specific Characters in Birds." This constitutes Part III of the memoir, and is the nucleus of the whole. Every paper of Mr. Allen's which we have had the pleasure of studying has plainly disclosed the drift of his views, and in this one his energies are focussed on an attempt to show that a very large proportion of the forms we commonly designate by means of the binomial nomenclature ought not to be so designated. The proposed reduction in our nominal lists is to be effected mainly by discarding all names imposed upon "*geographical differentiation*" among birds. We say this advisedly; for, since no ornithologist upholds the practice of naming *individual* variations, local or other climatic varieties are all that he has to fight against in his present crusade. The attack is first made, very judiciously, with an elaborate and interesting exposition of purely individual variation in birds, based upon an examination of extensive series of specimens.

Mr. Allen says (p. 188), that he has the material to "disclose a hitherto unsuspected range of purely individual differentiation;" but this we are not prepared to admit. Fully aware ourselves of the extent of variation that he demonstrates, we cannot presume that other ornithologists are less informed. Still we must, in the same breath, do Mr. Allen the justice to add that he shows the known wide range of both individual and climatic variation to be more extensively applicable than we practically consider it; in short, that he proves what we are accustomed to regard as exceptional to be the rule. Several prominent phases of individual variation are discussed. In *color*, he holds that it is solely a matter of intensity, "while in allied species there is almost always an appreciable variation in the *style of coloration*" (p. 187), and illustrates the fact with many examples. This is so true, that we wonder how Mr. Allen can unite *Chordeiles Texensis* with *C. popetue*, while he keeps *Rallus elegans* and *R. crepitans* apart; for, in the latter case, the difference is solely in intensity, while in the former it is largely in style of coloration! Other color-variations, as those dependent upon age and season, are faithfully presented; but these have not, perhaps, on the whole, so much importance as the differences in size and proportion of parts, to which he justly gives special attention. His admirable tables of meas-

urements demonstrate what he claims — that many or most species, vary in total stature, in the length of different members, and in the relative proportions of different parts, from twelve to eighteen per cent. of the mean dimensions. This, it should be remembered, is independent of *geographical* differentiation; and it will, we trust, be enough to put us on our guard, against too ready acceptance of slight discrepancies in size as an element in our diagnoses of species. To cite but a single case in point: — twenty-seven specimens of *Parus atricapillus*, taken in the same locality and at nearly the same time, differ *over an inch* in length; that is, they grade between the extremes of *P. septentrionalis* and *P. Carolinensis*.

"Climatic differentiation," like individual variation, is shown to occur under three principal phases: — in total size, in length and stoutness of bill, and in color. The first of these is well known and need not detain us. The second consists in the curious fact above mentioned, of development of the bill in *inverse* ratio to the size of the bird, with decrease in latitude. Climatic variation in color, Mr. Allen holds, may be in respect of both latitudinal and longitudinal conditions. In the matter of latitude, he shows a gradual increase in intensity of color to the southward, probably dependent upon the greater energy of the sunlight; and in this way disposes of several West Indian forms, commonly reputed as species, pointing out that they are not more different from their Floridan analogues, than these are from New England examples. As to longitudinal variation, Mr. Allen brings prominently forward the fact that "the general tendency from the East westward, is to darker or deeper colors in specimens of the same species" (p. 237). and supports this by numerous unquestionable cases, many of which will readily occur to the reader. The very notable exceptions afforded by the bleached specimens of the Colorado desert, furnish the occasion for what we regard as decidedly the most important point in the whole discussion, and one that we do not remember to have seen in print before. Under head of "Causes of Climatic Variation" (p. 239), Mr. Allen takes *humidity of the atmosphere*, as determined by the *mean annual rain-fall*, to be the real cause of this intensity of color. In examining Dr. Foster's "The Mississippi Valley," some time since, we were struck with the determinations there made of the hygrometric influences resulting in the production of forest, prairie and desert, according to the mean annual water-supply, and, at the same time, perceived the

exact relations that subsist between the average intensity of coloration of the birds that collectively inhabit the regions so defined. We are gratified to find ourselves endorsed by Mr. Allen's investigations, as appears from the following paragraph: —

"I had long suspected that hygrometric conditions had much to do with local variations in color in individuals of the same species, but I was not a little surprised when I came to compare the known areas most prolific of dark or light local forms with rain-charts — which may be assumed as indicating relatively the hygrometric conditions of different regions — to find the distribution of the light colored races so strictly coincident with the regions of minimum mean annual rain-fall, and the dark forms with those of maximum mean annual rain-fall, as seems to be the case. Humidity has hence apparently more to do with climatic variation than solar intensity." (p. 240.)

Part III concludes with a vehement protest — certainly not lacking in the force that comes of conscientious and earnest belief — against the custom of naming forms, however distinct, that are found to intergrade; and at the risk of protracting this notice beyond due bounds, we cannot, in justice to our author, refuse to follow him further, although by so doing we must defer (perhaps to take up in another connection), what we should wish to say respecting Part V, in which the several bird-faunæ of eastern North America are defined.

Mr. Allen undertook a laborious and not entirely grateful task; and has won enviable laurels in its execution. It is so discouraging to the strongest swimmer to feel that he is breasting the tide of nearly universal opinion, that moderate success must be correspondingly acceptable. If it be something to deserve thorough criticism it is more when close scrutiny detects nothing worse than indiscretion. From the nature of his task, he was peculiarly exposed to the danger of over-doing; and in using the old maxim, *ne quid nimis*, we indicate the pith of what adverse criticism we feel compelled to make. In contributing invaluable material, carefully elaborated and forcibly presented, Mr. Allen seems nevertheless to have viewed his theme through the medium of enthusiastic iconoclasm so refractive that he has lost some of his bearings, and reached a position so extreme, that we fear ornithologists must suspect his reasoning simply because his premises are unquestionable and his conclusions untenable. And what does he offer instead of the idols he deposes? After being shown what is not a

species, we have a right to demand that he should say what a species is. But this is all we have:—"The question of species and of specific synonymy is simplified to this: that whenever two forms which have both received specific names are found to intergrade, the more recent name shall become a synonym of the older." (p. 245.) Simple and easy as this seems, it presents great if not insuperable obstacles; and we will add just here, that this shifting of the question from the vital point, namely, the discussion of what a species is, to a superficial issue, namely, the propriety of imposing names upon this or that form, is not what we should have expected from a naturalist of Mr. Allen's position.

Following his rule we hold our nomenclature by a frail tenure indeed; for nothing in biology is more certain than that the multitude of animals and plants now existing, are the ramifications of comparatively few trunks; and nothing is more unstable than intergradation which he proposes as a crucial test. To speak roundly, *everything runs into something else;* not necessarily just now (though this is frequently the case), but at some period. "Species," like some plants, are *stoloniferous;* they produce offsets that finally separate from their parent stock, and appear like distinct entities. Our *positive* specific forms — those that alone we should recognize, according to Mr. Allen — are simply those whose wide divergence has concealed or broken their connections with the original stem; while all debatable forms (and these constitute a great part of our lists) are merely those that are in visible process of separation. When a form has diverged to the slightest appreciable degree, some ornithologists, like Brehm, for instance, label it with a binomial; most ornithologists, probably, wait till they think that this divergence is a settled thing not likely to revert; but nearly all will name with the connecting links before their eyes. Mr. Allen, however, like Prof. Schlegel, would virtually ignore the process of divergence, until it has reached a certain, or rather an uncertain, point, and effaced connections that once existed. We are opposed to this, and still plead for names, if only as "convenient handles for facts" that it is of the last importance to bear in mind. Pure synonyms are pure trash, of course, and none detest them more cordially than ourselves; but we insist upon the advisability, *in the present stage of our science*, of recognizing geographical and some other differentiations by name.* No stronger

*Not necessarily a "specific" name, but some one additional word, with or without

evidence of the utility of this could be desired than is afforded by the advance of our knowledge of American birds within the last ten or fifteen years; for it is undeniable that the searching scrutiny to which they have been subjected has been facilitated by the custom of Prof. Baird and others of naming *all* recognizable "forms," without the least reference, even by implication, to the abstract question of species. Mr. Allen himself admits that these geographical binomials "have furnished stepping-stones to later generalizations;" a very proper admission, for the road he has just travelled with signal success was first opened, and afterward smoothed by them. The present is no time to discard such useful adjuncts: let the scaffolding stand till the building is finished.

We hold that the whole matter at issue between Mr. Allen and most of the rest of us is a war of words — a mere difference of opinion as to what a binomial may properly be used to express.

To illustrate: Assume that *Sturnella magna*, *neglecta*, *Mexicana*, *hippocrepis* and *meridionalis* are climatic differentiations, and that very likely they all came from one pair of birds. Mr. Allen would of course be the first to disclaim any more information than Dr. Sclater, for instance, possesses. Both these gentlemen know exactly how the case stands; but one of them chooses to predicate *Sturnella magna* upon a diagnosis wide enough to include without specifying the five forms; while the other chooses to sort out the five lots and label each of them with a different name. We repeat Mr. Allen's own words; it *does* "depend entirely upon individual predilection whether two, three or four 'species' or 'binomial forms'" shall be recognized; and to argue the point, under color of discussing the origin and nature of species, is to saw the air. A species, as far as naming it is concerned, is quite as much an opinion as a genus or a family is; for it is certain that genera and that families shade into each other. If the test that Mr. Allen proposes for species be applied to higher groups, our nomenclature falls to the ground; and if it be not thus applicable, it is equally inapplicable to species. By what rule would Mr. Allen separate *Tropialis militaris* from *Sturnella magna*? In spite of the fact that these are not known, at present, to intergrade, there is no assur-

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the sign "yes," that shall stamp the form we wish to binomialize. Perhaps this would be a judicious middle course, most applicable to the present state of the science. But if use of a regular binomial for geographical races be so dire, lumping them all under one name as pure synonyms, with no hint of the different shades of meaning they represent, is assuredly a greater evil, and one that seriously militates against the progress of ornithology. If, indeed, it does not tend to throw the science back.

ance that if the difference in climate, etc., between Kansas and Pennsylvania has differentiated *S. neglecta* from *S. magna*, greater yet parallel discrepancies in physical conditions have not in the course of time changed yellow to red, and made *Trupialis* out of *Sturnella*. Refusing to name one short offset, we must refuse to name another, if a longer one; and must add *Trupialis militaris* to the synonyms of *Sturnella magna*. The instability of "species" (which are practically our units of zoological computation) once admitted — and it is admitted by leaders in all branches of natural history — it becomes a logical necessity to admit a corresponding instability of all groups based upon an aggregation of these units; and if we are not to name *Sturnella neglecta*, because it is only a little differentiation of *S. magna*, we cannot consistently name a king-crab because it is great differentiation of a trilobite. All differentiations are or were once, gradual and imperceptible; all are of degree only, not of kind; to name, or not to name, is a matter of individual discretion. Mr. Allen's plan, fully carried out, renders our nomenclature simply an index of our skill or luck in tracing links between species; and if our efforts could be commensurate with his enthusiasm, we could not consistently name anything.

To our mind, this forcibly illustrates the inefficiency of the Linnæan nomenclature as an adequate method of formulating our knowledge. It answered, when a thing was either square or else it was round — when species were held for fixed facts as separate creations; but now that we know a thing may be neither square nor round, but something between, it is lamentably defective. Not many years hence, we trust, naturalists will have discarded it for some better method of notation; and then the wonder will be that we advanced so far with such a stumbling-block in the way. Who shall say how much the advance of chemistry, for instance, or of philosophic anatomy, has been facilitated, or indeed rendered possible, by the invention of expressive symbols and apt formulas? or how much of the acknowledged confusion in zoology and botany flows from our cramped method of expressing our views? If we must continue to use a tool so blunt and unhandy as the binomial nomenclature, all cannot be expected to use it with equal skill and effect. — Elliott Coues.

The Tenebrionidæ of the United States.*—This long neglected family of beetles, of which the meal worm is the type, have at length obtained justice at the hands of Dr. Horn. This extensive group is remarkably developed in California, where the author devoted four years of field work before sitting down to work up the family. As the result he has succeeded in bringing before "the student of our fauna as nearly a correct list, with synonymy, of all our species as possible, with short descriptions and synoptic tables whereby all our known species can be readily recognized, rendering it necessary to refer only doubtful or new ones to those having typical collections for proper comparison."

The author states that the classification adopted is substantially that of Dr. LeConte, with such alterations as the further study of the family seems to indicate, "and while the systems adopted by LeConte and Lacordaire are so widely and fundamentally different, the arrangement of the genera is very strikingly similar." Dr. Horn finds what seems to occur throughout the animal kingdom, a remarkable parallelism between the "individual genera of many widely separated tribes." In concluding, the author gives a bit of criticism of much significance at the present day. "If this paper can in the least aid those whose collections are in disorder, in properly systematizing their species and appreciating the difference between the genera and species, and above all, if it will succeed in preventing them, should they ever aspire to authorship, from creating genera and species unnecessarily, I shall feel that I am amply repaid."

Entomologists are under great obligations to the author for this elaborate revision, and its publication will undoubtedly infuse a greater interest in this and other families of less known beetles.

The Canadian Entomologist† has entered upon its third volume, with improvements in its size, paper and illustrations. We rejoice in the assured success of this useful and interesting journal and trust it will be liberally sustained on this side of the border. It will interest readers in the Northern States as much as in Canada.

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*Revision of the Tenebrionidæ of America, North of Mexico. By George H. Horn, M.D. From the Transactions of the American Philosophical Society. Philadelphia. 1870. 4to. pp. 151. With 2 plates.

†Edited by Rev. C. J. S. Bethune, Port Hope, Ont. Remittances to be sent to E. Baynes Reeds, London, Ontario, Canada. Price $1.00 per annum.

ZOOLOGICAL LITERATURE.*—After a long delay, owing wholly to the tardiness with which zoologists have come forward to its support, the sixth volume of this important work has been published. This volume covers the literature for the year 1869, and consists of 683 closely printed large 8vo pages, showing that zoologists were as active during that year as in any preceding. With this volume Dr. Günther retires from the editorship and the future volumes will appear, as we understand, under the direction of the "Zoological Record Association," to which we have previously called attention. The British Association have liberally aided the publication of the Record by another grant of £100, and the several recorders have continued to perform their labors without compensation. They are Günther, Newton, Dallas, Rye, Marshall, Kirby, M'Lachlan, von Martens, and Wright.

For the benefit of those of our readers who have not seen the previous volumes, we will state that the volume does not consist of simple lists of names with references to the books where the species are described, but that a short résumé of each important work and paper is given as well as references to all the new genera and species described during the year in all countries.

PARASITES OF MAN AND THE DOMESTIC ANIMALS.†—This is an admirable treatise on a subject of great importance to agriculturists. It would make an excellent text book on this subject for use in our agricultural colleges, or, at least a book of reference. It begins with the insect parasites, and then treats of the internal parasites of the domestic animals as well as man, giving especial attention to the tape worms and trichina. It also gives a full account of the gape worm of the domestic fowl which we shall reproduce elsewhere, as the disease is wide spread, and correspondents have made inquiries regarding it.

The remarks upon the mode of treatment and remedies are practical, and give the treatise additional value.

PROCEEDINGS ESSEX INSTITUTE.—The second part of vol. 6 of the "Proceedings and Communications of the Essex Institute," re-

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*The Record of Zoological Literature. 1869. Vol. VI. Edited by Albert C. L. G. Günther. London. Van Voorst. 1870. 8vo. cloth, pp. 683. [Though bearing date 1870 our copies were not received until the very last of June, 1871.] For sale at Naturalists' Agency.

†The External and Internal Parasites of Man and Domestic Animals. From the report of the Connecticut Board of Agriculture for 1870. Hartford, Conn. 1870. 8vo. pp. 140. With many wood cuts.

cently published, contains several papers of unusual interest. The continuation of the late Horace Mann's "Flora of the Hawaiian Island" comprises seven pages only. The editor finds it impossible to complete this important work, and accordingly the "Flora" is closed at the end of the Umbelliferæ. He announces that the government of the Hawaiian Island have made an appropriation for the publication of the completed work with illustrations. The other papers are "Notes on the Birds of Minnesota," by J. M. Trippe. "Note on the Earth worm," by R. T. Knight. "Synopsis of the Primary Subdivisions of the Cetaceans," by Theodore Gill, "On the Myology of the Ornithorhynchus," by Elliott Coues.

THE EARTHQUAKES OF NEW ENGLAND.* — This is a useful list of the earthquakes that have occurred in New England since 1638. The author is dependent for his material upon M. Alexis Perrey's series of local catalogues, containing a tolerably complete list of the earthquakes which are said to have taken place in the central and eastern part of North America. Prof. Williams, also, in the Memoirs of the American Academy, has collected much valuable material; and Prof. Mallet's catalogue, and many fragmentary scientific and historical papers contain nearly all the rest that is known. The list comprises 231 earthquakes.

HONDURAS.† — This is a timely guide book to the geography and natural resources of a portion of Central America, which will derive new interest and importance from the great interoceanic railroad which is to cross Honduras between the Gulf of Honduras and the Bay of Fonseca on the Pacific coast. It is reprinted as a "service to the British public" from a work entitled the "States of Central America" by Mr. Squier, who has revised the reprint, "so as to give a clear and accurate view of the condition of Honduras at the present time."

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* Historical Notes on the Earthquakes of New England. 1638-1869. By W. T. Brigham. (From the Memoirs of the Boston Society of Natural History.) 4to. 1871. pp. 28.

† Honduras; descriptive, historical, and statistical. By E. G. Squier. London. Trübner & Co., 1870. 12mo, pp. 278. With a map.

NATURAL HISTORY MISCELLANY.

ZOOLOGY.

Mimetic Analogy.—At a recent meeting of the Academy of Natural Sciences of Philadelphia, Prof. Cope described a new genus and species of snake, from the Museum of the Smithsonian Institution, which was interesting in several respects. It was called *Nothopsis rugosus*, and was said to be in structural characters near to the family of *Achrochordidæ*, but apparently nearest the genus *Xenodermus* Reinhdt., all which forms are natives of the East Indian Archipelago.

The description indicated how closely this serpent resembled in coloration the young examples of *Trigonocephalus atrox* from the same country, and the *Trigonocephalus Neuwidii* of Brazil. This is so marked as to constitute a case of mimetic analogy. But few cases of mimicry of the Crotaline venomous snakes are to be observed in South America, the imitations being chiefly of the other venomous group of *Proteroglypha* as represented by *Elaps*.

In this connection was made a reclamation of the discovery of this, perhaps the most extensive example of mimetic analogy known in Zoology. Alfred R. Wallace, in his admirable work "Contributions to the Theory of Natural Selection," London, 1870, gives Dr. Günther as his authority for the facts of the case with regard to the genera *Plicocercus*, *Oxyrrhopus*, *Erythrolamphrus*, etc., and refers to his own previously published account of it in one of the British reviews for 1867. Wallace is quoted by Darwin in his "Descent of Man," to the same effect. The first published account of the case will be found in the "Proceedings of the Acad. Nat. Sci., of Phila.," 1865, p. 190, in a paper by the author. It was repeated and extended in "Origin of Genera," 1868, but had been already pointed out in conversation with Dr. Wallace and probably Dr. Günther also, when in London in 1863, a fact which had probably escaped his memory.

Entomological Items.—The *Lachnosterna fusca*, the Maybeetle, or Dorbug, has appeared unusually early in Freehold, N. J. April 22d, I found numbers of well developed specimens in the streets under the maples, which as yet had their foliage not over

an inch long. The insects, however, were very stupid. On the 11th, the cherry blossomed, and on the 9th, the peach. On the 11th, I saw several specimens of the *Pieris rapæ*, the new cabbage butterfly. Since then, I regret to say, this fearful pest has appeared in alarming numbers. On the 28th, I saw the first specimen of *Colias Philodice*, the sulphur butterfly. The plow is turning up now (May 10) great quantities of chrysalids of the Carolina Sphinx, the dreaded potato worm.—S. Lockwood, *Freehold, N. J.*

A Strawberry Cut Worm.—Mr. Hooper, of Marblehead, brought us the full-sized larvæ of the Dorbug, *Lachnosterna fusca*, about the middle of June, at which time they were cutting off his strawberry plants to considerable extent.

Correction.—On page 714, Vol. iv of the Naturalist, it is stated that the *Euphonia elegantissima* in the Vassar Cabinet has a bright yellow forehead. This is true only of the female, and the specimen is very likely young. So that the discrepancy exists only in the throat of the male.—James Orton.

Fishes of the Ambyiacu River.—At a recent meeting of the Academy of Natural Sciences of Philadelphia, Prof. Cope read a paper on the ichthyology of the Ambyiacu River, a tributary of the Amazon, in Eastern Equador. The results of the investigation were summed up as follows. The fishes in the collection examined were referred to nine families, fifty-one genera, and seventy-five species, distributed as follows:

	Genera.	Species.		Genera.	Species.
Tetraodontidæ,	1	1	Erythrinidæ,	2	2
Chromididæ,	7	15	Characinidæ,	21	29
Clupeidæ,	1	1	Siluridæ,	15	24
Osteoglossidæ,	1	1	Symbranchidæ,	1	1
Sternopygidæ,	2	3			

Forty-seven of the above species, and nine of the genera are new to Science, and are referable to the following families:

	Genera.	Species.		Genera.	Species.
Chromididæ,	0	9	Characinidæ,	3	16
Erythrinidæ,	0	1	Siluridæ,	6	20

The general character of this list is that of any other part of the Amazon basin, presenting local peculiarities in peculiar species and in genera not found in the Lower Amazon. Such genera among Characinidæ are *Triportheus*, *Megalobrycon*, *Aphyocharax*, *Iguanodectes* and *Stethaprion*; among Siluridæ, *Dianema*, *Brochis*,

Zathorax, *Physopyxis*, *Otocinclus* and *Pariolius*. A genus (*Characidium*) previously only known by one small species from a Brazilian coast stream, has its range greatly extended by the discovery of a species in the Ambyiacu.

GEOLOGY.

Aurora Island.—With reference to the alleged disappearance of Aurora Island, one of the New Hebrides group, to which we alluded some weeks since on the authority of a paper read before the Academy of Natural Sciences of Philadelphia, a correspondent of the "Shipping and Mercantile Gazette" affirms that the whole story is a fable. The original statement rested on a notice by Captain Plock, of the French ship *Adolphe*, bound from Iquique to London, that he passed over the position of the Iles de l' Aurore, as marked on his French chart of the South Atlantic, and saw nothing of them, from which he concluded that they had disappeared It appears, however, that the Iles de l'Aurore (Aurora Islands) never existed. They were formerly placed between lat. 52° 38′ and 53° 15′ S., and between long. 47° 43′ and 47° 57′ W., of Greenwich. The first reporters of the islands probably saw icebergs in the given locality, and mistook their character. Aurora Island, in the New Hebrides group, has been confounded with the Aurora Island in the Paumotu, Tuamotu, or Low Archipelago. Aurora, Makatea, or Metia Island, lat. 15° 50′ S., long. 148° 13′ W., one of the Low Archipelago, has not been visited for some time, but its elevation would lead to the inference that it could not disappear suddenly; it is fertile and inhabited. This is the island visited by Wilkes, and on which the unique specimens of mollusca were found. It is upwards of 2,500 miles eastward of the New Hebrides.—*Nature*.

ANTHROPOLOGY.

Supposed Mexican Idol.—We have received from Dr. C. U. Shepard, jr., a stereoscopic view of an idol made of Mexican lava, presented to him by a Mr. Toomer of Charleston, S. C. The image is about three and a half inches high, and is at present deposited in the collection of Prof. Shepard, sr., at Amherst College, Mass. The image was said to have been found a few inches

under ground by a child, and Dr. Shepard was told that arrow-heads have been found in that neighborhood, but he was unable to obtain any. The locality, where the idol was found, is a swampy tract some twelve to fifteen miles southwest of Sommerville, and from thirty to thirty-five miles from Charleston.

An eminent archaeologist to whom we submitted the photograph considers this as undoubtedly a Mexican idol, and threw out the suggestion that it might have been brought by some soldier from **Mexico during the Mexican war.**

The Quissama Tribe of Angola.—At a meeting of the Anthropological Institute (May 29), Mr. F. G. H. Price read a paper on this tribe, which inhabit that portion of Angola situated on the south bank of the Quanza river. The country had lately been visited by Mr. Charles Hamilton, well known for his travels among the Kaffirs. The Quissama bear the reputation of being cannibals, but cannibalism, although undoubtedly practised by them to some extent, does not largely prevail. The men are well formed, and average about five feet, eight inches in height, they are copper-colored, have long, coarse, and in some instances, frizzled hair; their heads are mostly well developed, and the Roman nose is not unfrequently met with. Their weapons are spears, bows and arrows, and occasionally guns, the latter being rude copies from the Portuguese article. Mr. Hamilton was well received by the chief, who told him that he was the first white man who had seen the tribe at home. The men and women of the Quissama are addicted to hunting; they are virtuous, practice monogamy, marry young, and are very prolific. The men largely preponderate in numbers over the women, the result, it is supposed, of infanticide, but of that practice Mr. Hamilton had seen no evidence. The Quissama believe in the existence of a Supreme Being.—*Nature.*

The Patagonians.—A paper was also read at a meeting of the Anthropological Institute by Lieut. George C. Musters, R.N., on the races of Patagonia inhabiting the country between the Cordillera and the Atlantic, which the author had traversed during the years 1869 and 1870. The Patagonians consist of three races distinctly differing in language and physique, and partially differing in religion and manners, Tehuelches or Patagonians, Pampas and Manzaneros, the latter being an offshoot of the Araucanians of Chile. The Tehuelches and Pampas are nomadic tribes subsisting

almost entirely by the chase. The proverbial stature of the Patagonians was so far confirmed by the observation that the Tehuelches give an average height of five feet ten inches, with a corresponding breadth of shoulders and muscular development; the Manzaneros come next in order of height and strength, the Pampas being the smallest of the three races. The Manzaneros are remarkable for their fair complexions, while the Tehuelches are, literally speaking, Red Indians. Lieut. Musters had visited all the various tribes of those races, from the Rio Negro to the Straits of Magellan, for political purposes, and he estimated the population, which he described as diminishing, as follows:—Tehuelches 1,400 to 1,500, Pampas 600, and the remainder Manzaneros, amounting in all to about 3,000.—*Nature*.

MICROSCOPY.

The Foot of Dytiscus and the Fly.—Mr. B. T. Lowne (in a paper read before the Royal Microscopical Society, London, May 3, 1871), gives a very interesting and conclusive study of this familiar and interesting object. The tarsi of the anterior feet of the males are furnished with some two hundred sucker-like disks, one of which is about one-sixteenth of an inch wide, another a thirty-second of an inch, and the rest one hundred and fiftieth of an inch each. These disks, more properly called pulvilli, are evidently designed for purposes of adhesion, and being believed by the majority of persons to act by atmospheric pressure, are popularly called suckers. They are evidently comparable to the pulvilli of many insects. The tarsi of some diamond beetles are furnished with tubular, bulbous hairs whose bases open into a gland in the tarsus, a viscid fluid from which fills the hair and exudes through the walls of the bulb. In flies the same structure is found, except that the minute organs are furnished, instead of bulbs, with flattened disks, which, by bearing an equal strain support the individual, though they are easily removed from their attachment by the insect, which separates one row at a time. In the male Dytiscus we observe an extraordinary modification of the same organs; the tarsus being mainly occupied by a large, glandular sac, into which open, by apertures visible under the microscope, the columella of the so-called suckers. These "suckers" are disk-bearing hairs, greatly modified in size but little in struct-

ure, and analogous to some caterpillars' hairs which have poison glands at the base. A viscid secretion from the sac fills the hair and exudes from its surface. The escape of this fluid when not in use is perhaps prevented by a change in shape of the organs when in a state of rest.

As announced by Blackwall in 1816, a viscid fluid, not atmospheric pressure, is the cause of adhesion in such cases. The theory of suction or atmospheric pressure, still popular, is disproved by the facts that a Dytiscus, chloroformed to prevent a voluntary relinquishment of his hold, still adheres to the surface of glass in a receiver exhausted of air; that every foot-step leaves a microscopic print upon the surface of a clean glass slide; and that the suckers in action are applied evenly to the surface, or are partially filled with water, so that any attempt at suction would cause, and would be defeated by, a flow of the viscid fluid from the sac.

The tenacious fluid which is the means of adhesion, coagulates readily, does not mix easily with water, and is extremely insoluble. It sometimes hardens so thoroughly as to glue the disks inseparably to their object of attachment, the insect escaping only at the expense of mutilation, somewhat as flies in autumn often become so firmly adherent to the window-panes that the enfeebled insects are unable to escape.—R. H. W.

NOTES.

At a meeting of the Faculty of the Museum of Comparative Zoology, held May 6, 1871, the Humboldt Scholarship was awarded to J. A. Allen, in consideration of his paper upon the "Mammals and Winter Birds of East Florida," and the proceeds of the Humboldt Fund for one year, granted to him in aid of his exploration of the Fauna of the Rocky Mountains.

The Albany Institute and the Troy Scientific Association enjoyed a field meeting of rare interest at North Adams on the 27th of May, visiting the Natural Bridge and the Hoosac Tunnel, and receiving throughout the day an enthusiastic reception. They want to go to North Adams again.

Prof. F. V. Hayden, U. S. Geologist, writes us, May 30th, from Cheyenne, Wyoming: "We start from this place to-day with twenty-eight persons and five freight cars loaded, and hope to camp at Ogden on the evening of June 1st. We start north from that point to Fort Ellis, Montana, and examine the Yellowstone.

A few weeks ago the "Explorador" made her trial trip on the Thames. She is a little iron craft drawing thirty inches, and was built for the Robinson Navigation Company of New York. She is designed for a most interesting expedition which cannot fail to increase the commerce of the west of South America and develop its natural history. Ascending the Amazon, the "Explorador" will be rolled around the rapids of the Madeira, and will then penetrate far into the interior of Bolivia by the Manu-tata and into the rich region of Matto Grosso by the Itenez. Peru is busily exploring its oriental side by the noble Ucayali. The "Tambo" has been up over eight hundred miles, nearly reaching the fort of Chanchamayo on the tributary Rio Tambo, only three days from Lima.

The Troy Scientific Association, accompanied by the Albany Institute and the Dana Societies of Troy and Albany, held a memorable field meeting on the Helderberg Mountains on the seventeenth of June, visiting the Indian Ladder, Tory House, Rock Mine, Thompson Lake, etc. There are few more really enjoyable spots in America, and none more suited for a scientific field-day, than this comparatively unknown locality, which is reached *via* Guilderland Station on the Albany and Susquehanna Railroad.

Among the signs of the scientific life of the present day one of the most encouraging, is the increasing frequency and enthusiasm of these delightful occasions of scientific study, intercourse and recreation called Field Meetings. A day upon the mountains is worth a week among the books.

Prof. Marsh of Yale College, with twelve other gentlemen, has started for the Rocky Mountains and Pacific Coast. He will be absent until winter, and will continue his investigations of the Tertiary and Cretaceous formations which his explorations last year proved to be very productive in new species of vertebrates.

Mr. Albert H. Tuttle has been appointed instructor in the use of the microscope at Harvard University.

Mr. J. A. Allen, of the Museum of Comparative Zoology, has been appointed University Lecturer on Ornithology at Harvard, and Mr. J. B. Perry also of the M. C. Z. has been appointed University Lecturer on "The Life of the Primordial Era."

Government is continuing the survey of the Great Lakes, and it is expected that the survey of Lake St. Clair will be completed this year, and that of Lake Michigan well begun before winter stops operations.

The American Journal of Science and Arts for July, has a short article by "B. S.," stating how the "Cardiff Giant" was cut out of a block of gypsum quarried near Fort Dodge, Iowa. The block was carried to the workshop of Mr. Burckhardt, a well known marble worker in Chicago, who contracted to furnish the originators of the scheme with a gigantic recumbent figure of a man. The newly made "antique" was then conveyed to the Newell Farm and buried; after seven months it was "accidentally" discovered and thousands of persons were, and still are being humbugged.

The University of Pennsylvania have just laid the corner stone of the new buildings for its scientific school, in a plot of about eight acres purchased from the city. Provost Charles J. Stillé, to whom this new movement is largely due, gave an historical address, tracing the fortunes of the University from the organization of the College of Philadelphia as the sixth American College, just one hundred and sixteen years ago, an event largely due to the public spirit of Benjamin Franklin.— *Independent*.

A hydrographic party under Mr. W. H. Dall, acting assistant U. S. Coast Survey, will leave San Francisco in the course of a few weeks to undertake a reconnaissance of the Aleutian Islands and the adjacent islands. The work is directed by the U. S. Coast Survey, in accordance with a plan submitted a year and a half ago by Mr. Dall to Prof. Pierce, which was approved by the Secretary of the Treasury, and for the execution of which an appropriation was made by Congress at its last session. The work will include astronomical determinations of position, corrections of the old charts as far as possible, deep sea soundings and dredgings, and collections of Natural History and geology. Prof. M. W. Harrington of Ann Arbor, accompanies the party as astronomical observer.

M. Octave Pavy proposes to leave San Francisco in August, and to leave Petropavlovski, in Kamtchatka, in winter to reach Cape Yakan, N. E. Siberia, and try to get across Long's Strait to Wrangell Land, in a rubber boat like the "Nonpareil" which crossed the Atlantic. It will be carried to Cape Yakan by reindeer, and his small party of five or six will take sledges to cross the ice, and their boats for open water, and try to get across Long's Straits. After reaching Wrangell Land they will push as far north as possible, and return at the end of the season. The plan is good though difficult, and the explorations between Anadyrsk and Cape Yakan will be very valuable even if they get no farther.

INDIANAPOLIS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. — In the May number of the NATURALIST we gave the list of officers for the next meeting of the Association, and called attention to some of the arrangements that had been made for the meeting; we now give the

Circular of the Local Committee.—"The objects of the American Association for the Advancement of Science are, "by periodical and migratory meetings to promote intercourse between those who are cultivating science in different parts of North America: to give a stronger and more general impulse, and a more systematic direction to scientific research in our country, and to procure for the labors of scientific men increased facilities and a wider usefulness."

The following extracts from the Constitution and Resolutions of the Association relate to membership:

"RULE 1. — Any person may become a member of the Association upon recommendation in writing by two members, nomination by the Standing Committee, and election by a majority of the members present."

"RESOLUTION 9. — Associate members may be admitted for one, two, or three years, as they shall choose at the time of admission; to be elected in the same way as permanent members, and to pay the same dues. They shall have all the social and scientific privileges of members, without taking part in the business."

The Twentieth Annual Meeting of the Association will be held at Indianapolis, Indiana, commencing WEDNESDAY, AUGUST 16, 1871, at ten o'clock, A. M.

It is hoped that all members will be present at the organization of the meeting.

On the afternoon of the first day, the Association will meet at the Academy of Music, where a reception will be extended to them by his Excellency, Conrad Baker, Governor of Indiana; to which, Prof. T. Sterry Hunt, President of the Association, will respond.

Members, and those who wish to become members, are requested, immediately upon their arrival, to register their names at the office of the Local Committee, at the State House, where they will be furnished with members' tickets, and such information as may be desired in regard to accommodations, etc.

The citizens have signified their desire to extend hospitality to the members. There are likewise ample hotel accommodations, and special arrangements will be made with hotel and boarding house proprietors for reduced rates. It is therefore particularly requested that persons intending to be present will notify the Local Secretary by letter, as early as practicable, and when possible, state the day they will arrive.

It is believed that the Committee will be able to make half-fare arrangements with all the railroads.

The members of the Local Committee will be known by a badge of ribbon.

Microscopists will please confer, as soon as possible after their arrival, with Dr. W. W. Butterfield at the Reception Room in the State House, in relation to the exhibition **and care of any instruments or apparatus they may bring.**

A suite of rooms have been secured in the State House for the special use of Microscopists."

By order of the Committee.

DANIEL MACAULEY, Chairman.
E. T. COX, Secretary.

Indianapolis, Ind., June 26, 1871.

We can give the following additional information to that contained in the Circular of the Local Committee. The meetings of all the sections, and the reception room and offices of the Local and Standing Committees will be at the State House. Sections A and B having allotted to them the Senate Chamber and the Hall of Representatives. The address of Prof. Hunt, the retiring president, will be delivered on Wednesday (the first) evening at the Music Hall, and we understand that President Gray will not take the chair until after the address, thus introducing one of the much desired reforms, which we hope will be followed by other needed changes. All the Railroads terminating at Indianapolis have agreed to furnish free return passes to members, and the Local Committee are endeavoring to obtain similar concessions from connecting roads. Prof. Cox, the Local Secretary and State Geologist of Indiana, in answer to our letter of inquiry, has given us a most favorable account of the health and comfort of the city, and assures us that if members wish to get sick they must go elsewhere, but if they want to enjoy a pleasant vacation and return to their duties fat and hearty he advises them to attend the Indianapolis meeting. We have in a previous number called attention to the proposed excursions of the Association. Prof. Cox also assures us that perfect safety will be guaranteed to the microscopes that are taken to the meeting, and that a suite of rooms, properly furnished, have been secured at the State House for the use of the section of microscopy, and that postal and telegraph facilities will be provided at the reception room. In fact, nothing will be omitted by the Local Committee to make the meeting an agreeable reunion and scientific success.

ANSWERS TO CORRESPONDENTS.

J. A. P., Bedford, Mass. — Your bird is the Red-eyed Vireo, *Vireosylvia olivacea*.— E. C.

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NOTES ON THE RANGE OF SOME OF THE ANIMALS IN AMERICA AT THE TIME OF THE ARRIVAL OF THE WHITE MEN.*

BY W. J. HAYS.

In the present condition of this country, since civilization has reached half way across the continent, few persons think of the prodigious changes that have taken place in the animal life in the comparatively short time since the discovery of the country. At that time the whole country was an unbroken wilderness, through which roamed the Indians and countless numbers of animals, many of which are now so rare as to be unknown to many and objects of curiosity to all. The moose which has now been driven almost entirely out of the United States, was then found as far south as New Amsterdam, now New York City.

In Sir Martin Frobisher's account of his second voyage to Newfoundland and adjacent land, 1577, he says "There is no wood at all, there is a great quantity of deer, their skins like unto asses. their heads or horns do far exceed any, both in length and breadth. their feet are great as oxen, which measured were seven or eight inches in breadth; there are also hares, wolves, etc."

Anthonie Parkhurst in 1578, says of the Island of Newfoundland, "I saw mighty beasts, like to camels in greatness, and their

* Recently read before the New York Lyceum of Natural History.

Entered according to Act of Congress, in the year 1871, by the PEABODY ACADEMY OF SCIENCE, in the Office of the Librarian of Congress, at Washington.

feet cloven." Vanderdonck in his "History of the New Netherlands," 1642, says, "There are also white bucks and does, and others of a black color; the Indians aver that the haunts of the white deer are much frequented by the common deer, and that those of the black species are not much frequented by the common deer." The same peculiarity is noticed now, the moose and common deer are rarely found near each other.

James Hall, in his fourth voyage, July 22d, 1563, saw "in lat. 65, the tracks of some great deer as big as an ox." This shows the extent of the range of the moose at this period. They are not found now in Newfoundland, although they are still abundant in some parts of Canada, Nova Scotia, New Brunswick, and Alaska. The reindeer still exists in large numbers from the Arctic regions to the south end of Hudson's Bay, an average of five thousand horns being annually shipped from Greenland to Europe.

The carraboo abounds now south of Hudson's Bay to the United States, and from Newfoundland to the Pacific; and although fossil remains have been found as far south as the Ohio, its range at the time of the arrival of the white men was no more extensive than at present; the settlers of New Amsterdam knew of it only from the Indians, and from their description of it wrote back to their friends in Europe that the fabled Unicorn had been found.

The musk ox is not mentioned by the early travellers, but some of them mention having seen in Greenland the track of some big beast like an ox. The musk ox is not found now in Greenland.

The common deer (*Cervus Virginianus*) was everywhere represented as existing in incredible numbers; this animal is still found, although in greatly diminished numbers, all over the unsettled portions of the United States, a portion of Mexico, Central America, and South America to the Orinoco. It exists in immense numbers on the savannas of the northern part of South America, although there it is known by another name (*Cervus campestris*). As many as two hundred and fifty thousand have been shipped from Angostura in one year, and one hundred and seventy-five thousand from Para.

The Wapiti deer (*Cervus Canadensis*) was found all along the coast from Canada to the Gulf of Mexico. Vanderdonck mentions them as being plenty around New Netherlands in 1642. In 1654 Father LeMoine made a journey to the western part of New York, and speaks of the astonishing number of the deer, and of the great

numbers of elk, many of which were killed while crossing the rivers. Brickell says that the elk were plenty in the Carolinas as late as 1737. As late as 1826 a few elk were killed on the Saranac, in New York; a few were in the mountains of Virginia in 1847; several were seen in the mountains of Pennsylvania in 1864; now it is probable that not one could be found east of the Great Lakes.

The Bison (improperly called buffalo by the early settlers on account of its fancied resemblance to the European buffalo) also ranged along the coast from the valley of the Connecticut to Florida. When Hendrick Hudson landed on the island of Manhattan, he found some of the Indians clothed in bison robes; they had also moccasins made of these skins.

When he sailed up the river which now bears his name, he landed at what is now the entrance to Newburg Bay; he was well received by the Indians, and one of the sailors happening to show some of the Indians an almanac in which were the signs of the Zodiac, they knew how to explain that it was the head of an animal with which they were acquainted, and gave the whites to understand that it could be found in what is now known as the valley of the Ramapo; the Indians also explained that the animal had already begun to retire from the coast before the white men came here. The river Titicus, in Connecticut, formerly bore the name of Mutighticos, which Indian tradition signified to mean bison creek.

Vanderdonck, in "History of New Netherlands," 1642, says "Buffaloes are also tolerably plenty; these animals keep towards the southwest where few people go. These animals are not very wild, and some persons are of opinion that they may be domesticated. Persons who have got them when young, say they become very tame as they grow older." It is remarked that the half of those animals have disappeared and left the country. The settlers of James River in Virginia also found them, and made an attempt to domesticate them.

Father Simon LeMoine in his journey to the Iroquois in 1654, in which he discovered the Onondaga salt springs, says "that they saw immense herds of cows and bulls." On a map of the Frontiers of the Northern Colonies with the boundary line established between them and the Indians at the treaty held by Sir William Johnson at Fort Stanwix in November, 1768, the west branch of the Susquehanna, and Toby's Creek, a branch of the Ohio, are represented as arising in a swamp called buffalo swamp.

Lawson says that "great plenty of buffaloes, elk, etc., existed near Cape Fear River;" and Purchas says that "in 1613, the adventurers in Virginia discovered a slow kind of cattle as big as kine, which were good meat."

Brickell says that two were taken alive in 1730, near where Newbern now stands; and those who settled the Abbeville district in South Carolina in 1756 found the buffalo there.

Bernard Romans, who wrote in 1774, speaks of the buffalo as a "benefit of nature bestowed upon Florida."

Alvar Nunez, about the year 1535, saw them not far from the coast, and Ioutel in 1685 saw them at the Bay of St Bernard.

De Soto, who traversed the coast of the Gulf of Mexico from Florida to the Mississippi, from 1539 to 1543, saw no buffalo, but frequently saw the skins, and was told that the animal was to the north of them.

Gomara says, that in 1591, they were in great numbers in what is now New Mexico.

Herrera states, that they roamed as far south as the river Yaquinie (supposed to be the Rio Gila).

The buffalo is not found now west of the Rocky Mountains, except a few on the head waters of the Columbia river, but the Indians have a tradition that shortly before the visit of the first explorers destructive fires drove the bison east of the mountains.

Thus, it would seem that the bison once roamed over the entire country, now known as the United States, and extending as far north as the sixtieth parallel in British America. They are not found now east of the Missouri river, nor south of Colorado; at the rate at which they have been driven back and destroyed, it is probable that they are soon to be known only in history.

For many years, the annual number of robes brought to market has been about fifty-five thousand, and when it is known that the skin of the cow only is preserved, and that only in the winter season, and that the cows are generally with calf at this season, and that the skin is not taken from more than one in ten of those animals that are killed, some estimate may be formed of the rapid destruction of these animals at the hand of man; and without taking into consideration the deaths from natural causes, accidents, etc., it is a low estimate to place the number of bison destroyed by man each year at not less than half a million.

It is a little strange that, while the harmless animals have been driven so far back from the Atlantic coast, the carnivorous still

remain, although scarce; the black bear, the cougar, the lynx, wolf, fox, and the smaller animals are still found occasionally. The jaguar is not now found east of Texas. Brickell states that they were found in the mountains of North Carolina as late as 1737.

It has been asserted that the red fox was an importation from Europe, and not a native; it is a fact that the European red fox has been imported and turned loose at different times, by English gentlemen for sporting purposes, but the red fox existed here before the arrival of the white men. Capt. James Hall, in the account of his fourth voyage 1563, says, "there are store of foxes in the main and islands, of sundry colors." Capt. Luke Fox found an island near the mouth of Hudson's Bay, where he killed several dun colored foxes, and on this account called the island "Dunne Foxe Island."

Carver 1763, says, "there two sorts of foxes in North America, one being of a reddish brown and the other of a gray."

Bartram 1761, says, "The foxes of Carolina and Florida are of the smaller red species."

Wolves are everywhere mentioned, and as late as 1820, the State of New York alone had expended thirty-eight thousand two hundred and sixty dollars in bounties for killing these animals during the preceding five years.

Stevens, 1708, says, "some years ago there were killed five hundred bears in two counties of Virginia."

The beaver was very abundant. Vanderdonck 1642, says, "That in the New Netherlands, and in the adjacent country, about eighty thousand beavers have been killed annually during my residence of nine years in the country."

The dog was found in all parts of the country, and from the description must have been the same as those now found with the Indians of the plains.

Columbus, in his second voyage, 1494, says, "no four-footed animal has ever been seen in this (Hispaniola) island or any other islands except some dogs of various colors, as in our own country, but in shape like large house dogs." These semi wild dogs have followed the Indians, and are only to be found with them in the far west. The wild animals having been removed in the march of civilization to make room for the domestic varieties that are more useful to man, it will, perhaps, be in place to say a word about their introduction to this country.

The first known to have been brought here, was by a colony of Northmen, in 1023, who settled in a portion of New England which they called Vineland; they brought with them a variety of stock, but as the colony afterwards broke up and returned to Iceland, and none of the subsequent settlers have ever seen anything like our domestic animals, it is to be presumed that they were destroyed. Columbus, in his second voyage 1493, brought to the islands horses and other domestic animals. The first horses brought to the mainland, were those brought to Florida in 1527, by Cabeca de Vaca, forty-two in number, but these all perished. The next were three hundred and fifty horses landed by De Soto on the 25th of May, 1539, on the coast of Florida, at the bay of Spiritu Sancto.

In 1604 L'Escarbot, a French lawyer, brought horses and other domestic cattle into Acadia: they were the Norman and Breton breeds.

In 1609 six mares and a horse were brought to Jamestown.

In 1629 horses were brought to Massachusetts from England.

In 1625 New Amsterdam received some Dutch horses.

The animals thus imported increased very rapidly, for Gent, who wrote in 1655, says "In the island of Hispaniola and ('tis likewise the same in many parts of the Continent, and other islands beside). there are many thousands of cattle that live wild in herds upon the mountains having no certain owners, so that it is free for any one to kill them that will, and thousands of them are every year killed only for their hides and tallow, and yet it is strange to consider what great multitudes of them are in private men's possession. The Bishop of Venezuela only is said to have had at one time sixteen thousand head of cattle feeding upon his own pastures."

In the year 1587 there came from St. Dominique thirty-five thousand four hundred and forty-four hides, and from New Spain sixty-four thousand three hundred and fifty. At this time it was said that in the islands of Hispaniola, Jamaica, Margueríta and Dominica "there were so great troops of horses, oxen, kine, dogs, and hoggs which have increased to such an extent that any one may kill them, the dogs have so increased that they travel in troops and kill many cattle."

These few facts from history will show how entire races of animals can be swept from the earth to be replaced by others.

LIFE AT GREAT DEPTHS.

BY PROFESSOR P. M. DUNCAN.

The researches of Hooker, who obtained Polyzoa and Foraminifera in soundings at a depth of nearly four hundred fathoms off the icy barrier of the South Pacific, of Wallich in the Atlantic, and of Alphonse Milne-Edwards in the Mediterranean, have had much influence upon geological thought in this age, which, so far as geologists are concerned, is remarkably averse to theory. For many years before any very deep soundings had been taken with the view of searching the sea-bottom for life, geologists had more or less definite opinions concerning the deposition of organisms in sediments at great depths. Certainly more than thirty years ago deep-sea deposits were separated by geologists from those which they considered to have been formed in shallower seas. The finely divided sediment of strata containing Crinoids, Brachiopods, Foraminifera, and simple Madreporaria, was supposed to have been deposited in deeper water than formations containing large pebbles, stones, and the mollusca whose representatives now live in shallows. The relations of such strata to each other during subsidence, the first being found occasionally to overlap the last, proved that there was a deeper sea-fauna in the offing of the old shores which were tenanted by littoral and shallow-water species. The deposition of strata containing Foraminifera, Madreporaria, and Echinodermata, whose limestone is remarkably free from any foreign substances, has been considered to have taken place in very deep water; this theory has been founded upon the observations of the naturalist and mineralogist. Indeed no geologist has hesitated in assigning a great depth to the origin of some deposits in the Laurentian, Silurian, or in any other formation. The "flysch," a great sediment of the Eocene formation, has been considered to have been formed at a very great depth and under great pressure. Its singularly unfossiliferous character was supposed to be due to the absence of life at the depths of the ocean where the sediment collected. But this was a theory of the early days of geology, when the destructive influence of chemical processes in strata upon the remains of organisms in them was hardly admitted.

The great value of such researches as those so ably carried out by Thomson, Carpenter, and Jeffreys is the definite knowledge they impart to the geologist, who is theorizing in the right direction, but whose notions of the depth at which the sediments containing invertebrata can be deposited are indefinite. These researches contribute to more exact knowledge, and they will materially assist the development of those hypotheses which are current amongst advanced geologists into fixed theories. I do not think that any geological theory worthy of the term, and which has originated from geological induction, will be upset by these careful investigations into the bathymetrical distribution of life and temperature. The theories involving pressure and the intensity of the hardness of deep-sea deposits will suffer from the researches; but many difficulties in the way of the palæontologist will be removed. The researches tend to explain the occurrence of a magnificent deep-sea coral fauna in the Palæozoic times in high latitudes, and of Jurassic and Cainozoic faunas on the same area, and they favor the doctrines of uniformity. They explain the cosmopolitan nature of many organisms, past and present, which were credited with a deep-sea habitat, and they afford the foundations for a theory upon the world-wide distribution of many forms during every geological formation.

It is not advisable, however, to make too much of the interesting identities and resemblances of some of the deep-sea and abyssal forms with those of such periods as the Cretaceous, for instance. In the early days of geological science there was a favorite theory that at the expiration of a period the whole of the life of the globe was destroyed, and that at the commencement of the succeeding age a new creation took place. There were as many destructions and creations as periods; or, to use the words of an American geologist, there was a succession of platforms. This theory held back the science, just as the theory that the sun revolved round the earth retarded the progress of astronomy. Moreover it had that armour of sanctity to protect it which is so hard to pierce by the most reasonable opposition. Nevertheless every now and then a geologist recognized the same fossils in rocks which belonged to different periods. A magnificent essay by Edward Forbes on the "Cretaceous Fossils of Southern India," a wonderful production and far before its age* gave hope and confidence to the few pala-

*Quarterly Journal of the Geological Society of London, vol. i. p. 79.

ontologists who began to assert that periods were perfectly artificial notions — that it did not follow, because one set of deposits was forming in one part of the world, others exactly corresponding to it elsewhere, so far as the organic remains are concerned, were contemporaneous — and that life had progressed on the globe continuously and without a break from the dawn of it to the present time.

The persistence of some species through great vertical ranges of strata, and the relation between the world-wide distribution of forms and this persistence, were noticed by D'Archiac, De Verneuil, Forbes and others. The identity of some species in the remote natural-history provinces of the existing state of things was established in spite of the dogmatic opposition of authorities; and then geologists accepted the theories that there were several natural-history provinces during every artificial period, that some species lived longer and wandered more than others, and that some have lasted even from the palæozoic age to the present.

Persistence of type was the title of a lecture delivered by Professor Huxley* many years ago; and this persistence has been admitted by every palæontologist who has had the opportunity of examining large series of fossils from every formation from all parts of the world.

Geological ages are characterized by a number of organisms which are not found in others, and by the grouping of numerous species which are allied to those of preceding and succeeding times, but which are not identical. Certain portions of the world's surface were tenanted by particular groups of forms during every geological age; and there was a similarity of arrangement in this grouping under the same external physical conditions. To use Huxley's term, the "homotaxis" of certain natural-history provinces during the successive geological ages has been very exact. The species differed; but there was a philosophy in the consecutive arrangement of high-land and low-land faunas and floras, and those of shallow seas, deep seas, oceans and reef-areas. The oceanic† conditions, for instance, can be traced by organic remains from the Laurentian to the present time, and the deep-sea corals now under consideration are representative of those of older deep seas.

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* Royal Institution. See also President's Address, Geol. Soc., 1870.

† P. M. Duncan, Quar. Jour. Geol. Soc., No. 101.

It is not a matter for surprise, then, that there being such a thing as persistence of type and of species, some very old forms should have lived on through the ages, whilst their surroundings were changed over and over again. But this persistence does not indicate that there have not been sufficient physical and biological changes during its lasting to alter the face of all things enough to give geologists the right of asserting the succession of several periods. The occurrence of early Cainozoic Madreporaria in the deep sea to the northwest of Great Britain only proves that certain forms of life have persisted during the vast changes in the physical geography of the world which were initiated by the upheaval of the Alps, the Himalayas, and large masses of the Andes. To say that we are, therefore, still in the Cainozoic or Cretaceous age would hardly be consistent with the necessary terminology of geological science.

During the end of the Miocene age and the whole of the Pliocene, the Sicilian area was occupied by a deep sea. The distinction between the faunas of those times and the present becomes less, year after year, as science progresses; and it is evident that a great number of existing species of nearly every class flourished before the occurrence of the great changes in physical geology which have become the artificial breaks of tertiary geologists. That the Cainozoic deep-sea corals should resemble, and in some instances should be identical in species with, the forms now inhabiting vast depths, is therefore quite in accordance with the philosophy of modern geology. Before the deposition of the Cainozoic strata, and whilst the deep-sea deposits of the Eocene age were collecting in the Franco-British area, there was a Madreporarian fauna there, which was singularly like unto that which followed it, both as regards the shape of the forms and their genera. Still earlier, during the slow subsidence of the great Upper Cretaceous deep-sea area there was a coral fauna in the north and west of Europe, of which the existing is very representative. The simple forms predominate in both faunas. Caryophyllia is a dominant genus in either; and a branching Synhelia of the old fauna is replaced in the present state of things by a branching Lophohelia. The similarity of deep-sea coral faunas might be carried still further back in the world's history: but it must be enough for my purpose to assert the representative character and the homotaxis of the Upper Cretaceous, the Tertiary, and the existing deep-sea

coral faunas. This character is enhanced by the persistence of types; but still the representative faunas are separable by vast intervals of time.—*Proceedings of the Royal Society.*

ON THE FOOD AND HABITS OF SOME OF OUR MARINE FISHES.

BY PROFESSOR A. E. VERRILL.

When we consider the great importance and extent of our fisheries, it seems very remarkable that so little reliable information has been recorded concerning the habits, even of our most common and important species of fishes. It is certainly true that the habits of fishes, and especially of marine fishes, are more difficult to observe than those of birds and beasts, but this ought not to be a sufficient excuse at the present day, for the marked neglect of this department of Natural History. The nature of the food of the more abundant species, even including those that are most commonly sold as food, is still very imperfectly known. Observations must be made in great numbers in various localities and at all seasons of the year before we can obtain adequate knowledge of this subject.

During several years past I have improved such opportunities as have occurred to make observations of this kind, and although they are very incomplete, and often isolated, I am induced to present some of the facts thus ascertained; hoping that the attention of others may be directed to the same subject.

While spending a few days at Great Egg Harbor, on the coast of New Jersey, in April of this year, I dissected the stomachs of many specimens of the common fishes, which were at that time being taken in seines in the shallow waters of the bay, near Beesley's Point. The following were the principal results, in regard to their food. The Striped-bass or "Rock" (*Roccus lineatus* Gill) had its stomach filled with large quantities of shrimp (*Crangon vulgaris*) unmixed with any other food. This shrimp is very abundant on all sandy bottoms in shallow water along the whole coast, from Labrador to Cape Hatteras, and seems to contribute very largely to the food of many of our most valuable fishes.

White Perch (*Merone Americana*) contained the same shrimp in abundance.

Weak-fish (*Cynoscion regalis* Gill), called "Blue-fish" at that locality had its stomach filled with the same Crangon.

Kingfish (*Umbrina regalis*), called "Hake" on the New Jersey coast, contained nothing but *Crangon vulgaris*.

Toad-fish or Oyster-fish (*Batrachus tau*). This fish is almost omnivorous. The stomach is large and usually distended with a great variety of food. Young edible crabs (*Callinectes hastatus* Ordw.) up to two inches across, *Crangon vulgaris*, and the common prawn (*Palæmon vulgaris* Say), were the principal articles of diet at that locality; but pipe-fishes (*Syngnathus Peckianus*) six inches long, and the common black Nassa (*Ilyanassa obsoleta*) were often found in their stomachs, as well as various young fishes. Among the latter were specimens of the Anchovy (*Engraulis vittata*). The toad-fish is, therefore, a fish that should not be encouraged.

The Shad (*Alosa tyrannus* Gill) contained large quantities of fragments of small crustacea, chiefly a small shrimp-like species (*Mysis Americanus* Smith) which was also captured alive in tide-pools on the salt marsh. The shad from the mouth of the Connecticut River, taken in May, contained the same, or another allied species of *Mysis*. Some of the shad also had fragments of eel-grass (perhaps accidental) mixed with the crustacean fragments.

The "Hickory Shad" (*Meletta Mattowacca*), the young called "Herring" at the locality, were also filled with comminuted crustacea, among which the common shrimp (*Crangon vulgaris*) could be recognized most commonly.

The Moss-bunker or Menhaden (*Brevoortia Menhaden* Gill), invariably had its stomach and voluminous intestine filled with the soft, oozy mud, containing a large proportion of organic matter, which abounds in the quiet part of this and all similar bays along the coast. This fish appears, therefore, to obtain its nutriment by swallowing the mud and digesting the organic particles contained in it,—a mode of feeding for which its complex digestive apparatus and toothless mouth are specially adapted. Many marine worms, bivalve mollusks, and echinoderms feed upon the same kind of food, which is everywhere abundant. The moss-bunker is often infested by a large parasitic Lernean (*Lernæera radiata* Les.) which buries its star-shaped head deeply in the flesh.

The "Summer Flounder" (*Chænopsetta ocellaris*) contained abundance of shrimp (*Crangon vulgaris* and *Mysis Americanus*). In one specimen we found a full-grown *Gebia affinis* Say.

The Spotted Flounder (*Lophopsetta maculata* Gill) feeds largely upon crustacea of various kinds. Many specimens contained large quantities of shrimp and prawns (*Crangon vulgaris*, *Palæmon vulgaris* and *Mysis Americanus*). The latter often made up the bulk of the contents of the stomach. In addition to these *Gammarus mucronatus* Say and *Gebia affinis* Say were sometimes found. The Gebia we obtained in considerable numbers by digging them out of their long, crooked burrows at low-water mark, near Mr. Peacock's hotel at Beesley's Point. The burrows, which are made in a tenacious clay soil, often with decaying sea-weed beneath, are from half an inch to nearly an inch in diameter, with smooth walls. They are several feet in depth and very long and tortuous. The Gebia has a distant resemblance to a young lobster about two or three inches long. The real lobster was not found on the New Jersey coast. The other species of crustacea found in the fishes above named, are all common in the shallow waters of the bay among eel-grass, with the exception of the *Crangon vulgaris*, which frequents the open sandy bottoms, living half buried in the sand, with which its color exactly accords, furnishing an excellent illustration of imitative adaptation for protection.*

Ophidium marginatum DeKay. This species appears to be very rare and its habits little known. We dug two specimens out of the sand near low-water mark, where they burrowed to the depth of a foot or more. When placed upon moist sand they burrowed into it *tail foremost* with surprising rapidity, disappearing in an instant.

At Fire Island on the southern side of Long Island, Mr. S. I. Smith observed last August a species of worm (*Heteronereis*) of a reddish color and two or three inches long, swimming in large numbers at and near the surface. These were at that time the favorite food of the Blue-fish (*Temnodon saltator*).

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*Many other crustacea of our coast afford similar instances. *Palæmon vulgaris* by its transparency and peculiar tints is scarcely distinguishable among eel-grass; *Idotæa irrorata* imitates in all its varied patterns of color the eel-grass and sea-weeds on which it lives; *I. cæca* imitates the color of sand; two species allied to *Sphæroma* imitate the colors of the rocks and white barnacles among which they live; *Crangon boreas* of the northern coast, imitates the colors of the red Nullipores among which it seeks concealment, as do also several species of *Hippolyte*, *Chiton ruber* and *C. marmoreus*, *Ophiopholis aculeata* and *Ophioglypha robusta*. Numerous other instances might be given.

At Eastport, Me., and Grand Menan during several years past. I have made many observations on this subject, but mostly relating to fishes of which the habits are better known, like the cod, hake, haddock, etc.

The Wolf-fish (*Anarrhicas romerinus*) is not at all particular as to its food. At Eastport I took from the stomach of a large one at least four quarts of the common round sea-urchin (*Eurypechinus Drōbachiensis* V.), most of them with the spines on, and many of them quite entire. From another, I took an equal quantity of a mixture of the same sea-urchin and the large whelk (*Buccinum undulatum*). Many of the latter were entire or but slightly cracked.

The Sculpins not unfrequently swallow entire large specimens of several crabs (*Cancer irroratus*, *Hyas coarctatus*, etc.).

The Haddock is addicted to the same habit, but is a very general feeder, swallowing all sorts of mollusca, worms, fishes, etc.

The Herring (*Clupea elongata*) in the Bay of Fundy feeds very extensively, at least during all the months when I have observed them (June to November), upon several species of *Mysis* and *Thysanopoda*, called "shrimp" by the fishermen. These swim free at and near the surface in extensive "schools" and are persistently pursued by the Herring. The commonest species, apparently a *Thysanopoda*, is about an inch and a half long, of a pale reddish color. The species of *Mysis* are smaller and paler. The two genera often occur together. Young Pollock or Coal-fish, four to ten inches long, pursue the same species in large schools, often coming around the wharves of Eastport in great numbers in eager pursuit of their prey, and by leaping out after them produce a great commotion in the water. When thus pursued the *Thysanopoda* will leap out of the water to the height of a foot or more. The common *Sebastes*, or "Red Perch" at Eastport, feeds upon the same species when they come around the wharves, but probably does not pursue them to the same extent as the herring and pollock.

POLYMORPHIC FUNGI.

BY M. C. COOKE.

It is now generally admitted that a great many fungi, formerly regarded as good and distinct species, are in reality, only conditions

or stages of other forms. It has been proved beyond doubt that many species of fungi are truly polymorphic, appearing under different phases. It is, notwithstanding all this, most premature and unjustifiable to conclude, as some have done, that there are no good species at all, or that there is no certainty whatever in the study. Whilst admitting that many of our old notions have been overturned, that what at one time we hardly deemed possible has been proved to take place, we are not prepared to go the length of some, whose knowledge of the subject falls far short of their assumption. It is not very long since that one writer gravely asserted his opinion that all the British species of *Æcidium*, for instance, would be reduced to a single species; that, in fact, there was no sound specific distinction between them. This opinion originated probably rather in prejudice than as the result of study and investigation. Others have lumped together a host of unassociated species, without satisfactory evidence, and declared them to be only the same thing under different conditions. Hasty generalizations in this, as in other cases, produce more harm than good.

It is exceedingly difficult to trace such minute organisms as fungi, especially moulds, and to prove, without doubt, that they are conditions, the one of the other. It is easy enough to sow the spores of a certain Mucedine on paste, or potato, or any other matrix, cover them carefully, and watch the result; then, if the common *Aspergillus* or *Penicillium* makes its appearance, to some minds it is at once conclusive that the said Mucedine is only a condition of *Aspergillus* or *Penicillium*. Such a conclusion is not only rash, but mischievous, and far from the truth. There is no evidence that the *Aspergillus* or *Penicillium* originated from the spores of the Mucedine which were sown, but perhaps never germinated. When two moulds proceed apparently from the self-same mycelium, judgment may be pronounced too hastily, for the mycelium of both *may* be distinct, though interlaced together; the safest conclusion being based on two forms of fruit when developed upon the same thread. Beyond this, there is always room for doubt. Hence it will be seen how difficult it is to prove dimorphism in moulds under such conditions. In many cases it is more presumption than proof. These remarks are not made with the view of discrediting the conclusions of such observers as Prof. De Bary and the brothers Tulasne, but rather as a caution against assuming as fact that which is only conjecture.

Messrs. Tulasne, in their splendid work, "Selecta Fungorum

Carpologia," have given a great number of instances of polymorphism. We have no reason to doubt that in many cases, perhaps most, they are quite correct, but even some of their conclusions require verification before they can be accepted as established fact. As an illustration of the results determined with regard to one species by these authors, we may instance the very common *Sphæria* (*Plæospora*) *herbarum*. It occurs on the dead stems of herbaceous plants, on the leaves of some trees, and even sometimes on decaying *Algæ*. On pea and bean stems it is usually plentiful. In fact, it is almost the commonest *Sphæria*, and easily recognized. The sporidia are, of course, contained in elongated, transparent, membranaceous asci; they are of a yellowish-brown or amber color, ovate-oblong, and divided by numerous septa, with transverse divisions. The asci are enclosed within carbonaceous perithecia.

Equally as common, and even more so, is a mould which forms sooty or dark olive spots, or patches, on all kinds of decaying vegetable substances. This is called *Cladosporium herbarum*. It may be characterized as cosmopolitan, and one of the commonest, if not the commonest, of fungi. Under the microscope this mould consists of a profuse mycelium, from which arise tufts of jointed threads, mixed with elliptical or elongated spores, ultimately septate. This mould is one condition, according to M. Tulasne, of *Sphæria herbarum*.

Another condition of the same plant is a very pretty mould found mixed with, or parasitic upon, the *Cladosporium*, and known as *Alternaria tenuis*. This species is figured in Corda's "Prachtflora," and consists of chains of spores resembling inverted jointed clubs. The joints are also transversely divided, as in the *Sphæria* sporidia.

A third form of the same species is that named by Rev. M. J. Berkeley, *Macrosporium sarcinula*, which is developed on decaying gourds. The spores are clavate, at length somewhat rectangular, with numerous septa, constricted, and very variable, both in size and in the number of cells.

Besides these, there are certain "distinct papillate, or bottle-shaped cysts, which contain naked spores, capable of germination." So that altogether we have five different forms of fungi, all of which are but stages or conditions of one and the same thing. It is very probable, that, in addition to these, *spermatia* may also hereafter be discovered, or traced to some already known Coniomyce-

tous species. From this example it will be readily understood what we mean when writing of "polymorphic fungi."

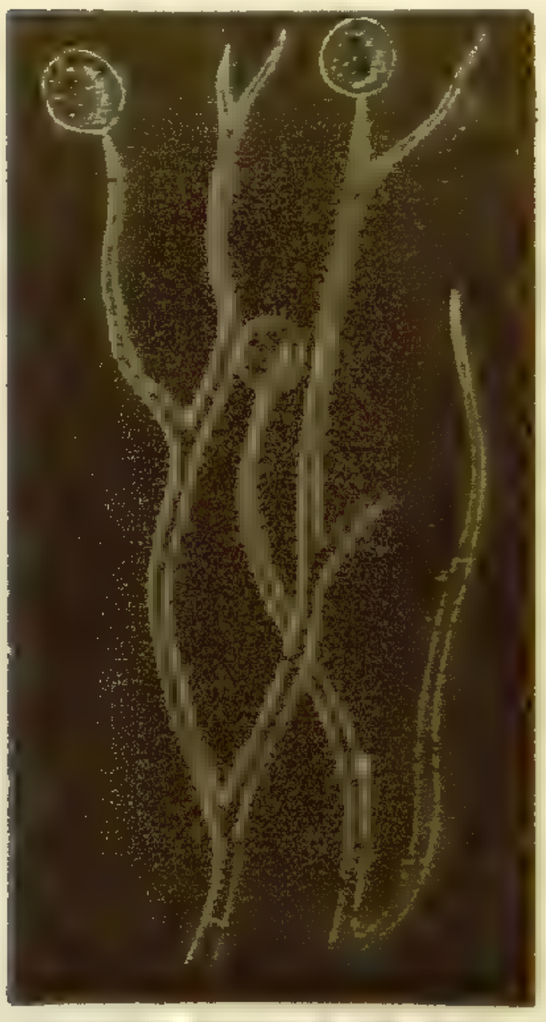
Fig. 76.



Penicillium spurium, considerably magnified; *a*, portion of chain of spores.

Having thus, as it were, defined our terms, we will proceed to notice two instances of apparent polymorphism which have come before us. We say "apparent" advisedly, because in the second instance only suspicions can be predicated. Some two or three years ago, we collected a quantity of dead box-leaves, on which grew a mould named by Link, *Penicillium roseum*. This mould has a roseate tint, and occurs in patches on the leaves; the threads are erect and branched above, bearing oblong, somewhat spindle-shaped, spores. When collected these leaves were examined, and nothing was observed or noted upon them except the Penicillium. After some time, certainly between two and three years, during which the box remained undisturbed, circumstances led to the examination again of one or two of the leaves, and afterwards of the greater number of them, and the patches of Penicillium were found to be intermixed with another mould of a higher development and far different character (Fig. 77). This mould or rather Mucor, for it belongs to the Mucorini, consists of erect branching threads, many of the branches terminating in a delicate, globose, glassy head, or sporangium, containing numerous very minute subglobose sporidia. This species has been named *Mucor hyalinus*. The habit is very much like that of the Penicillium, but without any roseate tint. It is almost certain that the Mucor could not have been present when the Penicillium was examined, and the leaves on which it had grown were enclosed in the

Fig. 77.



Fertile thread of *Mucor hyalinus*, bearing sporangia.

tin box, but that the Mucor afterwards appeared on the same leaves, sometimes from the same patches, and from the same mycelium. The great difference in structure of the two species lies in the fructification. In Penicillium, of which fig. 76 is a good illustration, the spores are naked, and in moniliform threads, whilst in Mucor the spores are enclosed within globose membranous heads or sporangia, as shown in fig. 77. The moulds, or Mucedines to which Penicillium belongs, are included in one of the large families of fungi termed *Hyphomycetes*, and the Mucors belong to another family, the *Physomycetes*. We entertain no doubt whatever, that the Mucor, to which we have alluded as growing on box-leaves, intermixed with *Penicillium roseum*, is no other than the higher and more complete form of that species, and that the Penicillium is only its conidiiferous state. The presumption in this case is strong, and not so open to doubt as it would be, did not analogy render it so extremely probable that such is the case, apart from the fact of both forms springing from the same mass of mycelium. In such minute and delicate structures it is very difficult to manipulate the specimens so as to arrive at positive evidence. If a filament of mycelium could be isolated successfully, and a fertile thread, bearing the fruit of both forms, could be traced from the same individual mycelium thread the evidence would be conclusive. In default of such conclusive evidence, we are compelled to rest with the assumption until further researches enable us to record the assumption as fact.

In Lewis's recent "Report on Microscopic Objects found in Cholera Evacuations" (Calcutta, 1870), a similar instance of presumed dimorphism between precisely the same genera is thus recorded. "On a preparation preserved in a moist chamber, on the third day a white speck was seen in the surface consisting of innumerable 'yeast' cells with some filaments, branching in all directions. On the fourth day, tufts of Penicillium had developed —two varieties, *P. glaucum* and *P. viride*. This continued until the ninth day, when a few of the filaments springing up in the midst of the Penicillium were tipped with a dew-drop like dilatation, excessively delicate—a mere distended pellicle. In some cases they seemed to be derived from the same filament as others bearing the ordinary branching spores of Penicillium, but of this I could not be positive. This kind of fructification increased rapidly, and on the fourteenth day *spores* had undoubtedly developed

within the pellicle, just as had been observed in a previous cultivation, precisely similar revolving movements being also manifested." Here we have another example of a Mucor developed from a Penicillium, and one observation strengthens and confirms the other.

Before entering upon the details of the second apparent polymorphism, it may be as well to give some particulars of the circumstances under which the fungi appeared. It was our fortune — *good* fortune as far as this investigation is concerned — to have a portion of wall in our dwelling persistently damp for some months; it was close to a cistern that became leaky. The wall was papered with "marbled" paper, and varnished. At first there was for some time — perhaps months — nothing worthy of observation except a damp wall; decidedly damp, discolored, but not by any means mouldy. At length, and rather suddenly, patches of mould, sometimes two or three inches in diameter, made their appearance. These were at first of a snowy whiteness, cottony, and dense, just like large tufts of cotton-wool, of considerable expansion but of miniature elevation. They projected from the paper about a quarter of an inch. In the course of a few weeks the color of the tufts became less pure, tinged with an ochraceous hue, and resembling wool rather than cotton, less beautiful to the eye or a lens, and more entangled. Soon after this, darker patches made their appearance, smaller, dark olive, and mixed with, or close to, the woolly tufts; and ultimately similar spots of a dendritic character either succeeded the olive patches, or were independently formed. Finally, little black balls, like small pinheads, or grains of gunpowder, were found scattered about the damp spots. All this mouldy forest was more than six months under constant observation, and, during this period, was held sacred from the disturbing influences of the housemaid's broom, being consigned to the master's care with little compunction, but occasionally it became the subject of remarks not altogether flattering either to the wall or the moulds, or the master who was protector and patron of such a wretched mess.

Curiosity prompted us from the first to submit the mouldy denizens of the wall to the microscope, and this curiosity was increased week by week, on finding that none of the forms found vegetating on nearly two square yards of damp wall could be recognized as agreeing specifically with any described moulds with

which we were acquainted. Here was a problem to be solved under the most favorable conditions, a forest of mould indoors, within a few yards of the fireside, growing quite naturally, and all strangers; could they all be related, or if not, why should all of them appear on that wall for the first time? Whence could these new forms proceed? Were they a new creation? Were they only other conditions of very common things? Certainly here was material for much reflection, perhaps some speculation. Some of the problems are still unsolved.

Fig. 78.



a, Barren thread of *Rhizotricum fusarium*. *b*, Fertile thread; *c*, Portion of fertile thread, showing one of the branchlets with terminal spicules bearing the spores; *d*, a spore detached.

The cottony tufts of white mould which were the first to appear had an abundant mycelium, but the erect threads which sprung from this were all for some time sterile (Fig. 78, *a*); they were slender, very delicate, jointed, and branched; so interlaced that it was difficult to trace the threads throughout their length, or to separate them from each other. Fertile threads were then developed in tufts mixed with the sterile threads, or individual fertile threads appeared amongst the sterile. These latter were rather shorter and stouter, also sparingly branched, but beset throughout nearly their whole length with short, patent, alternate (mostly) branchlets. The branchlets were broadest towards the apex, so as to be almost clavate, and the extremity was beset with two or three short spicules (Fig. 78, *b*). Each spicule was surmounted by an obovate spore (Fig. 78, *d*) attached to the spicule by its smallest end (Fig. 78, *c*). The presence of fertile threads gave the pale ochraceous tint to the tufts already alluded to. This tint was so slight that perhaps it would have passed unnoticed but for the proximity of the snow-white tufts of barren threads. The fertile

flocci, it may be from the weight of the spores, were decumbent. hence the fertile tufts were not much elevated above the surface of the matrix.

This is a most interesting mould belonging to the order of *Mucedines*, but it seemed to agree so little with the characters of any known genus, that, on distributing specimens last year, it was placed provisionally in a new genus under the name of *Clinotrichum lanosum;** since then, with the advice of some mycological friends, it has been referred to the old genus Rhinotrichum, as *Rhinotrichum lanosum*. Without entering here upon the reasons which led to this course, or attempting to discuss generic and specific distinctions, it is sufficient to indicate that the mould in question possessed such positive characters, and was so different from all recognized forms, that it not only had claims to be regarded as a distinct species, but it still remains doubtful whether it should not constitute the type of a new genus.

The mould above described having become established for a week or two, small blackish spots made their appearance on the paper, sometimes amongst thin patches of the mould and sometimes outside them. These spots, at first cloudy and indefinite, varied in size, but were usually less than a quarter of an inch in diameter. The varnish of the paper was afterwards pushed off in little translucent flakes or scales, an erect olivaceous mould appeared, and the patches extended to nearly an inch in diameter, maintaining an almost universal circular form.

This new mould sometimes possessed a dirty reddish tint, but was commonly dark olive. There could be no mistake about the genus to which this mould belonged; it had all the essential characters of Penicillium: erect jointed threads, branched in the upper portion in a fasciculate manner, and bearing long beaded threads of spores, which formed a tassel-like head, at the apex of each fertile thread (Fig. 76). For the benefit of the mycologist, we may observe that, although at first reminded of the *Penicillium olivaceum* of Corda by the color of this species, it differs in the spores being oblong (Fig. 76, *a*), instead of globose, and the ramifications of the flocci are different. Unable again to find a de-

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*CLINOTRICHUM, *gen. nov.* Hyphasma creeping; fertile flocci septate, decumbent, simple, or branched; branchlets alternate, patent, short, bearing at their tips a few spores attached to short spicules; spores simple. Type, *Clinotrichum lanosum*.—Cooke, *Fungi Brit. Exs.* No. 356.

scribed species of Penicillium with which this new mould would agree, it was named *Penicillium chartarum*.

Almost simultaneously, or but shortly after the perfection of the spores of the Penicillium, other and very similar patches appeared, distinguished by the naked eye more particularly by their dendritic form (Fig. 79, *e*). This peculiarity seemed to result from the dwarfed habit of the third fungus, since the varnish, though cracked and raised, was not cast off, but remained in small angular fragments, giving to the spots their dendritic appearance, the dark spores of the fungus protruding through the fissures. This same mould was also found in many cases growing in the same spots amongst *Penicillium chartarum*, but whether from the same mycelium could not be determined.

Fig. 79.

a, Part of chain of spores of *Alternaria chartarum* of Preuss; *b*, spores of *Sporidesmium alternaria*; *c*, supposed early condition of spores of the same; *d*, mode of growth of *Sporidesmium alternaria*, showing mycelium with erect threads and spores; *e*, dendritic patch of *Sporidesmium alternaria*, natural size, showing its habit.

The distinguishing features of this fungus consist in an extensive mycelium of delicate threads, from which arise numerous erect branches, bearing at the apex dark brown opaque spores. Sometimes the branches are again shortly branched, but in the majority of instances are single. The spores are septate, sometimes with two, three, or four divisions, many of them again divided by cross septa in the longitudinal direction of the spore, so as to give a muriform appearance. As far as the structure and appearance of the spores are concerned, they are very similar to those of *Sporidesmium polymorphum*; consequently specimens were published as a variety of that species, but the accuracy of this determination is open to very grave doubts. The mycelium and erect threads are much too highly developed for a good species of Sporidesmium, and certainly so for the species to which they were referred, so that in the "Handbook of British

Fungi" it is named *Sporidesmium alternaria*, for reasons hereafter detailed (Fig. 79, *d*).

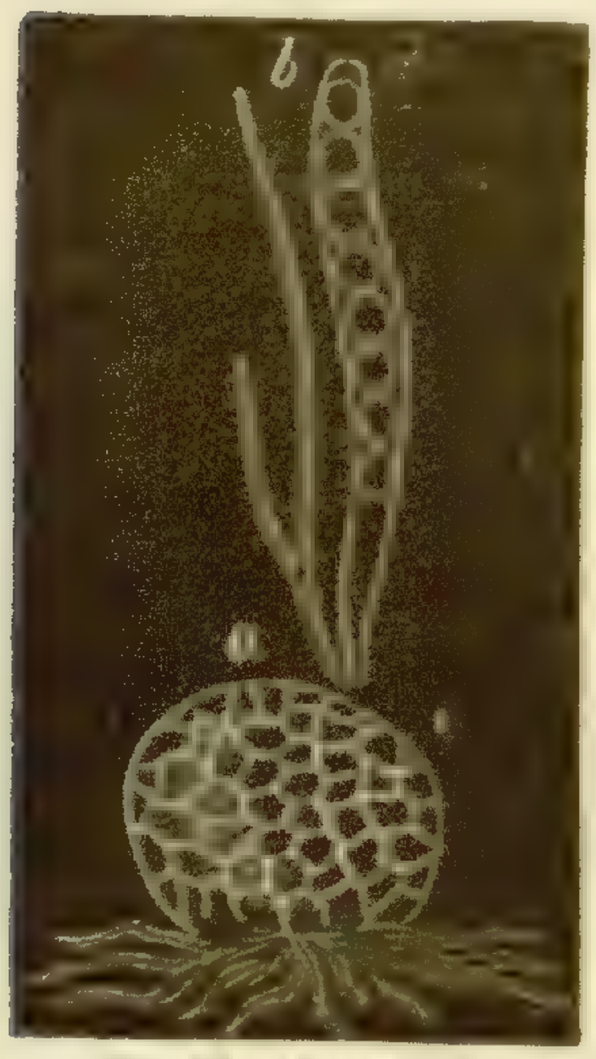
Preuss has described, in "Sturm's Flora," a species of Alternaria in which the spores are attached end to end in a beaded manner, as in other species of that genus, and the spores themselves are just of the character of the spores of our Sporidesmium, as will be seen by reference to, and comparison of, Figs. 79, *a* and *b*.

Preuss's Alternaria, which he calls *A. chartarum*, was also developed on paper, and it is not improbable that it is a more highly perfected form of the Sporidesmium in question. This view is strengthened by the appearance of freshly collected specimens of the Sporidesmium, in which, as seen by a half-inch objective, the spores seem to be moniliform; but if so, the attachment is so slight that all attempts to see them so connected when separated from the matrix have failed. On one occasion a very immature condition of the Sporidesmium was examined, containing simple beaded spores (Fig. 79, *c*), connected by a short neck. There is therefore some foundation for believing that the spores of this species are at first hyaline, simple, and connected together in a moniliform manner by a short apiculus; but, as subsequent search did not reveal any further corroborative evidence, it can only be considered probable. Finally, Mr. C. E. Broome, to whom specimens of the Sporidesmium were submitted, confirmed the observation that, when seen *in situ*, the spores seemed to be beaded.

The last production which made its appearance on our wall-paper burst through the varnish as little black spheres like grains of gunpowder. At first the varnish was elevated by pressure from beneath, then the film was broken, and the little blackish spheres appeared. These were, in the majority of instances, gregarious, but occasionally a few of the spheres appeared singly, or only two or three together. As the whole surface of the damp paper was covered by these different fungi, it was scarcely possible to regard any of them as isolated, or to declare that one was not connected with the mycelium of the others. The little spheres, when the paper was torn from the wall, were also growing from the under surface, flattened considerably by the pressure. We shall call this species, for the sake of distinction, *Sphæria cyclospora*. The spherical bodies, or perithecia, were seated on a plentiful colorless mycelium. The walls of the perithecia, rather more carbona-

ceous than membranaceous, are reticulated, bringing to mind the same structure in Erysiphe, to which the perithecia bear considerable resemblance. The ostiolum is so obscure that we could not be satisfied of its existence, or whether the perithecia are ruptured when mature. It is rather from analogy than positive evidence that the name of Sphæria is given (Fig. 80, *a*). The interior of the perithecia is occupied by a gelatinous substance consisting of long cylindrical sacs or asci, each containing eight globose, colorless sporidia (Fig. 80, *b*). These are accompanied by slender branched threads, called paraphyses, supposed to be abortive asci. At first, and for some time, the perithecia contain only a granular mass, at length mixed with paraphyses. The contents of the fertile asci are also at the first granular, and finally the sporidia are perfected.

Fig. 80.



a, Perithecium of *Sphæria cyclosperma*; *b*, ascus with sporidia and paraphysis.

We have now described, as fully as seemed to be necessary, the four forms of fungi which vegetated during last winter and spring on our damp wall. What presumption have we that they belong to one and the same fungus—direct evidence there is none—or should they be regarded each as autonomous? We have already intimated the difficulties which beset all attempts to obtain positive evidence in such cases. Already too many theories have been based on, or supported by, supposed results from the cultivation of fungi spores. Many ridiculous assertions have been made by those who have thus exhibited their thorough ignorance of even generic distinctions, to say nothing of more complex relations in mycologic science. Still we are by no means prepared to doubt that many of the recorded cases of polymorphism will ultimately be proved to be fact, and that many more will yet be discovered. We would admit that it is possible that none of the species, now included in the two great families of *Coniomycetes* and *Hyphomycetes* are autonomous. But, because it is *possible*, it by no means follows that we are prepared to condemn them by wholesale, or to admit that there is at present any evidence for doubting the autonomy of some entire genera. In the present condition of the study, and in the face of some startling facts, it is important that

all observations should be recorded which bear upon the subject of polymorphism, whilst great care ought to be exercised in the declaration of positive judgment.

Reviewing the instances of association above recorded, and we should prefer, for the present, calling them *association* only, the mind naturally reverts to other and similar recorded instances. Supposing the whole of the four forms described above to be conditions of *Sphæria cyclospora*, there is no greater faith needed to believe it true than in the case of *Sphæria herbarum*. If *Alternaria tenuis* is really a condition of a Sphæria, why not *Alternaria chartarum?* If Alternaria be associated with Cladosporium, why not with Penicillium? Or if *Sporidesmium epochnum*, why not *Sporidesmium polymorphum?* And as for Rhinotrichum and Penicillium, it is just as possible for these to be polymorphic, as for Dactylium, Dendryphium and Verticillium. When the presumption is confirmed by repetition, and more positive relations, there can be no doubt of a much more ready acceptance of their polymorphism than there would have been prior to the investigations of the Messrs. Tulasne and De Bary.

We are unable, within the limits prescribed for this article to explain the relations which subsist between such fungi as the "red-rust" and "mildew" of corn, and the barberry "cluster-cups;" or between the "yellow rust" and the "black brand" of the bramble and rose. In other words, the polymorphism of the *Uredines* and their allies. This is less to be regretted, since there has not, during the past four or five years, been any important additions to our knowledge on this subject and what had previously been discovered and illustrated is very generally known.

If we are asked what deductions we are to make from the facts proved and the presumptions admitted, but not proven, we may answer briefly—that the tendency of recent discoveries, in the relations of one form to another amongst fungi, is to demonstrate that reproduction is not so simple a process in these low conditions of plant life as had hitherto been supposed. "This it is and nothing more."

At one time the word "spore" represented the only recognized organ associated with the multiplication of fungi. Male organs or fecundative power was now and then mysteriously alluded to, but until recently all reproduction was supposed to be confined to a kind of germinative bud which was termed a spore. Each fungus was held to be perfect in itself, and reproduced itself, with

no relation to any other individual, by this means. The change of opinion amongst mycologists is manifested, as much as anything, in the new terms, or the appropriation of terms from other cryptogams, now in vogue. Conidia, spermatia, oospores, zoospores, pycnidia, protospores, etc., all relate to organs but recently recognized in fungi. And however much we may qualify the fact, however much we may doubt the evidence in special cases, we cannot ignore the conclusion that reproduction is very complicated, although very little understood in these extraordinary plants. Whilst admitting that the Cladosporium and the Macrosporium, the Alternaria, bottle-shaped cysts, and minute spermatia are all so intimately related with a certain species of Sphæria, that they can no longer be regarded as plants with a distinct autonomy and independent existence, we are unable to explain the relations which one bears to the other, or by what means each exerts its influence. The field for observation and research is a large one and promises a rich reward; all that is required is earnest and careful workers, in which *this*, of all European countries professing to be scientific, has hitherto been most lamentably deficient. How long shall such a reproach continue?—*Popular Science Review.*

REVIEWS.

Inland Fisheries.—The Report of the Massachusetts Commissioners * contains many items of encouragement for those who advocate restocking our rivers with salmon, trout, shad, alewives, bass, etc. Indeed the great run of shad in the Connecticut in the spring of 1870, has been by popular voice attributed to the artificial hatching of the fish in that river in 1867,—undoubtedly aided, however, by the law prohibiting the small mesh of the nets formerly used, which, being only two and a half inches, caught the fish of one and two years of age and of course at once diminished the catch of large fish. Under the new regulation a mesh of not less than five inches is allowed, and thus only the full

* Fifth Annual Report of the Commissioners on Inland Fisheries. 8vo pamph. pp. 77. January, 1871. State Document.

grown three year old fish can be caught in any number. The close time of thirty-six hours (it ought to be forty-eight), in each week will give these fish a chance to spawn up the river, now that the fish ways are open, and we congratulate our Connecticut fishermen on the good days that are before them, owing to the affection of "Green's shad" (as they have been called, as Mr. Green was the person who stocked the river in 1867) for their place of birth.

Many thousand young fry of the salmon, St. Croix salmon, Sebago salmon, togue and common trout have been placed in the rivers and ponds of Massachusetts and adjoining states during the past year, and we confidently expect to live to see good salmon and trout again abundant in our waters.

Much of the present report is taken up with the work of the Commissioners in bringing the owners of the Holyoke Water Co. to realize the fact that the fishes have a legal as well as natural right to a free passage in our rivers. and the Supreme Court having decided in favor of the fishes we trust that this case will settle all opposition to fish ways, which, as the commissioners state, the owners of dams are fast discovering, practically take little or nothing from their water power.

An account of the breeding and habits of the Black Bass by the late Mr. Tisdale (which we reprinted in our last number), and the valuable remarks made by Capt. Atwood, the veteran fisherman and Senator, on the habits and modes of capture of our sea fishes, conclude this very satisfactory report.

Mr. Atkins in his report as Commissioner of Fisheries of the State of Maine* enters very fully into the subject of fish ways, and in a most practical and common sense manner tells us what has been done, and still better, of the decided success of all the fish ways that were completed in time for the fish ascending during the season of 1870. From this report it can no longer be a matter of doubt but that properly constructed fish ways can be made at no very great cost, which not only will furnish a free passage to the fish, but also without materially injuring the water power of the parties owning the dams. Now that these points are secured practically, we shall hear but little about the "theory" regarding fish ways. Their construction on every salmon, shad and alewife

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*Fourth Report of the Commissioner of Fisheries of the State of Maine, for the year 1870. 8vo pamph. pp. 56. 2 plates. State Document, 1870.

river and stream in the country is now only a matter of time, for as it is proved that their construction is now simply a matter of dollars and cents, and also that the interest received by the community is very large on the small capital required to be invested, the most penurious of dam owners will be forced by public sentiment to keep the fish ways, which the laws oblige them to build, in good repair.

Mr. Atkins also enters into the question of "close time" and shows that far better results would be attained by giving up the close time at the mouths of rivers and substituting a law regulating the depth of seines and pounds, thus allowing a portion of the fishes a chance to escape the nets and ascend the river. As it is impossible to enforce the present law without breaking up the fisheries, this proposed change seems to us a very wise and practical way of aiding the unjustly treated fishes in their eternal "struggle for existence."

An appendix to the Report gives an account of the fish breeding establishment of the Canadian Government, situated on Wilmot's Creek and under the charge of Mr. Samuel Wilmot. The two plates illustrating the various plans of fish ways in use in this country and in Ireland, will be found of much practical benefit to persons engaged in their construction.

Mr. Robert B. Roosevelt, who, of the three commissioners, seems to be the "writing man," assisted by Mr. Seth Green, who is preëminently the practical "fish breeder" of the United States, has given an interesting report of the work accomplished by the New York Commissioners during 1870. *

Mr. Green was sent up the Hudson in May, for the purpose of obtaining shad spawn for stocking the river above the Troy dam, but owing to there being no "close time" on this river, and the consequent capture of about all the shad at its mouth, Mr. Green only succeeded in obtaining a few ripe fish (many days not getting any, and the best day's fishing only brought him twelve). From what he did get he hatched out and put in the river about two and a half million of young fry, or "more than double the entire yearly yield of shad on the whole river." As a commentary on the condition in which Mr. Green found things on the Hudson, he simply states that unless a weekly close time of one or two days

* Report of the Commissioners of Fisheries of the State of New York, for the year ending Dec. 31, 1870. 8vo pamph pp 32. State Document 1871

is enforced a net might as well be stretched entirely across the river and the fishery declared extinct. In which we think he is about right, for what use will it be to restock the rivers unless we have laws prohibiting excessive fishing, either by allowing the fish an unobstructed passage up the river for one or two days each week, or by not allowing the use of anything smaller than five inch mesh, and limiting the depth of all set nets, as proposed by Mr. Atkins.

During the year a large state hatching house was erected at Caledonia and placed under the charge of Messrs. Green and Collins, who very successfully carried out a number of experiments and hatched a large number of fish of various kinds. The attempt was made to hatch the spawn of the pike perch (Lucioperca) of Lake Ontario, but with little success, owing to the eggs being surrounded by a sticky substance and adhering so firmly together and to the sides of the pans as to prevent their being detached without destroying them. By constantly stirring the eggs for forty minutes after impregnation, Mr. Green succeeded in hatching a few. In a natural state he thinks the eggs are scattered as laid and adhere singly to the gravel, etc.

The experiment was tried of impregnating the eggs of the salmon trout with the milt of the white fish, and the eggs were hatched, bringing forth hybrids that have characters of both parents, which, at the time of writing the report, were thriving well. These fish will probably grow to good size, and may prove a very acceptable table fish, but it is hardly probable that they will be capable of continuing the race, as they are generic and not specific hybrids.

The Commissioners have hit upon the following expedient for obtaining young black bass and several other (they write it *hundreds*) species of fresh water fishes.

"Although no means of hatching black bass and hundreds of other species has yet been discovered, another method was found for reaching substantially the same end. Every year large numbers of various kinds of bass and other fresh water fish pass into various State canals, either when they are very young, or else they spawn there and raise their young, which attain the size of four to six inches during the summer and by the fall, when the canals have to be drawn off preparatory to the cold weather.

Heretofore, when the latter event occurred, the larger fish were taken from the holes and indentations in the bottom by the fisher-

men, with their nets, and sent to market, while the smaller fry were left to perish on the shore, or, when the holes dried up, to be frozen to death by the increasing severity of the winter.

Instead of permitting this terrible waste of valuable material, the commissioners made arrangements for saving a greater part of these little fish, and for distributing them throughout the waters of this State, whenever they are needed or can be used to advantage. In this way they have reached what bids fair to be an inexhaustible supply of fish that have heretofore defied the breeders' art."

This grand supply ground has been, by vote of the Canal Commissioners, placed entirely at the disposal of the Fish Commissioners.

The Fish Commissioners have also received authority from the Park Commissioners to use the ponds in Central Park for the purpose of experimenting on foreign fresh water fishes with the hope of introducing valuable species to this country. With this end in view they have started the experiment with the carp, so extensively used for food in Europe. Mr. Frank Buckland, the English Fish Commissioner, having promised his services. Mr. Roosevelt's letter to Mr. Buckland, however, shows that the New York Commissioners are not very well informed as to American ichthyology, as the following extract will exhibit.

"The carp of all the eastern waters of America is a small, comparatively worthless fish, while the western carp is little known, its habitat not being even established, and it has never been described scientifically. In fact, if I had not seen it personally, I might almost doubt its existence. The European fish, on the contrary, is a large, fine fish, as we are informed, and will probably bear transportation as easily as the gold fish, which, as you know, is a similar species."

Perhaps in the next report we shall be informed *what* species of fishes are intended under the names of the *carp of all the eastern waters*, and the little known *western carp* that has *never been described scientifically!* As there are no species of the true carp genera (*Cyprinus** and *Carassius*) indigenous to North America,

*There are two distinct species of fishes known as "Carp" in Europe. The true carp, *Cyprinus carpio* Linn., which is a native of Asia and was *introduced* to Europe, has always been kept in a more or less domesticated condition, producing several varieties and hybrids. This is the carp, or Cyprinus, of the early writers. The other species is the *Carassius vulgaris*, the *Cyprinus carassius* of Linnæus. This species is called the "Crucian" or Crucian Carp etc., and is a native of temperate Europe and Asia, and very extensively domesticated and employed for food. Its close ally is the Gold fish or Golden carp, *Carassius auratus*, which has been introduced from China and domesticated in all civilized countries.

and as the Western fishes usually called carp belong to the sucker family and are pretty well known to ichthyologists, we are somewhat surprised at the broad statement made by Mr. Roosevelt to the contrary. Then the Commissioners seem to be quite neglectful in not looking up the stock of carp which, according to a letter published in DeKay's "Fishes of New York" (p. 189), were introduced in 1831 and '32 by Henry Robinson, Esq., of Newburgh, Orange Co., N. Y. Mr. Robinson states that he put some six or seven dozen carp, which he brought from France, into his ponds, and that "they increased to a superior degree" and (in 1841) he had "more than sufficient for family use." It is hardly possible that the Robinson fish could have become exterminated, as they seem to have thrived well, and Mr. Robinson also states in his letter that "For the last four years past, I have put from one to two dozen carp every spring in the Hudson river near my residence. They have increased so much that our fishermen frequently take them in their nets. They are larger than those in my ponds." In "Frank Forester's Fish and Fishing" (1851) p. 166 an account of these carp is given, and mention made of a law of the state protecting them for five years, etc. This is certainly a matter worth looking into by the State Commissioners.

The Report closes with several characteristic letters from Mr. Green.

THE MAY FLIES.*—This elaborate work is of use to entomologists generally as it gives a list, with brief descriptions, of many foreign species, and hence will be of much use in America. It will evidently prove, when completed, to be the standard work on this interesting family, and with its excellent plates, full synonomy and many critical notes, is a great step in advance of any paper yet published on this group. The author finds that the study of alcoholic specimens is absolutely necessary for characterizing the species, as the bodies shrivel in drying. We hope the students of other groups of delicate-bodied insects will follow Mr. Eaton's excellent example, and that insects preserved in alcohol will be found in all our entomological collections.

The number of described recent species of this family is about one hundred and seventy-eight, of which fifty-three are found in

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*A Monograph on the Ephemeridæ. By the Rev. A. E. Eaton. Part I. The Nomenclature of the Ephemeridæ. (From the Transactions of the Entomological Society of London, 1871.) 8vo. pp. 164, with six plates.

the United States and British North America. There are three fossil species determinable, the oldest being from the Oolite formation at Solenhofen. The author gives a list of species of fossil insects which have been at various times and by different observers referred to this family. They are from formations older than the Tertiary, mostly the Carboniferous. Among them are the strange forms described as Dictyoneura, Eugereon, Miamia, Hemeristia, Haphlophlebium, Platephemera, Homothetus, Xenoneura, Gerephemera and Lithentomum. He says that "Platephemera and Homothetus may possibly be of the Ephemeridæ, but there is nothing in the figures to make this certain, and there is no reason for considering that Xenoneura belongs to this family." He then remarks:—

"Palæontologists have adopted a ridiculous course with regard to some insect fossils. Whenever an obscure fragment of a well-reticulated insect's wing is found in a rock, a genus is straightway set up, and the fossil named as a new *species*. The species is then referred to the Ephemeridæ, and is immediately pronounced to be a synthetic type of insects, at present distantly related to one another in organization. This enunciation of synthetic types is often nothing less than a resort to random conjecture respecting the affinities of animals which the writer is at a loss to classify. An insect allied to the Ephemeridæ which chirped like a Locust (such as Xenoneura is imagined to have been) is a tolerable sample of these synthetic types. When a fossil comprises only a fragment, or even a complete wing of an Ephemerid, it is hardly possible to determine the *genus*, and impossible to assert the *species*. The utmost that can be learned from such a specimen is the approximate relations of the insect. Neuration by itself is not sufficient to define the species or even the genera of recent Ephemeridæ.

This criticism on the labors of palæontologists seems to us, considering the great difficulties of the subject they have to deal with, scarcely fair, though perhaps in part deserved. That synthetic, or comprehensive, or generalized types exist among the vertebrates, as for instance the Archæopteryx, the pterodactyles, the palæozoic fishes; and others among the radiates and molluses, our critic would not probably deny. And among the palæozoic insects, genera such as Eugereon, Dictyoneura, and Palephemera, are not considered as generalized types simply as a device of the puzzled and distracted entomologist for a means of escape from coming to any decision. These "random conjectures" are, if such, due to the

singularly comprehensive character of many of the fossil remains of Carboniferous and Devonian times; and it is by the study of these fragments of wings that we are gradually coming to a better knowledge of the links uniting the families of the Neuroptera (in the Linnæan sense) and that the great differences in opinion between entomologists regarding the classification and position in nature of the Orthoptera and Neuroptera are to be settled. We would inquire what would recent zoology be without the "obscure fragments" left us of Palæozoic life? The inference forced upon us from their study is that the earlier forms of life were more generalized than now, and thus, in all probability, were the primitive stock or ancestral forms, which have been by evolution differentiated into the forms now living.

We would inquire also whether one is not safe, or whether it would not be safer in practice, to consider a fragment of a Palæozoic, or earlier Mesozoic insect's wing as belonging to a different species or genus from any now living, if the fragment does actually differ from corresponding portions of any living species with which it may be compared?

We quote the following useful remarks on the preservation of these insects for study. "In drying, the color and form of Ephemeridæ soon change. Color is of little importance, even in fresh examples; but form is necessary to the distinguishing of the species. They are, therefore, best preserved in a liquid. It is sufficient for ordinary purposes to dip the freshly killed specimen into dilute spirits, and then transfer it to a tube, or homœopathic globule bottle, partly filled with water. Next, Price's glycerine is added to the water—one or two drops a day—until the bottle is gradually filled. A small drop of acetic acid may be added finally, to prevent the growth of mould. The name of the species may be written on the disk of the cork, the date and locality of capture round its side. Hind-wings of the species of Baetis and Centroptilum should be mounted on slips of grass, for microscopical examination. Pinned specimens are often difficult to determine, in consequence of their shrinking; to card them is to render them fit for nothing."

Why does our author always call the larva a "nymph?" Does not this term apply to the pupa alone? The remarks on the principal points to be studied in the young and adult of these insects are capital.

ARRANGEMENT OF THE FAMILIES OF MOLLUSKS.* — This list of the families, orders and classes of mollusks, "prepared at the request of the Smithsonian Institution, for the purpose of facilitating the arrangement and classification of the mollusks and shells of the National Museum" is an exceedingly useful one, and every conchologist will find it indispensable in arranging his specimens. Dr. Gill states in the introduction, that "it must be considered simply as a provisional list, embracing the results of the most recent and approved researches into the systematic relations and anatomy of those animals, but from which, innovations and peculiar views, affecting materially the classification, have been excluded."

Those who have attempted the compilation even of a list of the groups of a class or higher division, know well enough the difficulties attending its preparation, and our author has not attempted it without giving the result of researches covering a number of years. He is assisted in some groups by Mr. Dall. Dr. Gill admits the division of the mollusks into two primary groups, the *Molluscoidea vera* and *Molluscoidea*, the latter embracing the Brachiopoda and Polyzoa.

Now that several continental zoologists, among them Leuckart and Gegenbaur, have placed the Polyzoa among the worms, and Prof. Morse has considered the Brachiopods as a division of Annelids, a change alluded to by Dr. Gill, the time may come when these two classes will not be mentioned in conchological works.

But as it will be long before such revolutionary views, should they prove correct, will be adopted, it is most expedient in such an arrangement as this to let them go under the provisional name of Molluscoidea.

Malacologists will be interested in the remarks on the different groups, the classes, orders, etc., containing as they do many valuable suggestions as to the general classification of the subkingdom. We trust that similar lists will be prepared by specialists in other departments, and published by the Smithsonian Institution.

ASYMMETRY IN INSECTS.† — While many of the molluscs are fair examples of asymmetrical animals, as seen in the shells as well as

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* Arrangement of the Families of Mollusks. By Theodore Gill, M. D. Smithsonian Miscellaneous Collections 227. Washington, D. C., Feb. 8, 1871. 8vo. pp. 49.

† On Asymmetry in the Appendages of Hexapod Insects. By S. H. Scudder and E. Burgess. (From the Proceedings of the Boston Society of Natural History.) 1871. 8vo. pp. 24, with a plate.

the bodies of these animals, and while in most of the radiates it is difficult to detect any line dividing their body into halves, the insects, and indeed all the articulates, are as a rule symmetrical, one-half of the body, together with its appendages, exactly repeating the opposite. As our authors remark, however, some of the Crustacea are asymmetrically developed, and they give as examples, the entire body of Bopyrus and Peltogaster, low parasitic forms, and the claws of many Decapods, such as the lobster and many species of shrimps. They further remark:—

"We are not aware that any cases of asymmetry have been recorded among the worms; and certainly very few among insects; there are occasionally slight differences in the right and left mandibles of some mandibulates [such as beetles], and Coccus has recently been referred to by Gerstaecker as an example of asymmetry, without further specification; we have been unable to discover to what he refers. Loew, also, in the first of his monographs of the North American Diptera, states that the hypopygium (the external genital armature) of the males of Syrphidæ and Pipunculidæ is unsymmetrical."

A figure of this organ, belonging to a species of fly, Phora, is given in illustration, with the left clasp very much stouter and somewhat longer than the right one.

In studying the external genital organs of the males of Nisoniades, a genus of butterflies belonging to the skippers, a most remarkable asymmetry was detected between the opposite clasps of the same individual. This is found more or less marked in all the species yet known, the left clasp "with some minor exceptions," being always more highly developed than the right.

It is difficult to account for this asymmetry. The males are much more numerous than the other sex, and the authors are inclined to think that "the excessive development of these parts in the male, is in correlation with their superior numbers, ensuring beyond doubt, the impregnation of every female; we do not, however, see how asymmetry gives any superior advantage." A description of these parts in the different species follows, and eleven new species are described. It is a pity that other than these secondary sexual characters were not added for the better discrimination of the species of so large and difficult a genus—but further descriptions of the new forms are probably reserved for another occasion.

RECORD OF AMERICAN ENTOMOLOGY FOR 1870.*—This useful index to our entomological literature published during the year 1870, forms a much thinner pamphlet than its predecessors. We are not, however, to infer from this that entomology is on the decline in this country, as we must expect some variation from year to year in the degree of attention to this study. The number of entomologists who have published articles of varying length is thirty-five, while three hundred and one new species of insects have been described in American journals during the year. We hope entomologists will continue as before to give this enterprise a cordial support, as the "Record" is by no means self supporting. Public libraries should have these annual records, as they are valuable for reference and relate to a large and growing department of zoology.

NEW ORNITHOLOGICAL WORKS.—A new edition, the fourth, of "Yarrell's History of British Birds," is now in course of publication by Van Voorst, under the editorship of Prof. Alfred Newton, the well known ornithologist, and Professor of Zoology in the University of Cambridge. The work is issued in monthly parts of eighty pages each, at 2*s* 6*d* a part. It is expected that twenty-five parts will complete the work, which will be comprised in three octavo volumes containing nearly six hundred illustrations. The names used by Yarrell in the former editions will be retained, but at the same time the nomenclature will be brought up to the present requirements of ornithological science, and all birds that have been found to be inhabitants of the British Isles since the time of Yarrell will be given.

A much larger and more pretentious work is the "History of the Birds of Europe, including all the species inhabiting the Western Palaearctic region," by R. B. Sharpe and H. E. Dresser.

This work, of which two parts are now ready for delivery, is to be issued in monthly parts of quarto size with colored plates. All the birds of Europe, amounting to about six hundred species, will be figured in their different stages of plumage, a plate being devoted to each species. Each annual volume will contain one hundred plates, with full descriptions of the species and remarks on the habits, geographical distribution, synonymy, etc.

The unrivalled facilities at the command of the authors, and the

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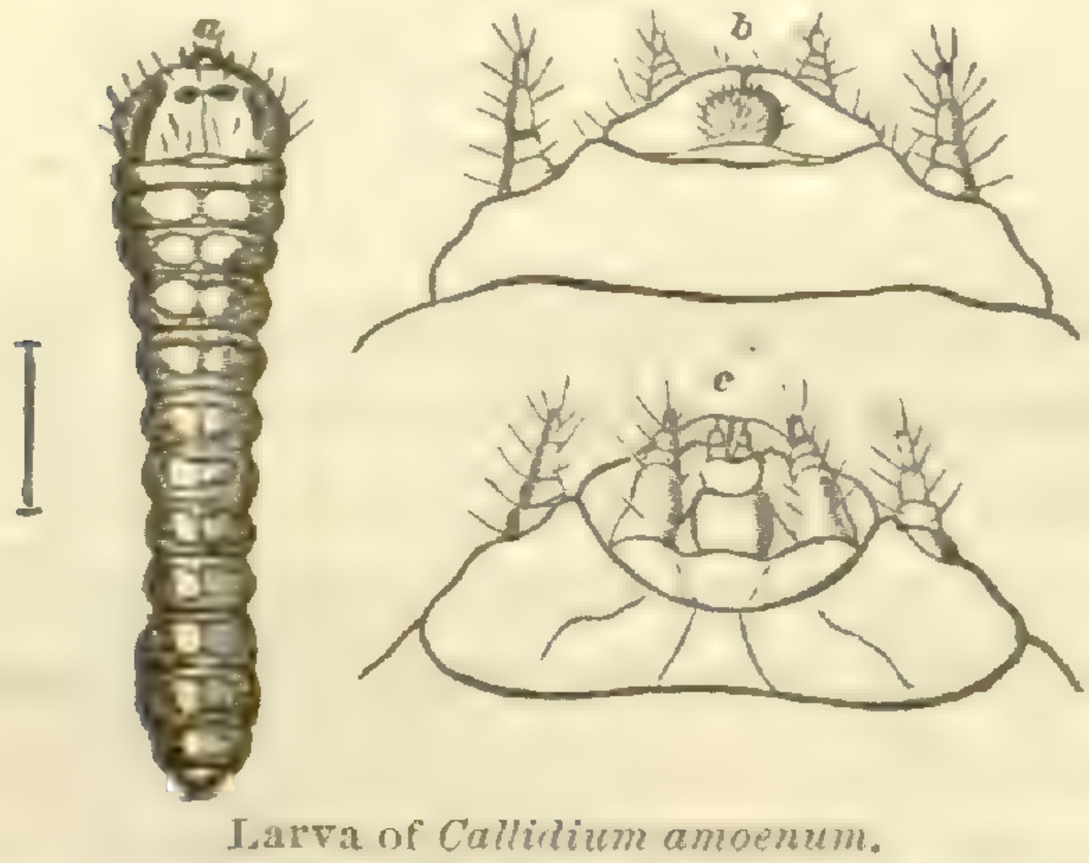
*Published by the Naturalists' Agency, 1871. 8vo. pp. 27. Price 50 cents. The Records for 1868, '69 and '70 for $1.50.

assistance guaranteed them by all the leading ornithologists of Europe, with the support of a good list of subscribers, will make the work a decided success in every way. Both the authors are well known as practical field naturalists, and the successful manner in which Mr. Sharpe has just completed his "Monograph of the Kingfishers" is sufficient evidence that the work will be carried through the press in the best manner possible.

As the work will hardly be accessible for the private libraries of most of the ornithologists of our country, owing to its necessarily high cost, it should have a place in all our large libraries, where those who cannot afford to own the work, can at least have a chance of consulting its pages: and as many of our birds are identical with those of Europe, and many others very closely allied, it will become the duty of every one engaged in the study of birds to consult this splendid monograph. The work is published by the authors, by special permission, at the office of the Zoological Society of London, where we should be pleased to forward the names of subscribers.

Economic Entomology in Massachusetts.*—This first report on the injurious and beneficial insects of Massachusetts opens with some general remarks on the losses sustained by insects. In this country alone they are estimated at not far from five hundred

Fig. 81.



Larva of *Callidium amoenum*.

Fig. 82.



Drepanodes juniperaria.

million dollars annually, of which amount, at least one-tenth, or fifty millions, could probably be saved by human exertions, were

*First Annual Report on the Injurious and Beneficial Insects of Massachusetts. By A. S. Packard, jr., M. D. Entomologist to the State Board of Agriculture. Boston, 1871. 8vo. pp. 31. Extracted from the Annual Report of the Secretary of the Mass. Board of Agriculture, from which the illustrations here used were taken.

farmers made better acquainted with the habits of insects and the best means of combating them.

Fig. 83.



Larva and Pupa of *Irrepanodes juniperaria.*

Then follows an account of the European saw-fly (*Nematus ventricosus*. fig. 88, larva, *a*, enlarged; 89, *a*, male; *b*, female) doing so much damage in the state. It is stated that June 29th the worms of the second brood were spinning their cocoons. It might be added that in the first and second weeks of August the worms were still on the bushes in Salem, and the females of the second brood were laying eggs for a third brood of worms. This destructive saw-fly is now pretty well distributed over New England. At Orono, Maine, early in July they were very destructive, and had been so the year previous. Another very destructive insect, the Rape caterpillar, *Pieris rapæ*. (Fig. 86, male; 87, female; 85 *a*, larva, *b*, chrysalis) which annually does two hundred and fifty thousand dollars worth of damage to the cabbage crop about Quebec alone, is now abundantly distributed over New England, and southward as far as New Jersey. During the last two years it has been common at Orono, Maine.

Fig. 84.



Cedar Borer (a).

Fig. 85.



A new insect is described as infesting the limbs of the apple tree. It is the *Leiopus linctus* of Say (fig. 91). The larva can scarcely be distinguished from that of a species infesting the prickly ash, the *L. xanthoxyli* Shimer (Fig. 92 90 *a*, larva, *b* upper, and *c* under side of the head.) A somewhat similar borer which injures the grape vine is noticed. This is

Fig. 86.



Rape Butterfly, male.

Fig. 87.



Rape Butterfly, female.

Fig. 88.



Larva of Currant Saw Fly.

Fig. 89.

Currant Saw Fly.

Fig. 90.

Larva of *Leiopus Xanthoxyli.*

Fig. 91.



Letopus facetus.

Fig. 92.

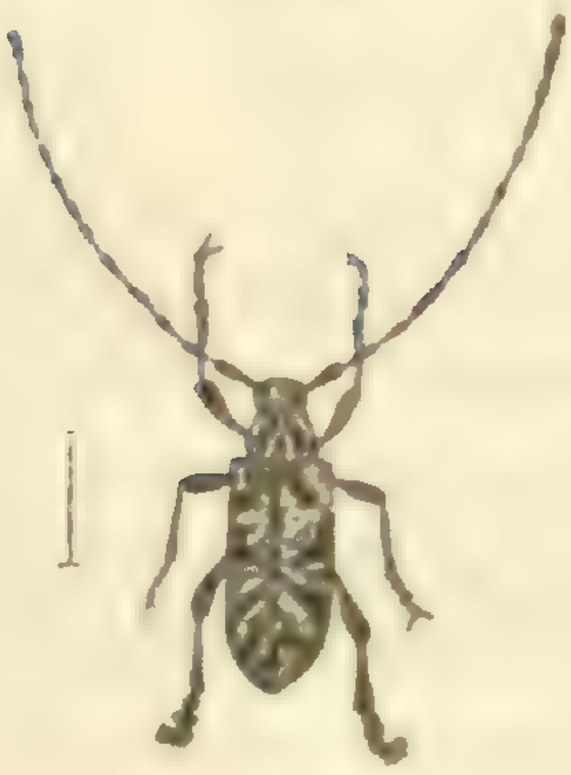


Fig. 93.



Larva of *Corydalis lateralis.*

Fig. 94.



Larva of *Galerita Janus.*

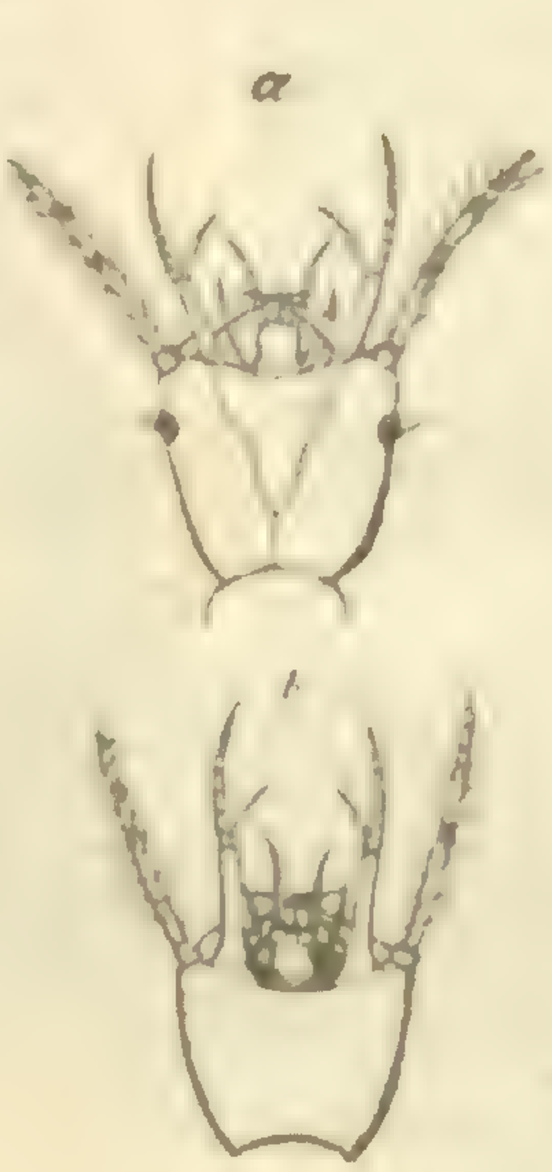
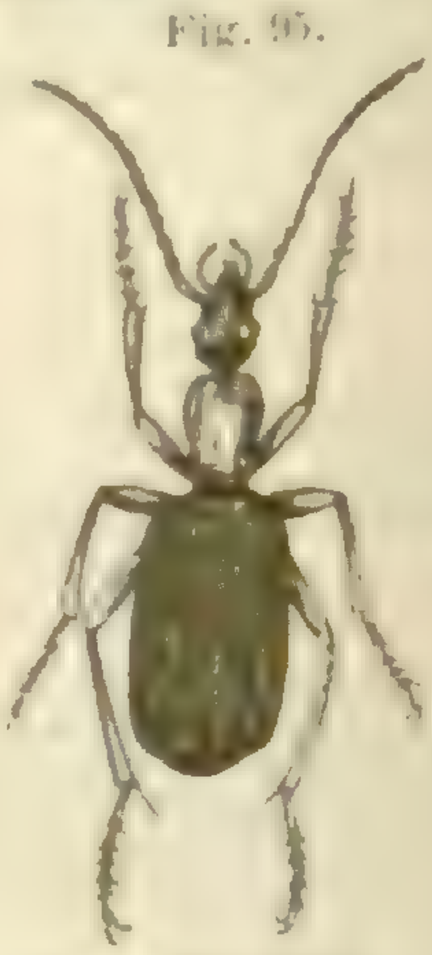


Fig. 96.



Telephorus bilineatus and larva.

Fig. 95.



Galerita Janus.

Fig. 97.



Larva of *Telephorus bilineatus.*

Fig. 98.



Callidium amœnum.

the *Callidium amœnum* Say (fig. 98). Its larva is represented by figure 81, *b*, upper, *c*, under side of the head.

One of the most wonderful cases of mimicry is that of a new span worm *Drepanodes juniperaria* Pack. (fig. 82; 83, larva and chrysalis) which can with difficulty be distinguished from the twigs of the juniper tree on which it feeds.

The cedar also has been found to be infested by a small Tinean, closely allied to the Apple Bucculatrix. This is described as the *B. thuiella* (fig. 84, enlarged; *a*, cocoon, nat. size). The transformations of *Telephorus bilineatus* Say (fig. 96; larva, enlarged, and adjoining fig. 97 showing *a*, upper, and *b*, under side of the head) are also described. The larva was identified by Mr. P. S. Sprague, who found it under stones in spring, where it changes to a pupa, and early in May becomes a beetle, when it eats the leaves of the birch.

Fig. 99.



Larva of Didymops?

Among beneficial insects are mentioned the ground beetle, *Galerita Janus* Fabr. (fig. 95) whose singular larva (fig. 94, *a*, upper, *b*, under, side of the head), was discovered by Mr. J. H. Emerton under stones early in July. The larvæ of two dragon flies, *Cordulia lateralis* (fig. 93) and a species of Didymops? (fig. 99) are also noticed.

NATURAL HISTORY MISCELLANY.

BOTANY.

The Number of Plants and Animals.—The days of a Systema Naturæ, or single work containing a synopsis of the genera and species of organized beings, are long since passed away.

Even a Species Plantarum, now that their number at the lowest estimate exceeds one hundred thousand, has become almost hopeless. The last attempt, De Candolle's Prodromus, has been nearly forty years in progress, the first portion has become quite out of date, and all we can hope for is that it may be shortly completed for one of the three great classes of plants. Animals might have been more manageable were it not for the insects. Mammalia estimated at between two and three thousand living species, birds at about ten thousand, reptiles and amphibia under two thousand, fishes at about ten thousand, crustacea and arachnida rather above ten thousand, malacozoa about twenty thousand, vermes, actinozoa, and amorphozoa under six thousand, would each by themselves not impose too heavy a tax on the naturalist experienced in that special branch who should undertake a scientific classification and diagnosis of all known species. In one important branch, indeed, the fishes, this work has been most satisfactorily carried out in Dr. Günther's admirable Genera and Species of all known fishes published under the misleading title of "Catalogue of the Fishes in the British Museum," and recently completed by the issue of the eighth volume. The sound philosophical views expressed in his preface to that volume (which, by some strange inversion, bears a signature not his own) can be appreciated by us all, and zoologists are all agreed as to the care with which they have been worked out in the text. Insects are, however, the great stumbling-block of zoologists. The number of described species is estimated by Gerstaecker at above one hundred and sixty thousand, viz.: Coleoptera, ninety thousand; Hymenoptera, twenty-five thousand; Diptera, twenty-four thousand; Lepidoptera, twenty-two to twenty-four thousand. Mr. Bates thinks that, for the Coleoptera at least, this estimate is too high by one-third, but even with that deduction the number would exceed that of plants, and it is probable that the number of as yet undiscovered species in proportion to that of the described ones is far greater in the case of insects than of plants. We can therefore no longer hope for a Genera and Species of insects, the work of a single hand, or indeed guided by a single mind. The great division of labor, however, now prevalent among entomologists may procure it for us in detail, with one drawback only, that the smaller the portion of the great natural class of Arthropoda to which the entomologist confines his attention, the less he will be able to appreciate the significance of

distinctive characters, and the more prone he will be to multiply small genera—that is to enhance beyond their due value the races of the lowest grades—to the great inconvenience of the general naturalist who has to make use of the results of his labor.

A Genera Plantarum is still within the capabilities of a single botanist, although he must, of course, trust much to the observations of others, and it therefore cannot be so satisfactory as if he had examined every species himself. The last complete one was Endlicher's, the result of several years' assiduous labor, but now thirty years old. Dr. Hooker and myself commenced a new one, of which the first part was published in 1862, and which might have been brought nearly to a close by this time had we not both of us had so many other works on hand to deter us, although the researches necessary for these other works have proved of great assistance to the Genera. As it is, the part now nearly ready for press carries the work down to the end of the Compositæ, or about half through the Phænogamous plants. In regard to works of a still more general description, the exposition of the families or orders of plants, we have nothing of importance since Lindley's "Vegetable Kingdom," dated 1845, but republished with some additions and corrections in 1853, and Le Maout and Decaisne's "Traité Générale," mentioned in my address of 1868, and of which Mrs. Hooker is now preparing an English translation, under the supervision of Dr. Hooker. Dr. Baillon has also commenced a "Histoire des Plantes," containing a considerable number of useful original observations, and illustrated by excellent woodcuts, but as a general work, one portion is of too popular a character, and in some cases too diffuse to be of much use to science, and the generic character too technical for a popular work without any contrasted synopsis, and its great bulk in proportion to the information conveyed will always be a drawback. I cannot believe that the author can have been a party to the unblushing announcement of the French publisher, that it is to be completed in about eight volumes. If carried out on the plan of the first one, it must extend to four or five times that number. In Zoology, Bronn's most valuable "Klassen und Ordnungen der Thierreichs," continued after his death by Keferstein and others, which I mentioned in my address of 1866, has advanced but slowly. The Amorphozoa, Actinozoa, and Malacozoa, forming the first two volumes, were then completed, and Gerstaecker has since been proceeding with

the Arthropoda, commencing with the Crustacea for the third volume, of which only the general matter and the Cirripedia and Copepoda are as yet published, and three or four parts of a sixth volume for birds have been issued by Selenka, treating the anatomical and other matters in great detail. Another general work of merit, although on a smaller scale, has been proceeding as slowly. Of Carus and Gerstaecker's "Handbuch der Zoologie," the second volume, containing the Arthropoda, Malacozoa, and lower animals, had been already published in 1861, and to this was added in 1868 the first half of the Vertebrata for the first volume, with a promise that the remainder should appear in the autumn, but which promise has not yet been fulfilled. Among the other recently published systematic zoological handbooks of which I have memoranda as published in various Continental states, the most important are said to be Harting's, published at Kiel, in the Netherlands, of which up to 1870 only three volumes had appeared, containing the Crustacea, Vermes, Malacozoa, and lower animals; A. E. Holmgren's "Swedish Handbook;" Zoology, of which Mammalia were published in 1865, and Birds in 1868 to 1871; and Claus's "Grundzuge," and Troschel's "Handbook" (7th edition) for University Teaching in Germany. — Bentham. Annual Address to Linnean Society, published in *Nature*.

Spontaneous Double Flower of Nymphæa tuberosa. — Dr. E. M. Hale of Chicago sends a flower of the Western White Water-Lily, having apparently only the ordinary number of petals, but no stamens and pistil whatever. If cared for it is likely that the root would soon send up flowers with an increased number of petals, like a full double rose. Unfortunately this species lacks the perfume of N. odorata.

ZOOLOGY.

Origin of Species. — Professor Hyatt alluded at a late meeting of the Boston Society of Natural History, to the color of the common Unios and Anodons as probably protective, and the well-known case of the Melanias of the Western rivers, which are hardly distinguishable to the unpractised eye, and to the peculiar and marked variations of the siluroid fishes of the same region, which

agree very closely with the ground on which they live. Professor Hyatt added that he by no means desired to indorse the Darwinian doctrine of natural selection. A belief in evolution and the derivation of all higher forms from lower and simple organisms, perhaps from inorganic matter itself, by means of secondary natural forces, is perfectly consistent with opposition to the Darwinian theory. According to this theory, new characteristics and therefore new kinds and species of animals arise by the survival of the fittest; as in a recent instance cited by the AMERICAN NATURALIST, where a new race of deer is supposed to be in course of formation in the Southern Adirondacks. In this case certain full-grown bucks about thirteen years ago were produced with short, stabbing horns like the young deer. These were thus enabled to drive away the branching-horned forms during the rutting season, and to leave a larger number of descendants. These and their descendants, in turn enjoying similar advantages, are, it is stated, gradually supplanting the branching-horned deer in this locality. The facts have been disputed, and need the confirmation of further observation and experience; but they form, perhaps, one of the best illustrations of the theory of natural selection ever recorded. Assuming, however, that it is true, and that a new species of deer is now being evolved in this region, what does natural selection really account for? It must account for the preservation and perpetuation of the branching-horned variety, as well as the rise of the straight-horned.

The Anoplotherium of the Eocene, which has always been considered by Owen and others as the probable ancestor of the *Cervidæ*, had no horns, even in the adults. The young deer, when it is born, has none and the process by which they are acquired takes place subsequently. The general characteristics of the deer antlers of the Miocene and Pliocene were simple, with only one tyne or prong like those of the young deer, and the palmate and extensively pronged were not brought out fully until the post-pliocene. To-day a decline seems to be taking place, since neither the reindeer, nor the moose equals the extinct Irish elk in the complexity and rise of its horns.

If Darwinism can account for the propagation of this new race, by the advantage which the short stabbing horns gives to the bucks, how could any branching antlers ever have arisen from the Miocene deer? In accordance with the theory of natural or

sexual selection the horns should have become longer and sharper, and have dropped their tynes, thus making them better weapons. The reverse has certainly occurred, and antlers developed of extraordinary size, cumbersome and useless in comparison with the short dagger-like horns of the Miocene deer. According to Darwin's latest modification, in his Descent of Man, the increase in the size would be accounted for by sexual selection; namely that the females would select the males having the largest horns, and thus the size of the horns would be increased by successive generations. If this be the explanation, how shall we account for the rise of the short-horned variety at the present time? Darwin quotes this instance as an example of natural and sexual selection, in his last book, "The Descent of Man," vol. ii. p. 243. Am. ed.

Presuming, however, that natural selection does account for the evolution of the branching horns, and also for the preservation and gradual increase in numbers of the present spike-horned buck, as it may be fairly assumed in many instances to act in the preservation and perpetuation of many characteristics, it neither does nor can account for the first appearance of horns, or the first appearance of a full-grown buck having the spike-horns. This inadequacy of the theory of natural selection to show us how characteristics arise has been repeatedly insisted upon by several authors. Professor Cope and himself, in two widely separated departments, among the Reptiles on the one hand, and the Mollusks on the other, have repeatedly pointed out the mode in which characteristics, races, species and genera have arisen. Several writers on the continent, and Mr. St. George Mivart, in his "Genesis of Species," have lately taken similar views. The latter continually alludes to the sudden rise of species or races, and gives an instance of the sudden appearance of the black-shouldered peacock. This variety, previously known in India as a separate species, speedily increased to the extinction of the original form. Here, as St. George Mivart points out, under different geographical influences, the same species has suddenly arisen in India and in England. Here are no slow changes similar to those perpetually cited by Darwin and Wallace, no gradual fading of one species into another, but a sudden evolution of a new distinct form.

Mivart, too, states that the view here advocated regards the whole organic world as arising and going forward in one harmonious development, similar to that which displays itself in the growth

and action of each separate individual organism. This apparently is the keynote of his book. This was the view advocated by the speaker, some four years previous in the Memoirs of the Society, in a paper written to establish the fact that all characteristics had arisen suddenly among the *ammonites* and *nautili* of past geological epochs. This paper was a short, preliminary statement of facts observed, and it did not excite his surprise that Mivart had overlooked it. He could not however help wondering at the absolute silence preserved with relation to the essay of Professor Cope of Philadelphia. This had been issued at about the same time and independently, but advocated nearly the same views as regarded the sudden production of characteristics among the Reptiles, and must have been well known to Professor Huxley, with whom Mivart seems to have taken council. This omission is by no means creditable to the author of a work written to refute such books as Darwin is in the habit of producing, and contrasts unfavorably with that writer's evident acquaintance with the essay alluded to above. This is shown most by the manner in which he is obliged to rest the proof of his assertion, that species arise suddenly, upon a number of isolated facts; whereas either Professor Cope's paper, or the speaker's, especially the former, would have furnished him with a number of reliable and serially connected illustrations of the quick evolution of species.

Parasites. — Prof. Van Beneden, as we have before noticed, has distinguished true parasites, which live *on* their host, from commensals, those which live merely *with* their host, the thieving impostor from the respectable lodger. In an admirable work on the "Fishes of the coasts of Belgium, their Commensals and Parasites" published by the Academy of Sciences of Brussels, he now further classifies parasitic organisms. The commensals are either 1, *Oikosites*, fixed; or 2, *Coinosites*, free. The Oikosites fish for their own living, and merely ask a free passage from their hosts. They are either fixed in perpetuity, as Coronula, Cochliolepis, Modiolaria, Mnestra, and Loxosoma, temporarily as the Remora Aniocra, Praniza, or only in the young state, *e. g.*, Caligus and Anodon. The Coinosites, on the other hand, never give up their liberty; they occasionally leave their host, and between Coinosite and host there is often an exchange of good offices, one furnishing a solid house or a strong claw, the other a sharp eye, and they

may share their prey in common. The digestive canal is occupied by the following Coinosites: —Fierasper, Stegophyle, Stylifer, Phronimus. Hyperia, the mantle by Pimotheres and Pagurus, the exterior by Myzostoma, Cyamus, Pycnongonon, Caprella and Chætogaster.

The true parasites cannot live without assistance; they are divisible into several categories. Some, such as the leech, fleas, and some dipterous insects, suck the blood of their victim, and then quit him to take their after-dinner nap in the open air; others, such as the ichneumon flies, do not quit their host till they have become adult, and have in the process exhausted the last drop of blood of their unfortunate prey. The greater number lead a free life when young and merely attach themselves to a host at the time of reproduction, such are the Bopyrian and Lernean Crustacea. There is a further very interesting group, who enter a host while yet young, simply in order that they may get carried by its means into a second host, where they will ripen their eggs. Often whilst waiting in their first host (sometimes vainly waiting, no doubt) for him to be devoured by their second and ultimate victim they reproduce *agamically*. Such parasites are the Flukes and many Tapeworms. These divisions are thus tabularly set forth:—

Parasites free.

during all their life.	during a part of their life they pass through	
	a single host.	several hosts whilst immature.
Leeches.	whilst immature.	Distomata.
Fleas and Flies.	when mature.	Cestoids.
Caligus.	Ichneumons.	
	Bopyrians.	
	Mermis.	
	Lerneans.	

The parasites of the first category which are free during all their life, Professor Van Beneden calls Phagosites, and compares them to the *habitués* of a hotel who avail themselves of the *table d'hôte*, but do not have a bedroom in the building. The other parasites which have both board and lodging are divisible into three principal categories. 1st. Xenosites — who are pilgrims in transit — voyaging with a distinct but distant object in view. They are always agamic, lodge in such closed organs as the brain, muscles, and serous membranes, and wait patiently till they get into the stomach of the animal where they are destined to breed.

The stomachs and appendages of fishes swarm with parasites, and those which have the largest *clientèle* are by no means the least healthy or thinnest. Often one fish, having swallowed another, is swallowed by a third, and thus Xenosites find themselves set free in the wrong fish's stomach, for the stomach acts like a filter, straining out and retaining the parasites, while the flesh is digested. Such erring Xenosites merely wait and may often pass through several "hotels" before they reach their destination. 2nd, Nostosites—those who have reached their destination, and now can abandon themselves to generation. Whilst the Xenosite was obliged to put up often with an uncomfortable cramped lodging, biding his time, the Nostosite occupies the most eligible organs for parasitism—in fact, the most vast and commodious chambers of the hotel. The 3rd division are the Pilgrims, who have lost their way hopelessly, and are in worse plight than even in Giant Despair's castle. Such are the agamic worms which are found often in the Plagiostomous fishes, and who ought to have got into some Teleostean fish, there to fructify—a happy fate forever lost to them when by unlucky chance the host in whom they trusted was swallowed by a remorseless shark. They never quit this retreat.

Prof. Van Beneden gives directions for searching an animal for its parasites, and justly claims a high interest for the study of the fauna of individual species, and urges such neat and sharply-limited zoological inquiries on those who do not feel prepared to study the fauna of a geographical region—to the philosophy of which, indeed, the study of parasite-faunæ may furnish important suggestions. Ninety-three species of fish, with their parasites and commensals, are cited in this work from the author's own observation. Eight plates illustrate it.—E. R. L., in *Nature*.

The Theory of Natural Selection.—In "Nature" for Nov. 10, Mr. A. W. Bennett discusses the theory of natural selection, which he holds to be inadequate to account for the origin of species. Taking as his starting point the two principles laid down by Mr. Darwin himself, that natural selection always operates through the perpetuation of exceedingly small changes, and that every change thus perpetuated by natural selection must be directly beneficial to the individual, he applies these principles to the phenomena of Mimicry, as illustrated in Mr. Wallace's "Contributions to the The-

ory of Natural Selection." Mr. Bennett maintains that in those cases where a butterfly mimics exactly the external facies of a species belonging to a different tribe, the amount of change in the direction of the species ultimately mimicked which can have been established in a single generation, is so small as to be absolutely useless to the individual, and hence, according to one of the cardinal principles of the Darwinian hypothesis, cannot have been brought about by natural selection. He then traces a connection, which he believes to have been overlooked hitherto, between the development of the power of mimicry or protective resemblance, and that of instinct, in the various classes of the animal kingdom, and argues that their parallelism must result from some connection between these phenomena. In conclusion, he contends that Mr. Wallace's abandonment of the theory of natural selection, in accounting for the development of man and of the various races of mankind, is inconsistent and illogical, and that whatever "intelligence," as Mr. Wallace expresses it, has been operative in the origination of man, the same principle must have been at work also in the various lower races of animals. In reply, Mr. Wallace and other naturalists maintain that the steps necessary to transform a butterfly from its normal facies to one imitating exactly an entirely different butterfly of another genus, need not be so numerous as is generally supposed; and that each step may be proved to be directly beneficial to the individual; and hence natural selection is amply sufficient to account for the whole phenomenon. In a subsequent number (Dec. 22) Mr. A. Murray attributes the phenomenon of mimicry to an entirely different cause, that of hybridization, drawing a parallel between the hybridization which he assumes in Lepidoptera and that which is known to take place in plants. This theory is strongly opposed by other entomologists, mainly on the ground that it is unsupported by observed facts, and that from the crossing of plants belonging to different species of the same genus, no assumption can be made that butterflies belonging to entirely different genera and even orders can possibly hybridize.— *The Academy.*

Mode of Life of the Sucking-Fish and Pilot-Fish. — Professor Van Beneden has ascertained the nature of the food of these two forms of fishes. The sucking-fish has sometimes been supposed to derive its nourishment from the sharks, to which it

attaches itself by the curious apparatus on the crown of its head. M. Van Beneden finds that the common sucking-fish (*Echeneis remora*) feeds upon small fishes. From an examination of the contents of the stomach in several examples of the pilot-fish (*Naucrates*) — it would appear that this fish is omniverous — the food consisted of portions of fishes, crustacea, fucoid plants, and, in one instance, parings of potatoes. These observations have been communicated to the Royal Academy of Belgium.—*The Academy.*

African Ant Cats.—The plains of South Africa are characterized by numerous animals generally known to the Boers as "mierkatjes." or ant cats. Most of these are Viverra, Herpestes, Luricates, etc., and all have nearly similar habits. Early in the morning these pretty animals may be seen in numerous groups sitting upon their hind legs warming themselves in the sun, and when startled, scampering away to their holes, with their tails cocked high up in the air. They all feed on mice, small reptiles, grasshoppers and locusts. They likewise greedily devour birds' eggs. They are more or less colored like the Karoo soil. Mr. Weale also gives in the same letter to "Nature," an interesting account of the protective resemblances of animals in that part of the world.

American Birds in Great Britain.—Mr. H. E. Dresser exhibited to the Zoological Society a specimen of the American Yellow-billed Cuckoo (*Coccyzus Americanus*) recently killed in England, and Sir Victor Brooke a specimen of the Esquimaux Curlew (*Numenius borealis*) lately killed in Ireland.

Wild Rabbits.—Seventy years ago some domestic rabbits were introduced upon Sable Island, a small, sandy islet lying about a hundred miles off the Nova Scotia coast, and being left alone and not crossed in breeding, they have entered their feral state in liveries of beautiful silver grey, with white collars, intimating some remote affinities with bygone races.

Two Ornithological Items.—On the twelfth of last January I shot here a female Evening Grosbeak, out of a flock of about a dozen individuals which was observed several times at Ann Arbor. On the fifteenth of April following, I found the young of the Shore Lark already fledged.—B. Walker, *Detroit, Mich.*

[Although the Hesperiphona is usually quoted as a western bird,

it ordinarily reaches eastward to the Lake Superior region. We have various accounts of its occurrence in Ohio, Illinois, etc., and even in Canada (McIlwraith). In the West, the Eremophila breeds anywhere on the plains suited to its wants, much further south than on the Atlantic border; thus we have found it in New Mexico, in June. But the fact that it nests and lays in March, in Michigan, may not be generally known.—E. C.

THE NOTES OF THE WHIPPOORWILL.—Several pairs of Whippoorwills nest near my house. One male bird sits night and morning on the roof of my front piazza, and sings there by the half hour, or even by the hour together. From windows opening upon that roof I observe him at the distance of ten, eight, often of only six feet. The same bird, or his ancestor, has occupied the same post in summer, morning and evening, for several years.

I am not aware that any writer ascribes to the Whippoorwill more than a single note. Wilson, quoted by Samuels, indeed says "When near, you often hear an introductory cluck between the notes." Besides this "cluck" which can scarcely be called a note, the Whippoorwill has *three* distinct notes. There is the common, well known note of Whip-poor-will; heard close by, this note is more nearly "Quipo-o-Will,"—the first and last syllables being very quickly and sharply uttered, the last almost like the cracking of a whip; while the second syllable is somewhat prolonged. Accompanying or preceding the first syllable is a sound like the striking of the bird's beak upon a board. The negroes affirm that the noise is so made; but after pretty careful observation, I think they are mistaken. How the sound is made I am not prepared to assert; possibly it is by the snapping of the beak. This is, I suppose, the "cluck" of Wilson and Samuels. Then the Whippoorwill has a note like "Whit, whit, whit"—very soft and musical—often uttered while the bird is upon the wing, yet often uttered also while at rest. It is soft and sweet as possible. Besides these, the bird has a low, harsh, discordant note like "Gor-gor-gor," or occasionally, "Go-ror, go-ror, go-ror." I have never heard this except when another bird was close by. I take it to be a scolding note, or note of defiance when another male bird comes near. While uttering this last note the bird stands erect, with its head raised as high as possible, and its feathers ruffled. While singing "Whip-poor-will" it always lies with its breast flat

to the roof, or fence or whatever it is sitting on. — Fairfax, Virginia, July 3d, 1871.

The Billfish in Fresh Water. — Mr. G. Brown Goode of the Museum of the Wesleyan University, informs us that a fine specimen of *Belone truncata*, "Green bone," "Billfish" or "Salt water Gar," measuring twenty inches in length, was taken, in June last, in the Connecticut River about thirty miles up, and that he has heard of several other specimens having been taken in the fresh waters of the river, though all the authorities he has been able to consult, give the habits of the species as strictly marine.

There are about fifty species of the genus *Belone* described, and though they are essentially marine fishes of the tropical and temperate regions, yet many of the species are known to live, in great part, at the mouths of rivers, and to ascend to, and thrive in, the fresh waters. It is probably a characteristic common to the whole genus and to the allied genus *Hemiramphus*. Many fishes, generally classed as marine, enter the rivers in pursuit of their food, or for the purpose of spawning, and our local authorities do not always mention such facts in their works, being often more taken up with describing and identifying the species, than in giving accounts of the habits of the fishes that come under their observation. — Eds.

New England Ascidians. — Prof. Verrill is publishing a series of illustrated articles on our ascidians in the "American Journal of Arts and Sciences." The number for June contains descriptions of some of our compound ascidians which have heretofore been sadly neglected. Several new genera and new species are described. He finds that the young of *Lissoclinum aureum* from Eastport, Maine, contained "tadpole-shaped embryos in an advanced stage of development," while in another species (*L. tenerum* n. sp.) from Newfoundland, the eggs were few and relatively very large. "The development of such eggs is *direct, without passing through a tadpole-shaped larval state*." This is remarkable, though paralleled in the crustacea, where, for instance the craw fish and several other crabs undergo no metamorphosis while the majority do pass through transformations. In a note Verrill says "with alcoholic specimens it is not possible to trace completely the early stages of this development, or to be perfectly certain that these egg-like bodies are genuine eggs, al-

though some of them appear to contain, at first, a germinal vesicle." The subject is one of great interest, in connection with the supposed kinship of ascidians with vertebrates, if there is anything in the fancied resemblance, which is much doubted by the most cautious and learned comparative anatomists.

Fighting Beetles.— Mr. Lewis exhibited to the Entomological Society of London, an earthen jar, like an ordinary tobacco jar, of Chinese manufacture. It had an enormously thick porous bottom, and it was stated that the inhabitants of Pekin use these jars for the purpose of confining large beetles, which they keep for fighting. The beetles are allowed no food but water, and become extremely ferocious. Prof. Westwood reminded the meeting that the Chinese were already known to keep Mantides for fighting purposes.

Immature Sexuality in Insects.— Mr. Lowne read a paper on this subject before the London Entomological Society. The author thought that species sometimes originated from the maturity of the sexual organization before the acquirement of adult characters; a conclusion he had arrived at in consequence of the early development of the organs in the embryo and larva. He further stated, that, in his opinion, the larval and pupal conditions were probably acquired and not direct stages of development.

The Embryology of Scorpions.— Dr. Elias Metschnikoff has recently published in Siebold and Kolliker's Journal, an elaborate account, highly illustrated, of the embryology of the *Scorpio Italicus* and of a species from Tyrol. The embryology of insects and crustacea as pursued at the present day by zoologists, who are directing especial attention to the provisional membranes of the egg and embryo, depends almost as much on the skilful use of chemicals as the microscope itself. The author says "the methods which I employ in these researches are not complicated. I study the eggs removed from the ovarian tubes; or, place the living embryo in a drop of a weak solution of salt (salzlosung); or I at first submit them to the influence of solutions of chromic acid of different strengths, and then examine them either with a simple or compound microscope. Out of embryos hardened in this way I can make sections. Much of the time I have to work with dissecting needles, while the embryos or portions of them treated in this

way, and in an equal mixture of fresh and salt water. afford very good objects for study."

The embryology of scorpions was sketched out in a general way by the distinguished German embryologist Rathke. Metschnikoff extends these researches very greatly, and considers as the most important results of his studies the discovery that "in the embryo of the scorpions three embryonal membranes are developed, which, in many respects are very strikingly similar to the Remackian embryonal membranes of the vertebrates."

A South American Bird in the United States.—The specimen of *Erismatura Dominica*, the gift of Mr. Thure Kumlien of Bussyville, Wisconsin, having been presented, Dr. Brewer called the attention of the Boston Society of Natural History to the interest attaching to this specimen. It is a South American bird, and this specimen is the second obtained in the United States. The first, a male, was shot at Lake Champlain, and was presented to the society by Dr. Samuel Cabot. This specimen, the second ever obtained north of Mexico, was shot at Rock River, Bussyville, Wisconsin, November, 1870. It is a female; its total length is fourteen inches; alar extent twenty and one-half inches. The tail consists of twenty very narrow feathers, of which the first is the shortest. The tail extends only three inches beyond the folded wings. Bill one and one-sixteenth inches from base to tip above; one and nine-sixteenths depth at base, and three-fourths of an inch wide. Wing with second primary longest; third and first, even. Iris, brown.

Shad Eggs.—When shad eggs are first impregnated they are very small, but after a short time they swell greatly *and the water in the impregnating pan becomes about* 10° *colder*.—A. S. Collins.

[Can any one give us an explanation of this *fact?*—Eds.]

Discovery of the Animal of the Spongiadæ Confirmed.—Just a line to tell you what you will be glad to learn, viz., that I have confirmed all that Prof. James Clark of Boston, [now of the Kentucky University] has stated about the sponge-cell, and much more too.

It is, after all, only what was published and illustrated in the "Annals" in 1857. Indeed, I am astonished now at the accuracy and detail of that paper ("Ultimate Structure of Spongilla," etc.), now *all* confirmed by an examination of a *marine* calcareous

sponge. I have not only fed the sponge with indigo, and examined all at the moment, but the sponge so fed was put into spirit directly afterward, and *now* shows all the cells (monociliated) with the *cilium attached and the indigo still in the cells*.

This, I think, will break down Hackel's hypothesis, which is as imaginative and incorrect as it is beautiful.

His "Magosphæra," too, is figured in the "Annals" (1856), and described *in extenso* as the ameboid cell which inhabits the mucus of the cells or internodes of the Bombay great *Nitella*.

But there are no people in England, if on the Continent, who seem to be able to show this, if even they be cognizant of it.

Ex oriente lux used to be the old phrase; the light is now being *reflected* back from America. It is from there that we must expect novelties now. — H. J. Carter, *in Annals and Mag. N. History*.

GEOLOGY.

Rocks Polished by Sand. — Dr. Kneeland, at a meeting of the Boston Society of Natural History, exhibited several specimens of glass, marble and hard stones engraved, carved and grooved by the action of sand driven by a blast of air or steam. The surface being covered with perforated paper or a stencil plate, the parts exposed by the perforations are cut rapidly and accurately, while the covered parts are untouched; protected, it is supposed, by the elasticity of the paper or metal. He drew attention to this industrial process as illustrating the advantage of diffusing, as a common branch of knowledge, information on the forces of nature, and, in this instance, on dinamical geology. This process which promises to revolutionize one of the most extensive of the industrial arts, is simply carrying out what natural forces have been doing to the surface rocks of our continent for ages. Sands carried by strong and steady winds, passing over rocks, often wear them smooth, or cover them with grooves and scratches, as noticed and figured by Mr. Blake in the granite rocks at San Bernardino Pass, California. (See Pacific Railroad Reports, Vol. V, pp. 92 and 231.) Quartz rocks were there found polished, the softer feldspar being cut away; where the latter had been protected by garnets, projections were left, tipped with the hard garnets, pointing like fingers in the direction of the wind.

On the surface of the Great Colorado desert the pebbles are finely polished by the drifting sand, or variously grooved, according to the hardness of their substance. Prof. J. Wyman also mentions that glass windows on Cape Cod have holes worn in them by the drifting sands blown by the winds.

It is the tendency, Dr. Kneeland remarked in conclusion, of modern education to pay less attention to the dead languages and to ancient history as a means of culture, and more to the practical and living issues of the day, and especially to combine a knowledge of natural phenomena with the elementary instruction of the schoolroom. In this particular instance it is altogether probable that, if the grooving of rocks by the wind-driven sands, long known by geologists and physicists and by them turned to no practical account, had been equally well known to our intelligent and skilful mechanics, the process here illustrated would have been invented years ago, and by this time have attained a high degree of perfection. The same reasoning will apply to other departments of natural and physical science, and goes to show the wisdom of those educators who are endeavoring to diffuse a knowledge of scientific principles and phenomena among the people.

Fossil Reptiles from the Rocky Mountains. — Prof. Marsh is continuing in the "American Journal of Arts and Sciences" his descriptions of the reptiles obtained during his recent expedition to the Rocky Mountains. He remarks that "the specimens from the Cretaceous formation are of great interest as they further illustrate the remarkable development in this country, both in numbers and distinct forms, of the Mosasauroid reptiles, which appear to have been comparatively rare in other parts of the world. Fortunately, moreover, some of these remains serve to clear up several obscure points in the structure of these reptiles, and prove conclusively that they had a well developed pelvic arch and posterior limbs; although up to the present time no satisfactory indication of this had been discovered, and the eminent palæontologists who have recently made these animals an especial study, consider them probably destitute of these extremities. The remains found in the Tertiary deposits are also of importance, since they show that types of reptilian life, almost unknown hitherto from that formation in the West, were, in one of the ancient lake-basins, at least, abundantly represented during that period." The

cretaceous reptiles are *Edestosaurus dispar* and *velox* and *Cladodes Wymani* and *pumilus*. Five new species of crocodiles, and land lizards belonging to a new genus (*Glyptosaurus nodosus*, *ocellatus*, and *anceps*) were found in the Tertiary deposits.

New Facts in Fossil Botany.—The first point mentioned was the occurrence in the Devonian Shales of Kettle Point, Lake Huron, of beds containing immense quantities of spore-cases, probably of Lepidodendron. These beds are referred by the Geological Survey to the horizon of the Genesee shales of New York, and are stated to be twelve or fourteen feet in thickness, and to extend over a considerable area of country. Specimens in the collection of the Survey show that the bituminous matter which causes the combustible quality of the shale, is due entirely to the immense quantities of spore-cases present, which, under the microscope, appear as flattened discs scarcely more than one hundredth of an inch in diameter. Specimens of the trunks of *Lepidodendron Veltheimianum* and *Calamites inoperatus* occur in the same beds. This is probably the oldest bed of fossil spore-cases known: but in later geological periods similar beds occur, the Tasmanite, or 'white coal' of Tasmania, which consists of spore-cases of ferns, being a notable instance. The author next referred to the discovery of specimens indicating the existence of three or four species of Tree-Ferns in the Devonian of New York and Ohio. He had received from Prof. Newberry of New York, a specimen, showing the upper part of a stem with five leaf stalks attached to it. This he had named *Caulopteris Lockwoodi*. Three other specimens collected by Prof. Newberry in Ohio indicated the existence of three distinct species belonging to two genera. The two most important had been named by Prof. Newberry *Caulopteris antiqua* and *Protopteris peregrina*. They are from the Corniferous Limestone, and thus carry down tree-ferns to the bottom of the middle Devonian. One of them has the cellular structure and vascular bundles in such preservation as to show their microscopic structure, which is precisely similar to that of modern ferns.—Principal Dawson, in *Nature*.

The Persistence of Palæozoic Types of Madreporaria.—The dredging expedition which searched the sea-floor in the track of the Gulf Stream of 1868, yielded, amongst other interesting Madreporaria, a form which has been described by Count Pourtales

under the name of *Haplophyllia paradoxa*, and which was decided by him to belong to the section *Rugosa*.

The last expedition of the Porcupine under the supervision of Dr. Carpenter and Mr. J. Gwyn Jeffreys, obtained, off the Adventure Bank in the Mediterranean, many specimens of a coral which has very remarkable structures and affinities. The species is described by Prof. P. Martin Duncan, under the name of *Guynia annulata* Dunc. The necessity of including it amongst the Rugosa and in the same family, the *Cyathoxonidæ*, as *Haplophyllia paradoxa*, is shown by him in a paper read before the Royal Society of London. Having this proof of the persistence of the rugose type from the Palæozoic seas to the present, the affinities of some so-called anomalous genera of Midtertiary and Secondary deposits are critically examined. The Australian Tertiary genus Conosmilia three of whose species have strong structural resemblances with the Rugosa is determined to be allied to the *Stauridæ* and especially to the Permian genus Polycœlia. The Secondary and Tertiary genera with hexameral, octomeral, or tetrameral and decameral septal arrangements are noticed, and the rugose characteristics of many lower Liassic and Rhetic species are examined. The impossibility of maintaining the distinctness of the Palæozoic and Neozoic coral faunas is asserted; and it is attempted to be proved that whilst some rugose types have persisted, hexameral types have originated from others, and have occasionally recurred to the original tetrameral or octomeral types; and that the species of corals with the confused and irregular septal members, so characteristic of the lowest Neozoic strata, descended from those *Rugosa* which have an indefinite arrangement of the septa. The relation between the Australian Tertiary and recent faunas, and those of the later Palæozoic and early Neozoic in Europe, is noticed, and also the long-continued biological alliances between the coral faunas of the two sides of the Atlantic Ocean.—*Nature*.

Crinoids injected by Silicates. — Dr. T. Sterry Hunt made a communication to the Natural History Society of Montreal, April 24th., on a Mineral Silicate injecting Palæozoic Crinoids.

The author described a gray granular Palæozoic limestone from New Brunswick, which had been examined by Dr. Dawson, and found to consist almost entirely of the comminuted remains of brachiopod and gasteropod shells, crustacea, and the joints and

plates of crinoids, cemented with a little calcareous spar. The crinoidal remains were, however, found to have their pores filled with a peculiar silicate, which is exposed in relief when the surface of the limestone is attacked by an acid, and then appears as a congeries of small cylindrical rods or bars, anastomozing and forming a beautiful net-work, which, under a magnifying glass, exhibits a frosted crystalline surface, and resembles the variety of arragonite known as *flos ferri*. This silicate, which also fills small interstices among the other calcareous fragments making up the limestone, is greenish in color and forms about five per cent of the rock. Though insoluble in dilute acids, it is completely decomposed by strong acids, and is found to be a hydrous silicate of ferrous oxide and alumina, with some magnesia and a little alkali, closely allied to fahlunite and to jollyte. The results of its analysis appear in "Silliman's Journal" for May.

Dr. Hunt remarked that this process of infiltration, by which the minute structure of these Palæozoic crinoids has been preserved, was precisely similar to that seen in the glauconite casts of more modern foraminifera, and in the Eozoon of older times. This ancient calcareous rhizopod, though most frequently preserved by serpentine, had been shown by himself in Canada and by Hoffman in Bohemia, to be in some cases injected by silicates related in composition to that of these crinoids. He then proceeded to speak of the great class of silicates of which serpentine, loganite, pyrosclerite, fahlunise, and jollyte are members, and which are generally described as the results of pseudomorphic changes of preëxisting silicates or carbonates, but which he, since 1853, has maintained to be original aqueous depositions, similar in their origin to the related mineral glauconite; a view now adopted by such investigators as Naumann, Scheerer, Gumbel and Credner. He noted in this connection the bearing of these facts on the *Eozoon Canadense* of Dawson, the organic nature of which, though almost universally admitted by zoologists and mineralogists, was nevertheless still questioned by Messrs. King and Rowney. These gentlemen object that the ancient rocks in which Eozoon is found are what are called metamorphic strata, which have been, according to them, subjected to pseudomorphic changes, and therefore, the Eozoon may be the result of some unexplained plastic force, which has fashioned the serpentine and other mineral silicates into forms so like those of foraminiferal organisms as to deceive the most

practical observer. This, said Dr. Hunt, was going back to the notions of those, who, rather than admit that mountains had been formed beneath the sea, imagined that the fossil shells which they often contain were not the real shells of animals, but the result of some freak of nature. The argument of Messrs. King and Rowney that the Eozoon rock is a result of pseudomorphic alteration because it contains serpentine, is a begging of the question at issue, by asking us to admit that the presence of serpentine is an evidence of metamorphic change, which is denied. He then remarked that the specimens of this organic limestone, with its injected crinoids, differed from Eozoonal rock only in containing at the same time recognizable fragments of other organic remains, and in presenting in its injected portions the differences which distinguish the minute structure of a crinoid from that of a calcareous rhizopod. In conclusion, he again adverted to the views which he had long maintained as to the origin of great masses of silicated rocks by a direct process of deposition from watery solutions, in which they were formed by chemical reactions.

Dr. Dawson spoke, confirming the observations of Dr. Hunt, which he had verified by microscopic examinations. He alluded to the structure of crinoids, which in the fossil state were generally filled with carbonate of lime so as to obliterate their pores. The infiltrating silicate in the present case however, showed, especially in decalcified specimens, that these ancient crinoids closely resembled in their minute structure, the modern forms lately studied by Dr. W. B. Carpenter and Professor Wyville Thompson, especially Comatula. Figures of these decalcified specimens were exhibited and will be published. Dr. Dawson alluded further to the process of filling up the porous calcareous skeleton of the crinoids, which was clearly shown to be prior to the cementing and consolidation of the fragmentary limestone.

MICROSCOPY.

The Submersion Microscope.—R. E. Dudgeon, M.D., describes under this name, in the Quarterly Journal of Microscopical Science for July, 1871, a contrivance by which the objective of an ordinary microscope can be plunged in water without affecting its optical qualities. A brass tube with its lower end closed watertight by a flat disc of glass is slipped over the objective from

below so far that the glass disc is considerably within the working focus of the lens. Thus protected the lens can be lowered into water, syrup, glycerine, etc., to a depth limited only by the mechanism of the microscope or the length of the protecting tube, and used to view objects floating in the liquid or lying on the bottom of the vessel containing it. While the common "tank microscope" can be worked best somewhat horizontally, through the side of the tank, this arrangement, besides being applicable to much higher powers, is adapted to give a more or less vertical view, being entirely free from any tremor on account of the motion of the top of the water, and is therefore especially useful for dissecting purposes. Its object, though not its method, is identical with that of Tolles' immersion objective for low powers, published more than two years ago; though the latter naturally possesses, being constructed especially for this use and dispensing with two unnecessary surfaces of glass, some optical superiority as well as a much longer working focus. The submersion tube, being applicable to ordinary lenses, only slightly lowering their magnifying power and considerably shortening their working focus, will doubtless be extensively useful; though the statement that it may be always retained in position as a protecting cover to the lens without impairing the definition or illumination in ordinary work, must be considered as too enthusiastic. It is especially applicable to lenses of from one inch to one-quarter inch focus (the latter limited to a very small angle), and the objects should be placed in a jar or tank having the bottom and at least one side quite smooth and transparent.—**R. H. W.**

NOTES.

Prof. C. F. Hartt, who has already become identified with Brazilian geology, zoology, and archæology, from his three former expeditions, in the first being an assistant to Prof. Agassiz on the Thayer expedition, left New York on July 24th for another and more extensive exploration of the eastern part of the valley of the Amazons. He will continue the series of geographical and geological investigations begun on his last journey, and expects on his return to be able to publish a detailed account of the region

examined. The principal points to be investigated are the following:

1st. The character and distribution of the Palæozoic rocks bordering the valley on both sides. Last summer he found Carboniferous rocks on the Tapajos, and Devonian beds near Monte Alegre. More complete suites of the fossils afforded by both these formations will be made, so that the fauna of the Carboniferous and Devonian of Tropical America may be illustrated and compared with those of North America and Europe.

2d. A search for Mesozoic rocks will be continued, none having yet been discovered east of the Purús.

3d. The Tertiary beds forming the Table topped hills will be carefully studied at Almeyrim and the Serra da Paranáguára, and the height of these hills will be measured.

4th. The deposits of the lower plain will be reëxamined, and in this connection a journey will be undertaken across the Island of Marajó.

5th. The shell banks, terraces, etc., on the borders of the valley will be explored to determine, if possible, the character and amount of the last uprise of the Amazonian region.

6th. The Indian mounds of Marajó will be explored.

7th. He will employ native guides, and continue the study of the Lingoa Geral, or Modern Northern Tupí.

Mr. Orville A. Derby, who distinguished himself on Prof. Hartt's last expedition, accompanies Prof. Hartt as special assistant. The latter has already had several months' experience in photography and goes furnished with apparatus for taking a series of views with which to illustrate his next volume. A popular illustrated sketch of the journey will appear immediately after his return, as we understand, in the columns of "Every Saturday." As extensive a collection of zoological, geological and ethnological specimens will be made as possible.

The expedition, though in the interest of Cornell University, has been privately gotten up. The greater part of the fund has been furnished by Col. Edwin Morgan of Aurora, N. Y., who also bore a large part of the expenses of his last expedition, and, in recognition of the kindness of this gentleman, Prof. Hartt has given to this exploration the name of the Morgan Expedition. Prof. Hartt has received considerable pecuniary aid from private individuals, and the Peabody Museum of Archæology has placed

five hundred dollars in his hands to be used for archæological purposes. As the expedition will be limited by the amount of funds subscribed for the purpose, we trust that some of our liberal countrymen will contribute to keep Prof. Hartt in the field as long as possible. Subscriptions will be received by Major O. C. James, P. O. box 6001, N. Y., or by Mr. E. G. Putnam, Business Manager of Cornell University, Ithaca, N. Y.

From Prof. Hartt's very extensive knowledge of the country and native languages, his well known accuracy of observation and former extended field work in the geology of North America, we believe that his return will make known many facts of the greatest importance to science, and that both Mr. Morgan and the Cornell University will be proud of the results attained by their indefatigable worker.

None of the entomological collections in Paris, says *Petites Nouvelle Entomologiques*, have suffered much. Those of the Museum were unharmed, and those of MM. Chaudoir, Sallé, Boisduval were also uninjured.

Mr. G. R. Crotch is to spend a year collecting insects in California and Oregon, and thence proceed to Australia and other places in the East. Dr. LeConte is to work up the American beetles collected by him.

Dr. Boisduval has been at work during and since the siege of Paris in finishing his work on the Sphinges of the world. This work, which will fill up one of the gaps in the *Suite à Buffon*, will form the fourth volume of the *Histoire Naturelle* des *Lepidoptères*; it will comprise the Sphingidæ, Castniæ, and Agaristæ.

The great work by the Messrs. Felder on the Lepidoptera of the Novara (the Austrian) exploring expedition will be completed this year. It will contain a complete classification of the moths, and will supplement Guénée's work on them.

Our next issue, which will probably be out by the middle of the month, will constitute Nos. 8 and 9, containing the Address of President Hunt before the American Association for the Advancement of Science, and the papers read before the Natural History Sections of the Indianapolis meeting. The publication of this double number will enable us to close our volumes with the close of each year; an end as much desired by our subscribers as by the proprietors.

THE

AMERICAN NATURALIST.

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ASSOCIATION NUMBER.

The Geognosy of the Appalachians and the Origin of Crystalline Rocks.

ADDRESS OF THOMAS STERRY HUNT.

ON RETIRING FROM THE OFFICE OF PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

GENTLEMEN OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: —

In coming before you this evening my first duty is to announce the death of Professor William Chauvenet. This sad event was not unexpected, since, at the time of his election to the presidency of the Association, at the close of our meeting at Salem in August, 1869, it was already feared that failing health would prevent him from meeting with us at Troy, in 1870. This, as you are aware, was the case, and I was therefore called to preside over the Association in his stead. In the autumn of 1869, he was compelled by illness to resign his position of Chancellor of the Washington University of St. Louis, and in December last died at the age of fifty years, leaving behind him a record to which science and his country may point with just pride. During his connection of fourteen years with the Naval Academy at Annapolis he was the chief instrument in building up that institution, which he left in 1859 to take the chair of Astronomy and Mathematics at St. Louis, where his remarkable qualities led to his selection, in 1862, for the post of

chancellor of the university, which he filled with great credit and usefulness up to the time of his resignation.* It is not for me to pronounce the eulogy of Professor Chauvenet, to speak of his profound attainments in astronomy and mathematics, or of his published works, which have already taken rank as classics in the literature of these sciences. Others more familiar with his field of labor may in proper time and place attempt the task. All who knew him can however join with me in testifying to his excellencies as a man, an instructor and a friend. In his assiduous devotion to scientific studies he did not neglect the more elegant arts, but was a skilful musician, and possessed of great general culture and refinement of taste. In his social and moral relations he was marked by rare elevation and purity of character, and has left to the world a standard of excellence in every relation of life which few can hope to attain.

In accordance with our custom it becomes my duty in quitting the honorable position of president, which I have filled for the past year, to address you upon some theme which shall be germane to the objects of the Association. The presiding officer, as you are aware, is generally chosen to represent alternately one of the two great sections into which the members of the Association are supposed to be divided; viz., the students of the natural-history sciences on the one hand, and of the physico-mathematical and chemical sciences on the other. The arrangement by which, in our organization, geology is classed with the natural-history division, is based upon what may fairly be challenged as a somewhat narrow conception of its scope and aims. While theoretical geology investigates the astronomical, physical, chemical and biological laws which have presided over the development of our earth, and while practical geology or geognosy studies its natural history, as exhibited in its physical structure, its mineralogy and its paleontology, it will be seen that this comprehensive science is a stranger to none of the studies which are included in the plan of our Association, but rather sits like a sovereign, commanding in turn the services of all.

As a student of geology, I scarcely know with which section of the Association I should to-day identify myself. Let me endeavor

* Amer. Jour. Sci., III, i, 233.

rather to mediate between the two, and show you somewhat of the two-fold aspect which geological science presents, when viewed respectively from the stand-points of natural history and of chemistry. I can hardly do this better than in the discussion of a subject which for the last generation has afforded some of the most fascinating and perplexing problems for our geological students; viz., the history of the great Appalachian mountain chain. Nowhere else in the world has a mountain system of such geographical extent and such geological complexity been studied by such a number of zealous and learned investigators, and no other, it may be confidently asserted, has furnished such vast and important results to geological science. The laws of mountain structure, as revealed in the Appalachians by the labors of the brothers Henry D. and William B. Rogers, of Lesley and of Hall, have given to the world the basis of a correct system of orographic geology,* and many of the obscure geological problems of Europe become plain when read in the light of our American experience. To discuss even in the most summary manner all of the questions which the theme suggests, would be a task too long for the present occasion, but I shall endeavor to-night in the first place to bring before you certain facts in the history of the physical structure, the mineralogy and the paleontology of the Appalachians: and in the second place to discuss some of the physical, chemical and biological conditions which have presided over the formation of the ancient crystalline rocks that make up so large a portion of our great eastern mountain system.

I. The Geognosy of the Appalachian System.

The age and geological relations of the crystalline stratified rocks of eastern North America have for a long time occupied the attention of geologists. A section across northern New York, from Ogdensburg on the St. Lawrence to Portland in Maine, shows the existence of three distinct regions of unlike crystalline schists. These are the Adirondacks to the west of Lake Champlain, the Green Mountains of Vermont, and the White Mountains of New Hampshire. The lithological and mineralogical differences between the rocks of these three regions are such as to have attracted the attention of some of the earlier observers. Eaton, one of the

* Amer. Jour. Sci., II, xxx, 406.

founders of American geology, at least as early as 1832, distinguished in his Geological Text book (2d edition) between the gneiss of the Adirondacks and that of the Green Mountains. Adopting the then received divisions of primary, transition, secondary and tertiary rocks, he divided each of these series into three classes, which he named carboniferous, quartzose and calcareous; meaning by the first schistose or argillaceous strata such as, according to him, might include carbonaceous matter. These three divisions in fact corresponded to clay, sand, and lime-rocks, and were supposed by him to be repeated in the same order in each series. This was apparently the first recognition of that law of cycles in sedimentation upon which I afterwards insisted in 1863.* Without, so far as I am aware, defining the relations of the Adirondacks, he referred to the lowest or carboniferous division of the primary series, the crystalline schists of the Green Mountains, while the quartzites and marbles at their western base were made the quartzose and calcareous divisions of this primary series. The argillites and sandstones lying still farther westward, but to the east of the Hudson River, were regarded as the first and second divisions of the transition series, and were followed by its calcareous division, which seems to have included the limestones of the Trenton group; all of these rocks being supposed to dip to the westward, and away from the central axis of the Green Mountains. Eaton does not appear to have studied the White Mountains, or to have considered their geological relations. They were, however, clearly distinguished from the former by C. T. Jackson in 1844, when, in his report on the geology of New Hampshire, he described the White Mountains as an axis of primary granite, gneiss and mica-schist, overlaid successively, both to the east and west, by what were designated by him Cambrian and Silurian rocks; these names having, since the time of Eaton's publication, been introduced by English geologists. While these overlying rocks in Maine were unaltered, he conceived that the corresponding strata in Vermont, on the western side of the granitic axis, had been changed by the action of intrusive serpentines and intrusive quartzites, which had altered the Cambrian into the Green Mountain gneiss, and converted a portion of the fossiliferous Silurian limestones of the Champlain valley into white marbles.† Jackson did not institute any comparison be-

* Amer. Jour. Sci., II, xxxv, 166.

† Geology of New Hampshire, 160–162.

tween the rocks of the White Mountains and those of the Adirondacks; but the Messrs. Rogers in the same year, 1844, published an essay on the geological age of the White Mountains, in which, while endeavoring to show their Upper Silurian age, they speak of them as having been hitherto regarded as consisting exclusively of various modifications of granitic and gneissoid rocks, and as belonging "to the so-called primary periods of geologic time."* They however considered that these rocks had rather the aspect of altered paleozoic strata, and suggested that they might be, in part at least, of the age of the Clinton division of the New York system; a view which was supported by the presence of what were at the time regarded by the Messrs. Rogers as organic remains. Subsequently, in 1847,† they announced that they no longer considered these to be of organic origin, without however retracting their opinion as to the paleozoic age of the strata. Reserving to another place in my address the discussion of the geological age of the White Mountain rocks, I proceed to notice briefly the distinctive characters of the three groups of crystalline strata just mentioned, which will be shown in the sequel to have an importance in geology beyond the limits of the Appalachians.

I. *The Adirondack or Laurentide Series.* The rocks of this series, to which the name of the Laurentian system has been given, may be described as chiefly firm granitic gneisses, often very coarse-grained, and generally reddish or grayish in color. They are frequently hornblendic, but seldom or never contain much mica, and the mica-schists, (often accompanied with staurolite, garnet, andalusite and cyanite), so characteristic of the White Mountain series, are wanting among the Laurentian rocks. They are also destitute of argillites, which are found in the other two series. The quartzites, and the pyroxenic and hornblendic rocks, associated with great formations of crystalline limestone, with graphite, and immense beds of magnetic iron ore, give a peculiar character to portions of the Laurentian system.

II. *The Green Mountain Series.* The quartzo-feldspathic rocks of this series are to a considerable extent represented by a fine-grained petrosilex or eurite, though they often assume the form of a true gneiss, which is ordinarily more micaceous than the typical

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* Amer. Jour. Sci., II, i, 411.
† Ibid, II, v, 116.

Laurentian gneiss. The coarse-grained, porphyritic, reddish varieties common to the latter are wanting in the Green Mountains, where the gneiss is generally of pale greenish and grayish hues. Massive stratified diorites, and epidotic and chloritic rocks, often more or less schistose, with steatite, dark colored serpentines and ferriferous dolomites and magnesites also characterize this gneissic series, and are intimately associated with beds of iron ore, generally a slaty hematite, but occasionally magnetite. Chrome, titanium, nickel, copper, antimony and gold are frequently met with in this series. The gneisses often pass into schistose micaceous quartzites, and the argillites, which abound, frequently assume a soft, unctuous character, which has acquired for them the name of talcose or nacreous slates, though analysis shows them not to be magnesian, but to consist essentially of a hydrous micaceous mineral. They are sometimes black and graphitic.

III. *The White Mountain Series.* This series is characterized by the predominance of well defined mica-schists interstratified with micaceous gneisses. These latter are ordinarily light colored from the presence of white feldspar, and, though generally fine in texture, are sometimes coarse-grained and porphyritic. They are less strong and coherent than the gneisses of the Laurentian, and pass, through the predominance of mica, into mica-schists, which are themselves more or less tender and friable, and present every variety, from a coarse gneiss-like aggregate down to a fine-grained schist, which passes into argillite. The micaceous schists of this series are generally much richer in mica than those of the preceding series, and often contain a large proportion of well defined crystalline tables belonging to the species muscovite. The cleavage of these micaceous schists is generally, if not always, coincident with the bedding, but the plates of mica in the coarser-grained varieties are often arranged at various angles to the cleavage and bedding-plane, showing that they were developed after sedimentation, by crystallization in the mass; a circumstance which distinguishes them from rocks derived from the ruins of these, which are met with in more recent series. The White Mountain rocks also include beds of micaceous quartzite. The basic silicates in this series are represented chiefly by dark colored gneisses and schists, in which hornblende takes the place of mica. These pass occasionally into beds of dark hornblende-rock, sometimes holding garnets. Beds of crystalline limestone occasionally occur in the

schists of the White Mountain series, and are sometimes accompanied by pyroxene, garnet, idocrase, sphene and graphite, as in the corresponding rocks of the Laurentian, which this series, in its more gneissic portions, closely resembles, though apparently distinct geognostically. The limestones are intimately associated with the highly micaceous schists containing staurolite, andalusite, cyanite and garnet. These schists are sometimes highly plumbaginous, as seen in the graphitic mica-schist holding garnets in Nelson, New Hampshire, and that associated with cyanite in Cornwall, Conn. To this third series of crystalline schists belong the concretionary granitic veins abounding in beryl, tourmaline and lepidolite, and occasionally containing tinstone and columbite. Granitic veins in the Laurentian gneisses frequently contain tourmaline, but have not, so far as yet known, yielded the other mineral species just mentioned.*

Keeping in mind the characteristics of these three series, it will be easy to trace them southward by the aid of the concise and accurate descriptions which Prof. H. D. Rogers has given us of the rocks of Pennsylvania. In his report on the geology of this state he has distinguished three districts of various crystalline schists, which are by him included together under the name of gneissic or hypozoic rocks. Of these districts the most northern, or the South Mountain belt, to the northwest of the Mesozoic basin, is said to be the continuation of the Highlands of New York and New Jersey, which, crossing the Delaware near Easton, is continued southward through Pennsylvania and Maryland into Virginia, where it appears in the Blue Ridge. The gneiss of this district in Pennsylvania is described as differing considerably from that of the southernmost district, being massive and granitoid, often hornblendic, with much magnetic iron, but destitute of any considerable beds of micaceous, talcose or chloritic slate, which mark the rocks of the southern district. These characters are sufficient to show that the gneiss of this northern district is lithologically as well as geognostically identical with that of the Highlands, and belongs like it to the Adirondack or Laurentian system of crystalline rocks. The gneiss of the middle district of Pennsylvania, to the south of the Mesozoic, but north of the Chester valley, is described by Rogers as resembling that of the South Mountain or

* Hunt, Notes on Granitic Rocks; Amer. Jour. Sci., III, i, 182.

northern district, and to consist chiefly of white feldspathic and dark hornblendic gneiss, with very little mica, and with crystalline limestones.

The gneiss of the third or southern district, that lying to the south of the Montgomery and Chester valleys, comes from beneath the Mesozoic of New Jersey about six miles northeast of Trenton, and stretching southwestward, occupies the southern border of Pennsylvania, extending into Delaware and Maryland. It is subdivided by Rogers into three belts; the first or southernmost of these, passing through Philadelphia, consists of alternations of dark hornblendic and highly micaceous gneiss, with abundance of mica-slate, sometimes coarse-grained, and at other times so fine-grained as to constitute a sort of whet-slate. To the northwestward the strata become still more micaceous, with garnets and beds of hornblende slate, till we reach the second subdivision, which consists of a great belt of highly talcose and micaceous schists, with steatite and serpentine, and is in its turn succeeded by a third, narrow belt resembling the less micaceous members of the first or southernmost subdivision. The micaceous schists of this region abound in staurolite, garnet, cyanite and corundum, and are traversed by numerous irregular granitic veins containing beryl and tourmaline. All of these characters lead us to refer the gneiss of this southern district to the third or White Mountain series, with the exception of the middle subdivision, which presents the aspect of the second or Green Mountain series.

Above the hypozoic gneisses Rogers has placed his azoic or semi-metamorphic series, which is traceable from the vicinity of Trenton to the Schuylkill, along the northern boundary of the southern hypozoic gneiss district. This series is supposed by Rogers to be an altered form of the primal sandstones and slates, and is described as consisting of a feldspathic quartzite or eurite, containing in some cases porphyritic beds with crystals of feldspar and hornblende, together with various crystalline schists; including in fact the whole of the great serpentine belt of Montgomery, Chester and Lancaster counties, with its steatites, hornblendic, dioritic, chloritic, and micaceous schists (often garnet-bearing), together with a band of argillite, affording roofing-slates. With this great series are associated chromic and titanic iron, and ores of nickel and copper. Veins of albite with corundum also intersect this series near Unionville. We are repeatedly assured by

Rogers that these rocks so much resemble the underlying hypozoic gneiss, as to be readily confounded with them; and when compared with the latter, as displayed in the southern district, it is difficult to believe that we have in this so-called azoic or metamorphic series of the Montgomery and Chester valleys, anything else than a repetition of these same crystalline schists which have been described along their southern boundary, representing the Green Mountain and the White Mountain series. We thus avoid the difficulty of supposing that we have in this region two sets of serpentinic rocks, and two of mica-schists, lithologically similar, but of widely different ages,—a conclusion highly improbable. It should be said that Rogers, in accordance with the notions then generally received, looked upon serpentine as an eruptive rock, which had altered the adjacent strata, converting the mica-schists into steatitic and chloritic rocks.

This so-called azoic series, according to Rogers, underlies the auroral limestone of Pennsylvania, thus apparently occupying the horizon of the primal paleozoic division or Potsdam series. We find, however, in his report on the geology of the state, no satisfactory evidence of the identity of the two series. On the contrary, a very different conclusion would seem to follow from certain facts there detailed. The azoic or so-called metamorphic primal strata are said to have a very uniform nearly vertical dip, or with high angles to the southward, while the micaceous and gneissic strata of the northern subdivision of the southern district of so-called hypozoic rocks, limiting these last to the south, present either minute local contortions or wide gentle undulations, with comparatively moderate dips, for the most part to the northward.* From this, I think we may infer that the nearly vertical strata must be, in truth, older underlying rocks belonging, not to the paleozoic system, but to our second series of crystalline schists. We conclude, then, that while the gneisses to the northwest, and probably those along the southeast rim of the Mesozoic basin of Pennsylvania are Laurentian, the great valley southward to the Delaware is occupied by the rocks of the Green Mountain and White Mountain series. The same two types of rocks, extending to the northeast, are developed about New York city, in the mica-schists of Manhattan and the serpentines of Staten Island and Hoboken;

* Rogers, Geology of Pennsylvania, I, pp. 69–74, and 154–158.

while in the range of the Highlands, the gneiss belt of the South Mountain crosses the Hudson river.

The three series of gneissic rocks which we have distinguished in our section to the northward have, in southeastern New York, as in Pennsylvania, been grouped together in the primary system, and may thence all be traced into western New England. In Dr. Percival's geological report and map of Connecticut, published in 1840, it will be seen that he refers to the gneiss of the Highlands two gneissic areas in Litchfield county; the one occupying parts of Cornwall and Ellsworth, and the other extending from Torrington, northward through Winchester, Norfolk and Colebrooke into Berkshire county, Massachusetts. Farther investigations may confirm the accuracy of Percival's identification, and show the Laurentian age of these New England gneisses, a view which is apparently supported by the mineralogical characters of some of the rocks in this region. Emmons informs us that primary limestones with graphite. (perhaps Laurentian), are met with in the Hoosic range in Massachusetts east of the Stockbridge (Taconic) limestones.

The rocks of the second series are traceable from southwestern Connecticut northward to the Green Mountains in Vermont, and the micaceous schists and gneisses of the third or White Mountain series are found both to the east and the west of the Mesozoic valley in Connecticut and Massachusetts. They also occupy a considerable area in eastern Vermont, where they are separated from the White Mountain range by an outcrop of rocks of the second series. To the southeast of the White Mountains, along our line of section, the same mica-schists and gneisses, often with very moderate dips, extend as far as Portland, Maine, where they are interrupted by the outcropping of greenish chloritic and chromiferous schists, in nearly vertical beds, which appear to belong to the second series.

I find that the strata of the second series appear from beneath the Carboniferous at Newport, Rhode Island, in a nearly vertical attitude, and also in the vicinity of Boston and Brighton, Saugus and Lynnfield. Their relations in this region to the gneisses with crystalline limestones of Chelmsford, etc., which I have referred to the Laurentian series,* have yet to be determined.

We have already mentioned that the crystalline rocks of Pennsylvania pass into Maryland and Virginia, where, as H. D. Rogers

* Amer. Jour. Sci., II, xlix, 75.

informs us, they appear in the mountains of the Blue Ridge. It remains to be seen whether the three types which we have pointed out in Pennsylvania are to be recognized in this region. A great belt of crystalline schists extends from Virginia through North and South Carolina, and into eastern Tennessee, where, according to Safford, these rocks underlie the Potsdam. It is easy, from the reports of Lieber on the geology of South Carolina, to identify in this state the two types of the Green Mountain and White Mountain series. The former, as described by him, consists of talcose, chloritic and epidotic schists, with diorites, steatites, actinolite-rock and serpentines. It may be noted that he still adheres to the notion of the eruptive origin of the last three rocks, which the observations of Emmons, Logan and myself in the Green Mountains have shown to be untenable. These rocks in South Carolina generally dip at very high angles. The great gneissic area of Anderson and Abbeville districts is described by Lieber as consisting of fine-grained grey gneisses with micaceous and hornblendic schists, and is cut by numerous veins of pegmatite, holding garnet, tourmaline and beryl. These rocks, which have the characters of the White Mountain series, appear, from the incidental observations to be found in Lieber's reports, to belong to a higher group than the chloritic and serpentinic series, and to dip at comparatively moderate angles.

Professor Emmons, whose attention was early turned to the geology of western New England, did not distinguish between the three types which we have defined, but, like Rogers in Pennsylvania, included all the crystalline rocks of that region in the primary system. It is to him, however, that we owe the first correct notions of the geological nature and relations of the Green Mountains. These, he has remarked, are often made to include two ranges of hills belonging to different geological series. The eastern range, including the Hoosic Mountain in Massachusetts, and Mount Mansfield in Vermont, he referred to the primary; which he described as including gneiss, mica-schist, talcose slate and hornblende, with beds and veins of granite, limestone, serpentine and trap. He declared, moreover, that there is no clear line of demarcation among the various schistose primary rocks, and cited, as an illustration, the passage into each other of serpentine, steatite and talcose schist. His description of the crystalline rocks of this range will be recognized as comprehensive and truthful.

have broken the strata, given them an eastward dip, and caused the newer beds to pass successively beneath the older ones. thus producing an *apparently inverted succession*, and making their present seeming order of superposition completely deceptive. In speaking of this supposed arrangement of the members of his Taconic system, Emmons alluded to them as "inverted strata;" while by Mr. Marcou, the strata were said to be "overturned on each side of the crystalline and eruptive rocks which occupy the centre of the chain, producing thus a fan-shaped structure," etc.* I have elsewhere shown that this notion, though to some extent countenanced by his vague and inaccurate use of terms, was never entertained by Emmons, whose own view, as defined in his *Taconic System* (p. 17),† is that just explained.

The view of Emmons that there exists at the western base of the Green Mountains, older fossiliferous series underlying the Potsdam, met with general opposition from American geologists. In May, 1844, H. D. Rogers, in his address as President, before the American Association of Geologists, then met at Washington, criticised this view at length, and referred to a section from Stockbridge, Massachusetts, to the Hudson River, made by W. B. Rogers and himself, and by them laid before the American Philosophical Society in January, 1841. They then maintained that the quartz-rock of the Hoosic range was Potsdam, the Berkshire marble identical with the blue limestone of the Hudson valley, and the associated micaceous and talcose schists, altered strata of the age of the slates at the base of the Appalachian system; that is to say, primal in the nomenclature of the Pennsylvania survey.

In 1843 Mather had asserted the Champlain age of the same crystalline rocks, and claimed that the whole of the division was there represented, including the Potsdam, the Hudson River group, and the intermediate limestones.‡ The conclusion of Mather was cited with approbation by Rogers, who apparently adopted it, and

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*Comptes Rendus de l'Acad., LIII, 804.

†See my further discussion of the matter, Amer. Jour. Sci., II. xxxii. 427. xxxiii, 135. 281. It is by an oversight that I have, in the latter volume, page 135, represented Barrande as sharing the misconception of Marcou, although his language, without careful scrutiny, would lead us to such a conclusion. In fact in the Bull. soc. Geol. de France II, xviii. 251), in an elaborate study of the Taconic question, Barrande heads a section thus, "*Renversement conçu pour tout un système*," and then proceeds to show that the *renversement* or *overturn* is only apparent, by explaining, in the language of Emmons, the view already set forth above.

‡Geology of the Southern District of New York, p. 138.

claimed that Hitchcock held a similar view. It will be seen that these geologists thus united in one group, the schists of the Hoosic range (regarded by Emmons as primary), with those of the Taconic range, and referred both to the age of the Champlain division, the whole of which was supposed to be included in the group.

In the same address Professor Rogers raised a very important question. Having referred to the Potsdam sandstone, which on Lake Champlain forms the base of the paleozoic system, he inquires, "Is this formation then the lowest limit of our Appalachian masses generally, or is the system expanded downward in other districts by the introduction beneath it of other conformable sedimentary rocks?" He then proceeded to state that from the Susquehanna River, southwestward, a more complex series appears at the base of the lower limestone than to the north of the Schuylkill, and in some parts of the Blue Ridge he includes in the primal division (beneath the Caleiferous sandrock) "at least four independent and often very thick deposits, constituting one general group, in which the Potsdam or white sandstone (with Scolithus) is the second in descending order." This sandstone is overlaid by many hundred feet of arenaceous and ferriferous fucoidal slate, and underlaid by coarse sandy shales and flagstones; below which, in Virginia and East Tennessee, is a series of heterogeneous conglomerates, which rest on a great mass of crystalline strata. The accuracy of these statements is confirmed by Safford, who, in his recent report on the geology of Tennessee (1869), places at the base of the column a great series of crystalline schists, apparently representatives of those of southeastern Pennsylvania. Upon these repose what Safford designates as the Potsdam group, including, in ascending order, the Ocoee slates and conglomerates, estimated at 10,000 feet, and the Chilhowee shales and sandstones, 2,000 feet or more, with fucoids, worm-burrows and Scolithus. These are conformably overlaid by the Knoxville division, consisting of fucoidal sandstones, shales, and limestones, the latter two holding fossils of the age of the Caleiferous sandrock. It is noteworthy that these rocks are greatly disturbed by faults, and that in Chilhowee Mountain the lower conglomerates are brought on the east against the Carboniferous limestone, by a vertical displacement of at least 12,000 feet. The general dip of all these strata, including the basal crystalline schists, is to the southeast.

The primal paleozoic rocks of the Blue Ridge were then by Rog-

ers, as now by Safford, looked upon as wholly of Potsdam age, including the Scolithus sandstone as a subordinate member. so that the strata beneath this were still regarded as belonging to the New York system. Hence, while Rogers inquires whether the Taconic system "may not along the western border of Vermont and Massachusetts include also some of the sandy and slaty strata here spoken of as lying beneath the Potsdam sandstone"* he would still embrace these lower strata in the Champlain division.

Thus we see that at an early period the rocks of the Taconic system were, by Rogers and Mather, referred to the Champlain division of the New York system, a conclusion which has been sustained by subsequent observations. Before discussing these, and their somewhat involved history, we may state two questions which present themselves in connection with this solution of the problem. First, whether the Taconic system, as defined by Emmons, includes the whole or a part of the Champlain division; and second, whether it embraces any strata older or newer than the members of this portion of the New York system. With reference to the first question it is to be remarked that in their attempts to compare the Taconic rocks with those of the Champlain division as seen farther to the west, observers were led by lithological similarities to identify the upper members of the latter with certain portions of the Taconic. In fact, the Trenton limestone, with the Utica slates and the Loraine or Hudson River shales, making together the upper half of the Champlain division (in which Emmons moreover included the overlying Oneida and Medina conglomerates and sandstones), have in New York an aggregate thickness of not less than three or four thousand feet, and offer many lithological resemblances to the great mass of sediments at the western base of the Green Mountains, to which the name of Taconic had been applied. It is curious to find that Emmons, in 1842, referred to the Medina the Red sandrock of the east shore of Lake Champlain, since shown to be Potsdam; and, moreover, placed the Sillery sandstone of the neighborhood of Quebec at the summit of the Champlain division, as the representative of the Oneida conglomerate; while at the same time he noticed the great resemblance which this sandstone, with its adjacent limestones, bore to similar rocks on the confines of Massachusetts, already referred by him to the Taconic system.†

* Amer. Jour. Sci., I, xlvii, 152, 153.

† Geol. Northern District of New York, pp. 124, 125.

This view of Emmons as to the Quebec rocks was adopted by Sir William Logan, when, a few years afterwards, he began to study the geology of that region. The sandstone of Sillery was described by him as corresponding to the Oneida or Shawangunk conglomerate, while the limestones and shales of the vicinity, which were supposed to underlie it, were regarded as the representatives of the Trenton, Utica, and Hudson River formations.* By following these rocks along the western base of the Appalachians into Vermont and Massachusetts, they were found to be a continuation of the Taconic system, which Sir William was thus led to refer to the upper half of the Champlain division, as had already been done by Professor Adams in 1847.† As regards the crystalline strata of the Appalachians in this region, he, however, rejected the view of Emmons, and maintained that put forward by the Messrs. Rogers in 1841, viz., that these, instead of being older rocks, were but these same upper formations of the Champlain division in an altered condition; a view which was maintained during several years in all of the publications of those connected with the geological survey of Canada.

This conclusion, so far as regards the age of the unaltered fossiliferous rocks from Quebec to Massachusetts, was supposed to be confirmed by the evidence of organic remains found in them in Vermont. Mr. Emmons had described as characteristic of the upper part of the Taconic system, two crustaceans, to which he gave the names of *Atops trilineatus* and *Elliptocephalus asaphoides*; the other fossils noticed by him being graptolites, fucoids, and what were apparently the marks of annelids. In 1847 Professor James Hall, in the first volume of his Paleontology, declared the Atops of Emmons to be identical with *Triarthrus* (*Calymene*) *Beckii*, a characteristic fossil of the Utica slate; while the Elliptocephalus was referred by him to the genus *Olenus*, now known to belong to the primordial fauna of Sweden, where it is found in slates lying beneath the orthoceratite limestone, and near the base of the paleozoic series. Although, as it now appears, the geological horizon of the Olenus slates was well known to Hisinger, this author in his classic work, *Lethæa Suecica*, published in 1837, represents, by some unexplained error, these slates as overlying the orthoceratite

*Geol. Survey of Canada, 1847–48, pp. 27, 57; and Amer. Jour. Sci., II. ix. 12.
†Amer. Jour. Sci., II, v, 108.

limestone, which is the equivalent of the Trenton limestone of the Champlain division. Hence, as Mr. Barrande has remarked, Hall was justified by the authority of Hisinger's published work in assigning to the Olenus slates of Vermont a position above that limestone, and in placing them, as he then did, on the horizon of the Hudson River or Loraine shales. The double evidence afforded by these two fossil forms in the rocks of Vermont, served to confirm Sir William Logan in placing in the upper part of the Champlain division the rocks which he regarded as their stratigraphical equivalents near Quebec; and which, as we have seen, had some years before been by Emmons himself assigned to the same horizon. The remarkable compound graptolites which occur in the shales of Pointe Levis, opposite Quebec, were described by Professor James Hall in the report of the Geological Survey of Canada for 1857, and were then referred to the Hudson River group; nor was it until August, 1860, that Mr. Billings described from the limestones of this same series at Pointe Levis a number of trilobites, among which were several species of Agnostus, Dikelocephalus, Bathyurus, etc., constituting a fauna whose geological horizon he decided to be in the lower part of the Champlain division.

Just previous to this time, in the Report of the Regents of the University of New York for 1859, Professor Hall had described and figured by the name of Olenus, two species of trilobites from the slates of Georgia, Vermont, which Emmons had wrongly referred to the genus Paradoxides. They were at once recognized by Barrande, who called attention to their primordial character, and thus led to a knowledge of their true stratigraphical horizon, and to the detection of the singular error in Hisinger's book, already noticed, by which American geologists had been misled.* They have since been separated from Olenus, and by Professor Hall referred to a new and closely related genus, which he has named Olenellus, and which is now regarded as belonging to the horizon of the Potsdam sandstone, to which we shall presently advert.

Farther studies of the fossiliferous rocks near Quebec showed the existence of a mass of sediments estimated at about 1200 feet, holding a numerous fauna, and corresponding to a great development of strata about the age of the Calciferous and Chazy formations, or more exactly to a formation occupying a position

*For the correspondence on this matter between Barrande, Logan and Hall, see Amer. Jour. Sci., II, xxxi, 210–226.

between these two, and constituting, as it were, beds of passage between them. In this new formation were included the graptolites already described by Hall, and the numerous crustacea and brachiopoda described by Billings, all of which belong to the Levis slates and limestones. To these and their associated rocks Sir William Logan then gave the name of the Quebec group, including, besides the fossiliferous Levis formation, a great mass of overlying slates, sandstones and magnesian limestones, hitherto without fossils, which have been named the Lauzon rocks, and the Sillery sandstones and shales, which he supposed to form the summit of the group, and which had afforded only an Obolella and two species of Lingula;* the volume of the whole group being about 7000 feet.

The paleontological evidence thus obtained by Billings and by Hall, both from near Quebec and in Vermont, led to the conclusion that the strata of these regions, so much resembling the upper members of the Champlain division, were really a great development, in a modified form, of some of its lower portions. Their apparent stratigraphical relations were explained by Logan by the supposition of "an overturned anticlinal fold, with a crack and a great dislocation running along the summit, by which the Quebec group is brought to overlie the Hudson River group. Sometimes it may overlie the overturned Utica formation, and in Vermont points of the overturned Trenton appear occasionally to emerge from beneath the overlap." He, at the same time, declared that "from the physical structure alone, no person would suspect the break that must exist in the neighborhood of Quebec, and, without the evidence of fossils, every one would be authorized to deny it."†

The rocks from western Vermont, which had furnished to Hall the species of Olenellus, have long been known as the Red sandrock, and as we have seen, were by Emmons, in 1842, referred to the age of the Medina sandstone, a view which the late Professor Adams still maintained as late as 1847.‡ In the mean time Emmons had, in 1855, declared this rock to represent the Calciferous and Potsdam formations, the brown sandstones of Burlington and Charlotte, Vermont, being referred to the latter.§

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*See Billings, Paleozoic Fossils of Canada, p. 69.

†Logan's letter to Barrande, Amer. Jour. Sci., II, xxxi, 218. The true date of this letter was December 31st, 1860, but, by a misprint, it is made 1831.

‡Adams, Amer. Jour. Sci., II, v, 108.

§Emmons, American Geology, II, 128.

This conclusion was confirmed by Billings, who, in 1861, after visiting the region and examining the organic remains of the Red sandrock, assigned to it a position near the horizon of the Potsdam.* Certain trilobites found in this Red sandrock by Adams in 1847, were by Hall recognized as belonging to the European genus *Conocephalus* (= *Conocephalites* and *Conocoryphe*), whose geological horizon was then undetermined.† The formation in question consists in great part of a red or mottled granular dolomite, associated with beds of fucoidal sandstone, conglomerates and slates. These rocks were carefully examined by Logan in Swanton, Vermont, where, according to him, they have a thickness of 2200 feet, and include toward their base a mass of dark colored shales holding Olenellus with Conocephalites, Obolella, etc.; *Conocephalites Teucer*, Billings, being common to the shales and the red sandy beds.‡ Many of these fossils are also found at Troy and at Bald Mountain, New York, where they accompany the Atops of Emmons, now recognized by Billings as a species of Conocephalites.

A similar condition of things extends northeastward along the Appalachian region. On the south side of the St. Lawrence below Quebec a great thickness of limestones, sandstones, and slates, formerly referred to the Quebec group, is now regarded by Billings as, in part at least, of the Potsdam formation; while on the coast of Labrador, and in northern Newfoundland the same formation, characterized by the same fossils as in Vermont, is largely developed, attaining in some parts, according to Murray, a thickness of 3000 feet or more. Along the northern coast of the island it is nearly horizontal, and appears to be conformably overlaid by about 4000 feet of fossiliferous strata representing the Calciferous sandrock and the succeeding Levis formation.

Mr. Billings has described a section from the Laurentian of Crown Point, New York, to Cornwall, Vermont, from which it appears that to the eastward of a dislocation which brings up the Potsdam to overlie the higher members of the Champlain division, the Potsdam is itself overlaid, at a small angle, by a great mass of limestones representing the Calciferous, and having at the summit some of the characteristic fossils of the Levis formation. Next in

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*Amer. Jour. Sci., II, xxxii, 232.
†Ibid., II, xxxiii, 374.
‡Geology of Canada, 1863, p. 281. Amer. Jour. Sci., II, xlvi, 224.

ascending order are not less than 2000 feet of limestones with Trenton fossils (embracing probably the Chazy division), while to the east of this the Levis again appears, including the white Stockbridge limestones.* We have here an evidence that the augmentation in volume observed in the lower members of the Champlain division in the Appalachian region extends to the Trenton, which to the west of Lake Champlain is represented, the Chazy included, by not more than 500 feet of limestone. The Potsdam, in the latter region, consists of from 500 to 700 feet of sandstone holding Conocephalites and Lingulella, and overlaid by 300 feet of magnesian limestone, the so-called Caleiferous sandrock. In the valley of the Mississippi these two formations in Iowa, Missouri, and Texas, are represented by from 800 to 1300 feet of sandstones and magnesian limestones, while in the Black Hills of Nebraska, according to Hayden, the only representative of these lower formations is about one hundred feet of sandstone holding Potsdam fossils.†

In striking contrast to this it has been shown that along the Appalachian range from Newfoundland to Tennessee these lower formations are represented by from 8000 to 15000 feet of fossiliferous sediments. It has been suggested by Logan that these widely differing conditions represent deep-sea accumulations on the one hand, and the deposits from a shallow sea which covered a submerged continental plateau, on the other; the sediments in the two areas being characterized by a similar fauna, though differing greatly in lithological characters and in thickness. To this we may add that the continental area, being probably submerged and elevated at intervals, became overlaid with beds which represent only in a partial and imperfect manner the great succession of strata which were being accumulated in the adjacent ocean.‡

In a paper which I hope to present to the geological section during the present meeting of the Association it will be shown from a study of the rocks of the Ottawa basin that the typical Champlain division not only presents important paleontological breaks, but evidences of statigraphical discordance at more than one horizon over the continental area, which, as the result of widely spread movements, might be supposed to be represented in the Appalachian region. In the latter Logan has already observed

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* Amer. Jour. Sci., 227.
† Ibid., II, xxv, 439, xxxi, 234.
‡ Ibid., II, xlvi, 225.

that the absence of all but the highest beds of the Levis along the eastern limit of the Potsdam, near Swanton, Vermont, while the whole thickness of them appears a little farther westward, makes it probable that there is a want of conformity between the two; and I have in this connection insisted upon the entire absence in this locality of the Calciferous, which is met with a little farther south in the section just mentioned, as another evidence of the same unconformity.* There are also, I think, reasons for suspecting another stratigraphical break at the summit of the Quebec group, in which case many problems in the geological structure of this region will be much simplified.

It should be remembered that the conditions of deposition in some areas have been such that accumulations of strata, corresponding to long geologic periods, and elsewhere marked by stratigraphical breaks, are arranged in conformable superposition; and moreover that movements of elevation and depression have even caused great paleontological breaks, which over considerable areas are not marked by any apparent discordance. Thus the remarkable break in the fauna between the Calciferous and the Chazy is not accompanied by any noticeable discordance in the Ottawa basin, and in Nebraska, according to Hayden, the Potsdam, Carboniferous, Jurassic and Cretaceous formations are all represented in about 1200 feet of conformable strata.† In Sweden the whole series from the base of the Cambrian to the summit of the Upper Silurian appears as a conformable sequence, while in North Wales, although there is no apparent discordance from the base of the Cambrian to the summit of the Lingula flags, stratigraphical breaks, according to Ramsay, probably occur both at the base and the summit of the Tremadoc slates,‡ which are considered equivalent to the Levis formation.

We have seen that, according to Logan, a dislocation a little to the north of Lake Champlain causes the Quebec group to overlie the higher members of the Champlain division. The same uplift, according to him, brings up, farther south, the Red sandrock of Vermont, which to the west of the dislocation rests upon the upturned and inverted strata of various formations from the Calciferous sandrock to the Utica and Hudson River shales. These

* Amer. Jour. Sci., II, xlvi, 225.
† Ibid., II. xxv, 440.
‡ Quar. Geol. Journal, xix, page xxxvi.

latter, according to him, are seen to pass for considerable distances beneath nearly horizontal layers of the Red sandrock, the Utica slate, in one case, holding its characteristic fossil, *Triarthrus Beckii*. This relation, which is well shown in a section at St. Albans, figured by Hitchcock,* was looked upon by Emmons and by Adams as evidence that the Red sandrock was the representative of the Medina sandstone of the New York system. When, however, the former had recognized the Potsdam age of the sandrock, with its Olenellus, which he supposed to be Paradoxides, this condition of things was conceived to be an evidence of the existence beneath the Potsdam of an older and unconformable fossiliferous series already mentioned.

The objections made by Emmons to Rogers's view of the Champlain age of the Taconic rocks were three-fold: first, the great differences in lithological characters, succession and thickness, between these and the rocks of the Champlain division as previously known in New York; second, the supposed unconformable infraposition of a fossiliferous series to the Potsdam: and third, the distinct fauna which the Taconic rocks were supposed to contain. The first of these is met by the fact now established that in the Appalachian region, the Champlain division is represented by rocks having, with the same organic remains, very different lithological characters, and a thickness ten-fold greater than in the typical Champlain region of northern New York. The second objection has already been answered by showing that the rocks which pass beneath the Potsdam are really newer strata belonging to the upper part of the division, and contain a characteristic fossil of the Utica slate. As to the third point, it has also been met, so far as regards the Atops and Elliptocephalus, by showing these two genera to belong to the Potsdam formation. If we inquire farther into the Taconic fauna we find that the Stockbridge limestone (the Eolian limestone of Hitchcock), which was placed by Emmons near the base of the Lower Taconic, (while the Olenellus slates are near the summit of the Upper Taconic), is also fossiliferous, and contains, according to the determinations of Professor Hall, species belonging to the genera Euomphalus, Zaphrentis, Stromatopora, Chaetetes and Stictopora.† Such a fauna would lead to the con-

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* Geology of Vermont, p. 374.

† Geology of Vermont, 419, and Amer. Jour. Sci., II, xxxiii, 419.

clusion that these limestones instead of being older, were really newer than the Olenellus beds, and that the apparent order of succession was, contrary to the supposition of Emmons, the true one. This conclusion was still farther confirmed by the evidence obtained in 1868 by Mr. Billings, who found in that region a great number of characteristic species of the Levis formation, many of them in beds immediately above or below the white marbles,* which latter, from the recent observations of the Rev. Augustus Wing in the vicinity of Rutland, Vermont, would seem to be among the upper beds of the Potsdam formation. Thus while some of the Taconic fossils belong to the Potsdam and Utica formations, the greater number of them, derived from beds supposed to be low down in the system, are shown to be of the age of the Levis formation. There is, therefore, at present, no evidence of the existence, among the unaltered sedimentary rocks of the western base of the Appalachians in Canada or New England, of any strata more ancient than those of the Champlain division, to which, from their organic remains, the fossiliferous Taconic rocks are shown to belong.

Mr. Billings has, it is true, distinguished provisionally what he has designated an upper and a lower division of the Potsdam, and has referred to the latter the Red sandrock with the Olenellus slates of Vermont, together with beds holding similar fossils at Troy, New York, and along the straits of Bellisle in Labrador and Newfoundland; the upper division of the Potsdam being represented by the basal sandstones of the Ottawa basin and of the Mississippi valley.† In the present state of our knowledge of the local variations in sediments and in their fauna dependent on depth, temperature and ocean currents, Billings, however, conceives that it would be premature to assert that these two types of the Potsdam do not represent synchronous deposits.

The base of the Champlain division, as known in the Potsdam formation of New York, of the Mississippi valley and the Appalachian belt, does not, however, represent the base of the paleozoic series in Europe. The Alum slates in Sweden are divided into two parts, an upper or Olenus zone, and a lower or Conocoryphe zone, as distinguished by Angelin. The latter is characterized by

* Amer. Jour. Sci., II, xlvi, 227.
† Report Geol. of Canada, 1863–66, p. 236.

the genus Paradoxides, which also occupies a lower division in the primordial paleozoic rocks of Bohemia (Barrande's stage C), the greater part of which are regarded as the equivalent of the Olenus zone of Sweden and the Potsdam of North America. The Lingula flags of Wales belong to the same horizon, and it is at their base, in strata once referred to the Lower Lingula flags, that the Paradoxides is met with. These strata, for which Hicks and Salter, in 1865, proposed the name of the Menevian group, are regarded as corresponding to the lower division of the Alum slates, and, like it, contain a fauna not yet recognized in the basal rocks of the New York system. We here approach the debatable land between the Cambrian and the Silurian of the British geologists. The Cambrian, as originally claimed by Sedgwick, included in its upper division the Middle and Upper Lingula flags, with the overlying Tremadoc slates, to the base of the Llandeilo rocks, and may be regarded as equivalent to the Potsdam, Calciferous and Levis formations; while in the Lower Cambrian were embraced the Lower Lingula flags and the Upper and Lower Longmynd rocks, corresponding respectively to the Harlech grits and the Llanberis slates. A portion of the Cambrian has, however, been claimed for the Silurian by Murchison, who draws the dividing line at the top of the Longmynd rocks, leaving the three divisions of the Lingula flags in the Silurian. Lyell, on the contrary, remarks that the Menevian beds, which were, on lithological grounds, made by Sedgwick a part of the Lower Lingula flags, have been shown by Hicks and Salter to be very distinct from these paleontologically: and, while he includes the Menevian in the Lower Cambrian, refers the whole of the Lingula flags to the Upper Cambrian.

Lyell therefore admits the whole of the Cambrian system as originally defined by Sedgwick, and the same classification is now adopted by Linarsson, in Sweden, where in Westrogothia, the Cambrian rocks, (resting unconformably on the crystalline schists to be noticed farther on), are overlaid conformably by the orthoceratite limestones, which are by him regarded as forming the base of the Silurian, and as the equivalent of the Llandeilo rocks of Wales. The total thickness of these lower rocks in Sweden, including the representatives of the Lingula flags, the Menevian beds and an underlying fucoidal (Eophyton) sandstone, is only three hundred feet, while the first two divisions in Wales have a thickness of five to six thousand, and the Harlech grits and Llanberis slates

(including the Welsh roofing-slates beneath) amount to eight thousand feet additional. Recent researches show that these lower rocks in Wales contain an abundant fauna, extending downward some 2800 feet from the Menevian to the very base of strata regarded as the representatives of the Harlech grits. The brachiopoda of the Harlech beds appear identical with those of the Menevian, but new species of *Conocephalites*, *Microdiscus* and *Paradoxides* are met with, besides a new genus, *Plutonia*, allied to the last mentioned. Mr. Hicks, to whom we owe these discoveries,* remarks, that the Menevian gives us, for the present, a well marked paleontological horizon for the summit of the Cambrian, corresponding with the Lower Cambrian as defined by Sedgwick.

The Upper Cambrian in North America would thus include the lower half of the Champlain division from the base of the Potsdam to the summit of the Levis (including perhaps the Chazy), while the Lower Cambrian, (the Cambrian of Murchison and Hicks) is represented by the strata holding Paradoxides in Newfoundland, New Brunswick and eastern Massachusetts. Although no strata marked by these fossils have yet been found in the Appalachians, it is not improbable that such may yet be met with. In May, 1861, I called attention to the fact that beds of quartzose conglomerate at the base of the Potsdam in Hemmingford, near the outlet of Lake Champlain on its western side, contain fragments of green and black slates, "showing the existence of argillaceous slates before the deposition of the Potsdam sandstone."† The more ancient strata, which furnished these slaty fragments to the Potsdam conglomerate, have perhaps been destroyed, or are concealed, but they or their equivalents may yet be discovered in some part of the great Appalachian region. They should not, however, be called Taconic, but receive the prior designation of Cambrian, unless, indeed, it shall appear that the source of these slate fragments was the more argillaceous beds of the still older Huronian schists. Emmons regarded his Taconic system as the equivalent of the Lower Cambrian of Sedgwick, but when in 1842, Murchison announced that the name of Cambrian had ceased to have any zoological significance, being identical with Lower Silurian,‡ Emmons, conceiving, as he tells us, that all

* Geol. Mag., V, 306; and Rep. Brit. Assoc., 1868, p. 69; also Harkness and Hicks in Nature, Proc. Geol. Soc., May 10, 1871.

† Amer. Jour. Sci., II, xxxi, 404.

‡ Proc. Geol. Soc., London, III, 642.

Cambrian rocks were not Silurian, instead of maintaining Sedgwick's name, which with the progress of paleontological study is assuming a great zoological importance, devised the name of Taconic, as synonymous with Lower Cambrian;* although, as we have seen, there is as yet no paleontological evidence to identify any portion of the Taconic strata with the well-defined Lower Cambrian rocks of our eastern shores.

The crystalline infra-Silurian strata, to which the name of the Huronian series has been given by the Geological Survey of Canada, have sometimes been called Cambrian from their resemblance to certain rocks in Anglesea, which have been looked upon as altered Cambrian. The typical Cambrian rocks of Wales, down to their base, are however unerystalline sediments, and, as pointed out by Dr. Bigsby in 1863,† are not to be confounded with the Huronian, which he regarded as equivalent to the second division of the so-called azoic rocks of Norway, the *Urschiefer* or primitive schists, which in that country rest unconformably on the primitive gneiss (*Urgneiss*), and are in their turn overlaid unconformably by the fossiliferous Cambrian strata. This second or intermediate series in Norway is characterized by eurites, micaceous, chloritic and hornblendic schists, with diorites, steatite and dark colored serpentines, generally associated with chrome: and abounds in ores of copper, nickel and iron. In its mineralogical and lithological characters, the Urschiefer corresponds with what we have designated the second series of crystalline schists. It is, in Norway, divided into a lower or quartzose division, marked by a predominance of quartzites, conglomerates and more massive rocks, and an upper and more schistose division. Macfarlane, who was familiar with the rocks of Norway, after examining both the Huronian of Lake Superior and the crystalline strata of the Green Mountains, had already, in 1862, declared his opinion that both of these were representatives of the Norwegian Urschiefer,‡ thus anticipating, from his comparative studies, the conclusions of Bigsby.

The crystalline rocks of Anglesea and the adjacent part of Caernarvon, which have been described and mapped by the British Geological Survey as altered lowest Cambrian, are directly overlaid by strata of the Llandeilo and Bala divisions, corresponding

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* Emmons, Geol. N. District of New York, 162; and Agric. of New York, I, 49.

† Quar. Jour. Geol. Soc., XIX, 36.

‡ Canadian Naturalist, VII, 125.

to the Trenton and Hudson River formations. If we consult Ramsay's report on the region, it will be found that he speaks of them as "probably Cambrian," and states as a reason for that opinion, that they are connected by certain beds of intermediate lithological characters with strata of undoubted Cambrian age.* These, however, as he admits, present great local variations, and, after carefully scanning the whole of the evidence adduced, I am inclined to see in it nothing more than the existence, in this region, of Cambrian strata made up from the ruins from the great mass of pre-Cambrian schists, which are the crystalline rocks of Anglesea. Such a phenomenon is repeated in numerous instances in our North American rocks, and is the true explanation of many supposed examples of passage from crystalline schists to uncrystalline sediments. The Anglesea rocks are a highly inclined and much contorted series of quartzose, micaceous, chloritic and epidotic schists, with diorites and dark colored chromiferous serpentines, all of which, after a careful examination of them in the collections of the Geological Survey of Great Britain, appear to me identical with the rocks of the Green Mountain or Huronian series. A similar view of their age is shared by Phillips and by Sedgwick, in opposition to the opinion of the British survey. The former asserts that the crystalline schists of Anglesea are "below all the Cambrian rocks;"† while Sedgwick expresses the opinion that they are of "a distinct epoch from the other rocks of the district, and evidently older."‡

Associated with the fossiliferous Devonian rocks of the Rhine, is a series of crystalline schists, similar to those just noticed, seen in the Taunus, the Hundsrück and the Ardennes. These, in opposition to Dumont, who regarded them as belonging to an older system, are declared by Römer to have resulted from a subsequent alteration of a portion of the Devonian sediments.§

Turning now to the Highlands of Scotland, we have a similar series of crystalline schists, presenting all the mineralogical characters of those of Norway and of Anglesea, which, according to Murchison and Geikie, are neither of Cambrian nor pre-Cambrian age, but are younger than the fossiliferous limestones of the west-

* Geol. of North Wales, pp. 145, 175.
† Manual of Geology (1855) 89.
‡ Geol. Journal for 1845, 449.
§ Naumann, Geognosie, 2d edition, II, 383.

ern coast (about the horizon of the Levis formation) which seem to pass beneath them. Professor Nicol, on the contrary, maintains that this apparent super-position is due to uplifts, and that these crystalline schists are really older than either Cambrian or Silurian, both of which appear to the west of them as unerystalline sediments, resting on the Laurentian. He does not, however, confound these crystalline schists of the Scottish Highlands with the Laurentian, from which they differ mineralogically, but regards them as a distinct series.* In the presence of the differences of opinion which have been shown in this controversy, we may be permitted to ask whether, in such a case, stratigraphical evidence alone is to be relied upon. Repeated examples have shown that the most skilful stratigraphists may be misled in studying the structure of a disturbed region where there are no organic remains to guide them, or where unexpected faults and overslides may deceive even the most sagacious. I am convinced that in the study of the crystalline schists, the persistence of certain mineral characters must be relied upon as a guide, and that the language used by Delesse, in 1847, will be found susceptible of a wide application to crystalline strata. "Rocks of the same age have most generally the same chemical and mineralogical composition, and reciprocally, rocks having the same chemical composition and the same minerals, associated in the same manner, are of the same age."†

In this connection the testimony of Professor James Hall is to the point. Speaking of the crystalline schists of the White Mountain series, he says: —

"Every observing student of one or two years experience in the collection of minerals in the New England States, knows well that he may trace a mica-schist of peculiar but varying character from Connecticut, through central Massachusetts, and thence into Vermont and New Hampshire, by the presence of staurolite and some other associated minerals, which mark with the same unerring certainty the geological relations of the rock as the presence of *Pentamerus oblongus*, *P. galeatus*, *Spirifer Niagarensis*, or *S. macropleura*, and their respectively associated fossils do the relations of the several rocks in which these occur."‡

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*Quar. Jour. Geol. Soc.; Murchison, XV, 353; Giekie, XVII, 171; Nicol, XVII, 58, XVIII, 443.

†Bull. Soc. Geol. de Fr. (2), IV, 786.

‡Paleontology of New York, Vol. III, Introduction, page 93.

I am convinced that these crystalline schists of Germany, Anglesea, and the Scotch Highlands, will be found, like those of Norway, to belong to a period anterior to the deposition of the Cambrian sediments, and will correspond with the newer gneissic series of our Appalachian region. There exists, in the Highlands of Scotland, a great volume of fine-grained, thin-bedded mica-schists with andalusite, staurolite and cyanite, which are met with in Argyleshire, Aberdeenshire, Banffshire and the Shetland Isles. Rocks regarded by Harkness as identical with these of the Scottish Highlands also occur in Donegal and Mayo in Ireland. Through the kindness of the Rev. Prof. Haughton of Trinity College, and Mr. Robert H. Scott, then of Dublin, I received some years since, a large collection of the crystalline rocks of Donegal, which I am thus enabled to compare with those of North America, and to assert the existence in the northwest of Ireland, of our second and third series of crystalline schists. The Green Mountain rocks are there exactly represented by the dark colored chromiferous serpentines of Aghadoey, and the steatite, crystalline talc and actinolite of Crohy Head; while the mica-schist of Loch Derg, with white quartz, blue cyanite, staurolite and garnet, all united in the same fragment, cannot be distinguished from specimens found at Cavendish, Vermont, and Windham, Maine. The fine-grained andalusite-schists of Clooney Lough are exactly like those from Mount Washington; while the granitoid mica-slates from several other localities in Donegal are not less clearly of the type of the White Mountain series. Similar micaceous schists, with andalusite (chiastolite), occur on Skiddaw, in Cumberland, England, the relations of which have been clearly defined by Sedgwick, who groups the rocks of Skiddaw into four divisions. The lowest of these, succeeding the granite, is a series of crystalline rocks, not described lithologically, with mineral veins, "having some resemblance to the rocks of Cornwall," and including towards the summit, "chiastolite schists and chiastolite rocks." These are followed in ascending order by two great series of slates and grits, succeeded by a fourth division of schists, sometimes carbonaceous, holding in parts fucoids and graptolites, which are apparently overlaid discordantly by sundry trappean conglomerates and chloritic slates.* The graptolites of the Skiddaw slates

* Synopsis of British Paleozoic Rocks, p. lxxxiv, being an introduction to McCoy's Brit. Pal. Fossils (1855).

are found to be identical with those of the Levis formation,* and it is worthy of notice that although Sedgwick places the mica-schists with andalusite (chiastolite) so far below the graptolitic beds, he elsewhere, in comparing the rocks of North Wales and Cumberland, states that the chloritic and micaceous rocks of Anglesea and Caernarvon are not represented in Cumberland, being distinct from the other rocks of North Wales, and much older.†

In Victoria, Australia, the position of the chiastolite schists, according to Selwyn, is beneath the graptolitic slates. Boblaye, it is true, asserted in 1838 that the chiastolite schists of Les Salles, near Pontivy in Brittany, include *Orthis* and *Calymene*,‡ but when we remember that even experienced observers in the White Mountains for a time mistook for remains of crustacea and brachiopods, certain obscure forms, which they afterwards found not to be organic, and that Dana, in this connection, has called attention to the deceptive resemblance to fossils presented by some imperfectly developed chiastolite crystals in the same region,§ we may well require a verification of Boblaye's observation, especially since we find that more recently D'Archiac and Dalimier agree with De Beaumont and Dufrenoy in placing the chiastolite schists of Brittany at the very base of the transition sediments, marking the summit of the crystalline schists.‖

With regard to the crystalline schists of Lakes Huron and Superior, to which the name of the Huronian system has been given, the observations of all who have studied the region concur in placing them unconformably beneath the sediments which are supposed to represent the base of the New York system, while, on the other hand, they rest unconformably on the Laurentian gneiss, fragments of which are included in the Huronian conglomerates. The gneissic series of the Green Mountains had, however, as we have seen, been, since 1841, regarded by the brothers Rogers, Mather, Hall, Hitchcock, Adams, Logan, myself and others, as of Silurian age. Eaton and Emmons had alone claimed for it a pre-Cambrian age until, in 1862, Macfarlane ventured to unite it with the Huronian system.

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* Harkness and Salter, Quar. Jour. Geol. Soc., xix, 135.

† Geol. Journal (1845), IV, 583.

‡ Bull. Soc. Geol. de Fr., X, 227.

§ Amer. Jour. Sci., II, i, 415, v, 116.

‖ Bull. Soc. Geol. de Fr., II, xviii, 664.

and to identify both with the crystalline schists of a similar age in Norway. Later observations in Michigan justify still farther this comparison, for not only the more schistose beds of the Green Mountain series, but even the mica-schists of the third or White Mountain series, with staurolite and garnet, are represented in Michigan, as appears by the recent collections of Major Brooks, of the Geological Survey of Michigan, kindly placed in my hands for examination. He informs me that these latter schists are the highest of the crystalline strata in the northern peninsula.

To the north of Lake Superior, as I have already shown elsewhere, the schists of this third series, which, as early as 1861, I compared to those of the Appalachians, are widely spread: while in Hastings County, forty miles north of Lake Ontario, rocks having the mineralogical and lithological characters both of the second and third series are found resting on the first or Laurentian, the three apparently unconformable, and all in turn overlaid by horizontal Trenton limestone.*

We have shown, that in Pennsylvania, while some of these schists of the second and third series were regarded as altered primal rocks by H. D. Rogers, others, lithologically similar, were referred by him to the older so-called azoic series, which we believe to be their true position. Professor W. B. Rogers has lately informed me that in Virginia the gneissic series having the characters of the Green Mountain rocks, is clearly overlaid unconformably by the lowest primal paleozoic strata of the region. Coming northward, the uncrystalline argillites and sandstones holding Paradoxides at Braintree, Massachusetts,† and St. John, New Brunswick, overlie unconformably crystalline schists of the second series, and in the latter region, in one locality, rocks which are by Bailey and Matthew regarded of Laurentian age. In Newfoundland, in like manner, a great series of crystalline schists, in which Mr. Murray recognizes the Huronian system as first studied and described by him in the west, is unconformably overlaid by a group of sandstones, limestones, and slates holding Paradoxides. The peculiar gneisses and mica-schists of the White Mountain series appear to be developed to a great extent in Newfoundland, which has led me to propose for them the name of the Terranovan system.‡

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* Amer. Jour. Sci., II, xxxi, 395, and l; 85.
† Hunt, Proc. Bost. Nat. Hist. Soc., Oct., 19, 1870.
‡ Amer. Jour. Sci., II, l, 87.

From the part which the ruins of these rocks play in the production of succeeding sediments it is not always easy to define the limits between the ancient mica-schists and the Cambrian strata in these northeastern regions. It is not impossible that the two may graduate into each other, as some have supposed, in Newfoundland and Nova Scotia, but until farther light is thrown upon the subject I am disposed to regard the relation between the two as one of derivation rather than of passage.

We have already alluded to the history of the rocks of the White Mountains, formerly looked upon as primary, and by Jackson described as an old granitic and gneissic axis uplifting the more recent Green Mountain rocks. Their manifest differences from the more ancient gneiss of the Adirondacks, and their apparent superposition to the Green Mountain series, then regarded by the Messrs. Rogers as belonging to the Champlain division, led them in 1846 to look upon the White Mountains as altered strata belonging to the Levant division of their classification, corresponding to the Oneida, Medina and Clinton of the New York system. In 1848 Sir William Logan came to a somewhat similar conclusion. Accepting, as we have seen, the view of Emmons that the strata about Quebec included a portion of the Levant division, and regarding the Green Mountain gneisses as the equivalents of these, he was induced to place the White Mountain rocks still higher in the geological series than the Messrs. Rogers had done, and expressed his belief that they might be the altered representatives of the New York system from the base of the Lower Helderberg to the top of the Chemung; in other words, that they were not Middle Silurian, but Upper Silurian and Devonian. This view, adopted and enforced by me,* was farther supported by Lesley in 1860, and has been generally accepted up to this time. In 1870, however, I ventured to question it, and in a published letter addressed to Professor Dana, concluded from a great number of facts that there exists a system of crystalline schists distinct from, and newer than, the Laurentian and Huronian, to which I gave the provisional name of Terranovan, constituting the third or White Mountain series, which appears not only throughout the Appalachians, but westward to the north of Lake Ontario, and around and beyond Lake Superior.† Although I have in common with most

* Geol. Survey of Canada, Report 1847–48, p. 58; also Amer. Jour. Sci., II, ix, 19.
† Amer. Jour. Sci., II, l, 83.

other American geologists, maintained that the crystalline rocks of the Green Mountain and White Mountain series are altered paleozoic sediments, I find, on a careful examination of the evidence, no satisfactory proof of such an age and origin, but an array of facts which appear to me incompatible with the hitherto received view, and lead me to conclude that the whole of our crystalline schists of eastern North America are not only pre-Silurian but pre-Cambrian in age.

In what precedes, I have endeavored to discuss briefly and impartially some of the points in the history of the older rocks, and of the views which during the past thirty years have been entertained as to their age and geological relations, both in America and in Europe. I have said some things which will provoke criticism, and at the same time, I trust, lead to farther study of these rocks, a correct knowledge of which lies at the basis of geological science.

I cannot, however, conclude this part of my subject without referring to the views put forth in 1869 by Professor Hermann Credner of Leipzig, in an essay on the Eozoic or pre-Silurian formations of North America.* With Macfarlane, he refers to the Huronian the gneissic series of the Green Mountains, but includes with it, as part of the Huronian system, the so-called Lower Taconic rocks of Vermont, "with remains of annelids and crinoids." Credner thus falls into the very error against which Emmons warned American geologists, namely, the confounding in one system the ancient crystalline schists with the newer fossiliferous sediments. Resting unconformably on these, he places, first, the Upper Taconic, corresponding, according to him, to a part of the Quebec group, and second, the Potsdam sandstone. In this he has copied, for the most part, Marcou, who, however, groups the whole of these various divisions in the Taconic system, while Credner, rejecting the name, unites a portion of the Taconic of Emmons with the Huronian system, and refers the other portion, together with the Potsdam, to the Silurian. These same views are set forth in a more recent paper, by the same author, on the Alleghany system, which is accompanied with sections and a geologically colored map.† In this, not content with including in the Huronian both the fossiliferous strata of the Levis formation and

* Die Gliederung der Eozoischen Formationsgruppe, u. s. w., pp. 53. Halle, 1869.

† Petermann's Geographische Mittheilungen. 2 Heft, 1871.

the crystalline schists of the Green Mountains, he refers the gneisses and mica-schists of the White Mountains to the same system; while the broad area of similar rocks from their base to the sea at Portland, is regarded as Laurentian. This, on Credner's map, is also made to include, with the exception of the White Mountains themselves, all the rocks of the third or White Mountain series which cover so large a part of New England. Those who have followed the historical sketch already given, can see how widely these notions of Credner differ from those of Emmons, and from all other American geologists, and how much they are at variance with the present state of our knowledge. It is much to be regretted that so good a geologist and lithologist should, from a too superficial study, have fallen into these errors, which can only retard the progress of comparative geognosy, for which he has done so much. In England, again, Credner confounds the Cambrian and Huronian, referring to the latter system the whole of the Longmynd rocks with their characteristic Cambrian fauna, a view which is supported only by the conjectured Cambrian age of the crystalline schists of Anglesea, which are probably pre-Cambrian and veritably Huronian, like the Urschiefer of Scandinavia: which Credner correctly refers to the latter system, as Macfarlane and Bigsby had done before him. He, moreover, recognizes in the similar crystalline schists of Scotland, the Urals, and various parts of Germany, including those of Bavaria and Bohemia, a newer system, overlying the primary or Laurentian gneiss, and corresponding to the Huronian or Green Mountain series of North America, while he suggests a correspondence with similar rocks in Japan, Bengal, and Brazil. In a collection of rocks brought from the latter country by Professor C. F. Hartt, I have found, as elsewhere stated,* what appear to be representatives of the three types of crystalline schists which have been distinguished in eastern North America.

It will be noticed that I have not, in the preceding pages, referred to the Labradorian (Upper Laurentian) system, which is characterized by a great predominance of norites and hyperites. Although occupying a considerable area in the Adirondack region, it is not certainly known in the Appalachian range, and was, therefore, omitted in the discussion. In addition to the facts

* The Nation, Dec. 1, 1870, and Hartt's Geology of Brazil, p. 550.

given by me in 1869,* it may be added that the observations of Mr. Richardson, during that season, on the north side of the Gulf of St. Lawrence, confirm the previous conclusions, and show that the rocks of the Labradorian (or rather Norian) system there repose transgressively, and often at comparatively moderate angles, on the nearly vertical Laurentian gneisses.† We may, I think, in the present state of our knowledge, regard these norites or Norian rocks as portions of a pre-Huronian system.

II. *The Origin of Crystalline Rocks.*

We now approach the second part of our subject, namely, the genesis of the crystalline schists whose history we have just discussed. The origin of the mineral silicates which make up a great portion of the crystalline rocks of the earth's surface is a question of much geological interest, which has been to a great degree overlooked. The gneisses, mica-schists and argillites of various geological periods do not differ very greatly in chemical constitution from modern mechanical sediments, and are now very generally regarded as resulting from a molecular re-arrangement of similar sediments formed in earlier times by the disintegration of previously existing rocks not very unlike them in composition; the oldest known formations being still composed of crystalline stratified deposits presumed to be of sedimentary origin. Before these the imagination conceives yet earlier rocks, until we reach the surface of unstratified material which the globe may be supposed to have presented before water had begun its work. It is not, however, my present plan to consider this far-off beginning of sedimentary rocks, which I have elsewhere discussed.‡

Apart from the clay and sand-rocks just referred to, whose composition may be said to be essentially quartz and aluminous silicates, chiefly in the forms of feldspars and micas, or the results of their partial decomposition and disintegration, there is another class of crystalline silicated rocks which, though far less important in bulk than the last, is of great and varied interest to the lithologist, the mineralogist, the geologist and chemist. The rocks of this second class may be defined as consisting in great part of the silicates of the protoxyd bases, lime, magnesia and ferrous oxyd.

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*On Norites, etc., Amer. Jour. Sci., II, xlviii, 180.
†Geol. Survey of Canada, Report 1866–69, p. 306.
‡Amer. Jour. Science, II, l, 25.

either alone, or in combination with silicates of alumina and alkalies. They include the following as their chief constituent mineral species:—pyroxene, hornblende, olivine, serpentine, talc, chlorite, epidote, garnet and triclinic feldspars such as labradorite. The great types of this second class are not less well defined than the first, and consist of pyroxenic and hornblendic rocks, passing into diorites, diabases, ophiolites and talcose, chloritic and epidotic rocks. Intermediate varieties resulting from the association of the minerals of this class with those of the first, and also with the materials of non-silicated rocks, such as limestones and dolomites, show an occasional blending of the conditions under which these various types of rocks were formed.

The distinctions just drawn between the two great divisions of silicated rocks, are not confined to stratified deposits, but are equally well marked in eruptive and unstratified masses, among which the first type is represented by trachytes and granites, and the second, by dolerites and diorites. This fundamental difference between acid and basic rocks, as the two classes are called, finds its expression in the theories of Phillips, Durocher and Bunsen, who have deduced all silicated rocks from two supposed layers of molten matter within the earth's crust, consisting respectively of acid and basic mixtures; the trachytic and pyroxenic magmas of Bunsen. From these, by a process of partial crystallization and eliquation, or by commingling in various proportions, those eruptive rocks which depart more or less from the normal types, are supposed by the theorists of this school to be generated.* The doctrine that these eruptive rocks are not derived directly from a hitherto uncongealed nucleus, but are softened and crystallized sediments, in fact that the whole of the rocks at present known to us have at one time been aqueous deposits, has, however, found its advocates. In support of this view, I have endeavored to show that the natural result of forces constantly in operation, tends to resolve the various igneous rocks into two classes of sediments, in which the two types are, to a great extent, preserved. The mechanical and chemical agencies which transform the crystalline rocks into sediments, separate these more or less completely into coarse, sandy, permeable beds on the one hand, and fine clayey impervious muds on the other. The action of infiltrating atmospheric waters on the first and more silicious strata, removes from them lime, magnesia, iron-oxyd and

* Hunt on Some Points of Chemical Geology, Quar. Jour. Geol. Soc., XV. 489.

soda, leaving behind silica, alumina and potash — the elements of granitic, gneissic and trachytic rocks. The finer and more aluminous sediments, including the ruins of the soft and easily abraded silicates of the pyroxene group, resisting the penetration of the water, will, on the contrary, retain their alkalies, lime, magnesia and iron, and thus will have the composition of the more basic rocks. *

A little consideration will, however, show that this process, although doubtless a true cause of differences in the composition of sedimentary rocks, is not the only one, and is inadequate to explain the production of many of the varieties of stratified silicated rocks. Such are serpentine, steatite, hornblende, diallage, chlorite, pinite and labradorite, all of which mineral species form rock-masses by themselves, frequently almost without admixture. No geological student will now question that all of these rocks occur as members of stratified formations. Moreover, the manner in which serpentines are found interstratified with steatite, chlorite, argillite, diorite, hornblende and feldspar rocks, and these, in their turn, with quartzites and orthoclase rocks, is such as to forbid the notion that these various materials have been deposited, with their present composition, as mechanical sediments from the ruins of preëxisting rocks; a hypothesis as untenable as that ancient one which supposed them to be the direct results of plutonic action.

There are, however, two other hypotheses which have been proposed to explain the origin of these various silicated rocks, and especially of the less abundant, and, as it were, exceptional species just mentioned. The first of these supposes that the minerals of which they are composed, have resulted from an alteration of previously existing minerals, often very unlike in composition to the present, by the taking away of certain elements and the addition of certain others. This is the theory of metamorphism by pseudomorphic changes, as they are called, and is the one taught by the now reigning school of chemical geologists, of which the learned and laborious Bischof, whose recent death science deplores, may be regarded as the great exponent. The second hypothesis supposes that the elements of these various rocks were originally deposited as, for the most part, chemically formed sediments, or precipitates; and that the subsequent changes have been simply

* Quar. Jour. Geol. Soc., xv, 489; also, Amer. Jour. Sci., II, xxx, 133.

molecular, or, at most, confined in certain cases to reactions between the mingled elements of the sediments, with the elimination of water and carbonic acid. It is proposed to consider briefly, these two opposite theories, which seek to explain the origin of the rocks in question respectively by pseudomorphic changes in preëxisting crystalline rocks, and by the crystallization of aqueous sediments, for the most part chemically formed precipitates.

Mineral pseudomorphism, that is to say, the assumption by one mineral substance of the crystalline form of another, may arise in several ways. First of these is the filling up of a mould left by the solution or decomposition of an imbedded crystal, a process which sometimes takes place in mineral veins, where the processes of solution and deposition can be freely carried on. Allied to this, is the mineralization of organic remains, where carbonate of lime or silica, for example, fills the pores of wood. When subsequent decay removes the woody tissue, the vacant spaces may, in their turn, be filled by the same or another species.* In the second place, we may consider pseudomorphs from alteration, which are the result of a gradual change in the composition of a mineral species. This process is exemplified in the conversion of feldspar into kaolin by the loss of its alkali and a portion of silica, and the fixation of water, or in the change of chalybite into limonite by the loss of carbonic acid and the absorption of water and oxygen.

The doctrine of pseudomorphism by alteration as taught by Gustaf Rose, Haidinger, Blum, Volger, Rammelsberg, Dana, Bischof, and many others, leads them, however, to admit still greater and more remarkable changes than these, and to maintain the possibility of converting almost any silicate into any other. Thus, by referring to the pages of Bischof's Lehrbuch der Geognosie, it will be found that serpentine is said to exist as a pseudomorph after augite, hornblende, olivine, chondrodite, garnet, mica, and probably also after labradorite, and even orthoclase. Serpentine rock or ophiolite is supposed to have resulted, in different cases, from the alteration of hornblende-rock, diorite, granulite and even granite. Not only silicates of protoxyds and aluminous silicates are conceived to be capable of this transformation, but probably also quartz itself; at least, Blum asserts that meerschaum, a closely re-

* Hunt on the Silicification of Fossils, Canadian Naturalist, new series, I, 46.

lated silicate of magnesia, which sometimes accompanies serpentine, results from the alteration of flint; while according to Rose, serpentine may even be produced from dolomite, which we are told is itself produced by the alteration of limestone. But this is not all, — feldspar may replace carbonate of lime, and carbonate of lime, feldspar, so that, according to Volger, some gneissoid limestones are probably formed from gneiss by the substitution of calcite for orthoclase. In this way, we are led from gneiss or granite to limestone, from limestone to dolomite, and from dolomite to serpentine, or more directly from granite, granulite or diorite to serpentine at once, without passing through the intermediate stages of limestone and dolomite, till we are ready to exclaim in the words of Goethe: —

"Mich ängstigt das Verfängliche
Im widrigen Geschwätz,
Wo Nichts verharret, Alles flieht,
Wo schon verschwunden was man sieht,"*

which we may thus translate: — "I am vexed with the sophistry in their contrary jargon, where nothing endures, but all is fugitive, and where what we see has already passed away."

By far the greater number of cases on which this general theory of pseudomorphism by a slow process of alteration in minerals, has been based are, as I shall endeavor to show, examples of the phenomenon of mineral envelopment, so well studied by Delesse in his essay on Pseudomorphs,† and may be considered under two heads: — first, that of symmetrical envelopment, in which one mineral species is so enclosed within the other that the two appear to form a single crystalline individual. Examples of this are seen when prisms of cyanite are surrounded by staurolite, or staurolite crystals completely enveloped in those of cyanite, the vertical axes of the two prisms corresponding. Similar cases are seen in the enclosure of a prism of red in an envelope of green tourmaline, of allanite in epidote, and of various minerals of the pyroxene group in one another. The occurrence of muscovite in lepidolite, and of margarodite in lepidomelane, or the inverse, are well-known examples, and, according to Scheerer, the crystallization of serpentine around a nucleus of olivine is a similar case. This phenomenon of symmetrical envelopment, as remarked by Delesse, shows

* Chinesisch-Deutsche Jahres und Tages Zeiten, xi.
† Annales des Mines, V, xvi, 317–392.

itself with species which are generally isomorphous or homœomorphous, and of related chemical composition. Allied to this is the repeated alternation of crystalline lamina of related species, as in perthite, the crystalline cleavable masses of which consist of thin, alternating layers of orthoclase and albite.

Very unlike to the above are those cases of envelopment in which no relations of crystalline symmetry nor of similar chemical constitution can be traced. Examples of this kind are seen in garnet crystals, the walls of which are shells, sometimes no thicker than paper, enclosing in different cases, crystalline carbonate of lime, epidote, chlorite or quartz. In like manner, crystalline shells of leucite enclose feldspar, hollow prisms of tourmaline are filled with crystals of mica or with hydrous peroxyd of iron, and crystals of beryl with a granular mixture of orthoclase and quartz, holding small crystals of garnet and tourmaline, a composition identical with the enclosing granitic veinstone.* Similar shells of galenite and of zircon, having the external forms of these species, are also found filled with calcite. In many of these cases the process seems to have been first the formation of a hollow mould or skeleton-crystal (a phenomenon sometimes observed in salts crystallizing from solutions), the cavity being subsequently filled with other matters. Such a process is conceivable in free crystals found in veins, as for example, galenite, zircon, tourmaline, beryl and some examples of garnet, but is not so intelligible in the case of those garnets imbedded in mica-schist, studied by Delesse, which enclosed within their crystalline shells irregular masses of white quartz, with some little admixture of garnet. Delesse conceives these and similar cases to be produced by a process analogous to that seen in the crystallization of calcite in the Fontainebleau sandstone; where the quartz grains, mechanically enclosed in well-defined rhombohedral crystals, equal, according to him, sixty-five per cent., of the mass. Very similar to these are the crystalloids with the form of orthoclase, which sometimes consist in large part of a granular mixture of quartz, mica and orthoclase, with a little cassiterite, and in other cases, contain two-thirds their weight of the latter mineral, with an admixture of orthoclase and quartz. Crystals with the form of scapolite, but made up, in a great part, of mica, seem to be like cases of envelopment, in which a small proportion of one substance in the act of crystallization, compels in-

* Report Geol. Survey of Canada, 1866, page 189.

to its own crystalline form a large portion of some foreign material, which may even so mask the crystallizing element that this becomes overlooked, as of secondary importance. The substance which, under the name of houghite, has been described as an altered spinel, is found by analysis to be an admixture of völlknerite with a variable proportion of spinel, which, in some specimens, does not exceed eight per cent., but to which, nevertheless, these crystaloids appear to owe their more or less complete octohedral form.*

The above characteristic examples of symmetrical and asymmetrical envelopment are cited from a great number of others which might have been mentioned. Very many of these are by the pseudomorphists regarded as results of partial alteration. Thus, in the case of associated crystals of andalusite and cyanite, Bischof does not hesitate to maintain the derivation of andalusite from the latter species by an elimination of quartz; more than this, as the andalusite in question occurs in a granite-like rock, he suggests that itself is a product of the alteration of orthoclase. In like manner the mica, which in some cases coats tourmaline, and in others, fills hollow prisms of this mineral, is supposed to result from a subsequent alteration of crystallized tourmaline. So in the case of shells of leucite filled with feldspar, or of garnet enclosing epidote, or chlorite, or quartz, a similar transformation of the interior is supposed to have been mysteriously effected, while the external portion of the crystal remains intact. Again the aggregates of tinstone, quartz and orthoclase having the form of the latter, are, by Bischof and his school, looked upon as results of a partial alteration of previously formed orthoclase crystals. It needed only to extend this view to the crystals of calcite enclosing sand-grains, and regard these as the result of a partial alteration of the carbonate of lime. There is absolutely no proof that these hard crystalline substances can undergo the changes supposed, or can be absorbed and modified like the tissues of a living organism. It may, moreover, be confidently affirmed that the obvious facts of envelopment are adequate to explain all the cases of association upon which this hypothesis of pseudomorphism by alteration, has been based. Why the change should extend to some parts of a crystal and not to others, why in some cases the exterior of the crystal is altered, while in others the centre alone

* Report Geol. Survey of Canada, 1866, pp. 189, 213. Amer. Jour. Sci., III, i, 188.

is removed and replaced by a different material, are questions which the advocates of this fanciful hypothesis have not explained. As taught by Blum and Bischof, however, these views of the alteration of mineral species have not only been generally accepted but have formed the basis of the generally received theory of rock-metamorphism.

Protests against the views of this school have, however, not been wanting. Scheerer, in 1846, in his researches in Polymeric Isomorphism,* attempted to show that iolite and aspasiolite, a hydrous species which had been looked upon as resulting from its alteration, were isomorphous species crystallizing together, and, in like manner, that the association of olivine and serpentine in the same crystal, at Snarum in Norway, was a case of envelopment of two isomorphous species. In both of these instances he maintained the existence of isomorphous relations between silicates in which 3HO replaced MgO. He hence rejected the view of Gustaf Rose that these serpentine crystals were results of the alteration of olivine, and supported his own by reasons drawn from the conditions in which the crystals occur. In 1853 I took up this question and endeavored to show that these cases of isomorphism described by Scheerer, entered into a more general law of isomorphism pointed out by me among homologous compounds differing in their formulas by nM_2O_2 (M = hydrogen or a metal). I insisted, moreover, on its bearing upon the received views of the alteration of minerals, and remarked, "The generally admitted notions of pseudomorphism seem to have originated in a too exclusive plutonism, and require such varied hypotheses to explain the different cases, that we are led to seek for some more simple explanation and to find it, in many instances, in the association and crystallizing together of homologous and isomorphous species."† Subsequently, in 1860, I combated the view of Bischof, adopted by Dana, that "regional metamorphism is pseudomorphism on a grand scale," in the following terms:—

"The ingenious speculations of Bischof and others, on the possible alteration of mineral species by the action of various saline and alkaline solutions, may pass for what they are worth, although we are satisfied that by far the greater part of the so-called cases of pseudomorphism in silicates are purely imaginary, and, when

* Pogg. Annal., lxviii, 319.
† Pogg. Annal., lxviii, 319.

real, are but local and accidental phenomena. Bischof's notion of the pseudomorphism of silicates like feldspars and pyroxenes. presupposes the existence of crystalline rocks, whose generation this neptunist never attempts to explain, but takes his starting-point from a plutonic basis."

I then asserted that the problem to be solved in regional metamorphism is the conversion of sedimentary strata, "derived by chemical and mechanical agencies from the ocean-waters and pre-existing crystalline rocks into aggregations of crystalline silicates. These metamorphic rocks, once formed, are liable to alteration only by local and superficial agencies, and are not, like the tissues of a living organism, subject to incessant transformations, the pseudomorphism of Bischof." *

I had not, at that time, seen the essay by Delesse on Pseudomorphs already referred to, published in 1859, in which he maintained views similar to those set forth by me in 1853 and 1860, declaring that much of what had been regarded as pseudomorphism had no other basis than the observed associations of minerals, and that often "the so-called metamorphism finds its natural explanation in envelopment." These views he ably and ingeniously defended by a careful discussion of the whole range of facts belonging to the history of the subject.

My own expression of opinion on this question, in 1853, had been privately criticised, and I had been charged with a want of comprehension of the question. It was, therefore, with no small pleasure, that I not only saw my views so ably supported by Delesse, but read the language of Carl Friedrich Naumann, who in 1861 wrote to Delesse as follows, referring to his essay just noticed:—

"You have rendered a veritable service to science in restricting pseudomorphs to their true limits, and separating what had been erroneously united to them. As you have remarked, envelopments have, for the most part, nothing in common with pseudomorphs, and it is inconceivable that they have been united by so many mineralogists and geologists. It appears to me, moreover, that they commit an analogous error, when they regard gneisses, amphibolites, etc., as being, all of them, the results of metamorphic epigenesis, and not original rocks. It is precisely because pseudomorphism has been so often confounded with metamorphism that this error has found acceptance. I only admit a pseudomorph

* Amer. Jour. Sci., II, xxx, 135.

where there is some crystal the form of which has been preserved. There are very many metamorphic substances which are, in no sense of the word, pseudomorphs. Had the name of *crystalloid* been chosen, instead of pseudomorph, this confusion would certainly have never found its way into the science. I think, with you, that the envelopment of two minerals is most generally explained by a *contemporaneous* and *original* crystallization. Secondary envelopments, however, exist, and such may be called pseudomorphs or crystalloids, if they reproduce exactly the form of the crystal enveloped, whether this last still remains, or has entirely disappeared."*

It is unnecessary to remark that the view of Delesse and Naumann, viz.: that the so-called cases of pseudomorphism, on which the theory of metamorphism by alteration has been built, are, for the most part, examples of association and envelopment, and the result of a contemporaneous and original crystallization,—is identical with the view suggested by Scheerer, and generalized by myself long before, when, in 1853, I sought to explain the phenomena in question by "the association and crystallizing together of homologous and isomorphous species."

Later, in 1862, I wrote as follows:—

"Pseudomorphism, which is the change of one mineral species into another, by the introduction or the elimination of some element or elements, presupposes metamorphism (*i. e.*, metamorphic or crystalline rocks), since only definite mineral species can be the subjects of this process. To confound metamorphism with pseudomorphism, as Bischof, and others after him have done, is therefore an error. It may be farther remarked, that, although certain pseudomorphic changes may take place in some mineral species, in veins and near the surface, the alteration of great masses of silicated rocks by such a process is as yet an unproved hypothesis."†

Thus this unproved theory of pseudomorphism, as taught by Bischof, does not, even if admitted to its fullest extent, advance us a single step towards a solution of the problem of the origin of the various silicates, which, singly or intermingled, make up beds in the crystalline schists. Granting, for the sake of argument, that serpentine results from the alteration of olivine or labradorite, and steatite or chlorite from hornblende, the origin of

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* Bull. Soc. Geol. de France, II, xviii, 678.

† Descriptive Catalogue, Crystalline Rocks of Canada, p. 80, London Exhibition, 1862; also, Dublin Quar. Journal, July 1863, and Amer. Jour. Sci., II, xxxvi, 218.

these anhydrous silicates, which are the subjects of the supposed change, is still unaccounted for. The explanation of this short-sightedness is not far to seek; as already remarked, Bischof, although a professed neptunist, starts from a plutonic basis. When the epigenic origin of serpentine and its related rocks was first taught, these were regarded as eruptive and unstratified, and it was easy to imagine intruded masses of dioritic and feldspathic rocks, which had become the subjects of alteration. As, however, the progress of careful investigation in the field has shown the stratified character of these serpentines, diallage-rocks, steatites, etc., and their intercalation among limestones, argillites, quartzites, gneisses, and mica-schists, and even among feldspathic and hornblendic strata, we are forced to reject, with Naumann, the notion of their epigenic derivation, and to regard them as original rocks.

This view brings us face to face with the problem of metamorphism as defined by me in 1860* (*ante*, page 46). We must either admit that these crystalline schists were created as we find them, or suppose that they were once sands, clays, marls, etc.; in a word, sediments of chemical and mechanical origin, which by a subsequent process have been consolidated and crystallized. Whence, then, come these silicates of magnesia, lime, and iron, which are the sources of serpentine, hornblende, steatite, chlorite, etc.? This is the question which I proposed in that same year, when, after discussing the results of my examinations of the tertiary rocks near Paris, containing layers of a hydrous silicate of magnesia related to talc in composition, among unaltered limestones and clays, I remarked that it is evident "such silicates may be formed in basins at the earth's surface, by reactions between magnesian solutions and dissolved silica;" and, after some farther discussion, said "farther inquiries in this direction may show to what extent certain rocks composed of calcareous and magnesian silicates may be directly formed in the moist way."† Subsequently, in a paper on "The Origin of some Magnesian and Aluminous Rocks," printed in the "Canadian Naturalist" for June, 1860,‡ I repeated these considerations, referring to the well-known fact that silicates of lime, magnesia

*Amer. Jour. Sci., II, xxx, 135.
† Ibid., II, xxix, 284; also II, xl, 49.
‡ Ibid., II, xxxii, 286.

and iron-oxyd are deposited during the evaporation of natural waters, including those of alkaline springs and of the Ottawa River. Having described the mode of occurrence of the magnesian silicate, sepiolite, in the Paris basin, and the related quincite, containing some iron-oxyd and disseminated in limestone, I suggested that while steatite has been derived from a compound like sepiolite, the source of serpentine was to be sought in another silicate richer in magnesia: and, moreover, that chlorite, unless the result of a subsequent reaction between clay and carbonate of magnesia, was directly formed by a process analogous to that which (according to Scheerer) has, in recent times, caused the deposition from waters of neolite, a hydrous alumino-magnesian silicate approaching to chlorite in composition.* "the type of a reaction which formerly generated beds of chlorite in the same way as those of sepiolite or talc." Delesse, subsequently, in 1861, in his essay on Rock-Metamorphism insisted upon the sepiolites or so-called magnesian marls, as probably the source of steatite, and suggested the derivation of serpentine, chlorite, and other related minerals of the crystalline schists, from deposits approaching these marls in composition.† He recalled, also, the occurrence of chromic oxyd, a frequent accompaniment of these magnesian minerals, in the hydrated iron ores of the same geological horizon with the magnesian marls in France. Delesse did not, however, attempt to account for the origin of these deposits of magnesian marls, in explanation of which I afterwards verified Bischof's observations on the sparing solubility of silicate of magnesia, and showed that silicate of soda, or even artificial hydrated silicate of lime, when added to waters containing magnesian chlorid or sulphate, gives rise, by double decomposition, to a **very insoluble magnesian silicate.**‡

To explain the generation of silicates like labradorite, scapolite, garnet, and saussurite, I suggested that double aluminous silicates allied to the zeolites might have been formed, and subsequently rendered anhydrous. The production of zeolitic minerals observed by Daubrée at Plombières and Luxeuil by the action of a silicated alkaline water on the masonry of ancient Roman baths, was appealed to by way of illustration. It had there been shown

* Pogg. Annal., lxxi, 288.
† Etudes sur le Metamorphisme, quarto, pp. 91. Paris. 1861.
‡ Amer. Jour. Sci., II. xl, 49.

by Daubrée that the elements of the zeolites had been derived in part from the waters, and in part from the mortar and even the clay of the bricks, which had been attacked, and had entered into combination with the soluble matters of the water to form chabazite. I, however, at the same time pointed out another source of silicated minerals, upon which I had insisted since 1857, viz.: the reaction between silicious or argillaceous matters and earthy carbonates in the presence of alkaline solutions. Numerous experiments showed that when solutions of an alkaline carbonate were heated with a mixture of silica and carbonate of magnesia, the alkaline silicate formed acted upon the latter, yielding a silicate of magnesia, and regenerating the alkaline carbonate; which, without entering into permanent combination, was the medium through which the union of the silica and the magnesia was effected. In this way I endeavored to explain the alteration, in the vicinity of a great intrusive mass of dolerite, of a gray Silurian limestone, which contained, besides a little carbonate of magnesia and iron-oxyd, a portion of very silicious matter, consisting apparently of comminuted orthoclase and quartz. In place of this, there had been developed in the limestone, near its contact with the dolerite, an amorphous greenish basic silicate, which had seemingly resulted from the union of the silica and alumina with the iron-oxyd, the magnesia and a portion of lime. By the crystallization of the products thus generated it was conceived that minerals like hornblende, garnet and epidote might be developed in earthy sediments, and many cases of local alteration explained. Inasmuch as the reaction described required the intervention of alkaline solutions, rocks from which these were excluded would escape change, although the other conditions might not be wanting. The natural associations of minerals, moreover, led me to suggest that alkaline solutions might favor the crystallization of aluminous silicates, and thus convert mechanical sediments into gneisses and mica-schists. The ingenious experiments of Daubrée on the part which solutions of alkaline silicates, at elevated temperatures, may play in the formation of crystallized minerals, such as feldspar and pyroxene, were posterior to my early publications on the subject, and fully justified the importance which, early in 1857, I attributed to the intervention of alkaline silicates in the formation of crystalline silicated minerals.*

*Proc. Royal Soc., May 7, 1857. Amer. Jour. Sci., II, xxiii, 438, and xxv, 289 and 435.

While, however, there is good reason to believe that solutions of alkaline silicates or carbonates have been efficient agents in the crystallization and molecular re-arrangement of ancient sediments, and have also played an important part in that local alteration of sedimentary strata which is often observed in the vicinity of intrusive rocks, it is clear to me that the agency of these solutions is less universal than once supposed by Daubrée and myself, and will not account for the formation of various silicated rocks found among crystalline schists, such as serpentine, hornblende, steatite and chlorite. When I commenced the study of these crystalline strata I was led, in accordance with the almost universally received opinion of geologists, to regard them as resulting from a subsequent alteration of paleozoic sediments, which, according to different authorities, were of Cambrian, Silurian or Devonian age. Thus in the Appalachian region, as we have already seen, they have, on supposed stratigraphical evidence, been successively placed at the base, at the summit, and in the middle of the Lower Silurian or Champlain division of the New York system. A careful chemical examination among the unaltered paleozoic sediments, which in Canada were looked upon as the stratigraphical equivalents of the bands of magnesian silicates in these crystalline schists, showed me, however, no magnesian rocks except certain silicious and ferruginous dolomites. From a consideration of reactions which I had observed to take place in such admixtures in presence of heated alkaline solutions, and from the composition of the basic silicates which I had found to be formed in silicious limestones near their contact with eruptive rocks, I was led to suppose that similar actions, on a grand scale, might transform these silicious dolomites of the unaltered strata into crystalline magnesian silicates.

Farther researches, however, convinced me that this view was inapplicable to the crystalline schists of the Appalachians, since, apart from the geognostical considerations set forth in the previous part of this paper, I found that these same crystalline strata hold beds of quartzose dolomite and magnesian carbonate, associated in such intimate relations with beds of serpentine, diallage and steatite, as to forbid the notion that these silicates could have been generated by any transformations or chemical re-arrangement of mixtures like the accompanying beds of quartzose magnesian carbonates. Hence it was that already, in 1860, as shown above, I

announced my conclusion that serpentine, chlorite and steatite had been derived from silicates like sepiolite, directly formed in waters at the earth's surface, and that the crystalline schists had resulted from the consolidation of previously formed sediments, partly chemical and partly mechanical in their origin. The latter being chiefly silico-aluminous, took, in part, the forms of gneiss and mica-schists, while from the more argillaceous strata, poorer in alkali, much of the aluminous silicate crystallized as andalusite, staurolite, cyanite and garnet. These views were reiterated in 1863,* and farther in 1864, in the following language, as regards the chemically-formed sediments: "steatite, serpentine, pyroxene, hornblende, and in many cases, garnet, epidote and other silicated minerals are formed by a crystallization and molecular re-arrangement of silicates generated by chemical processes in waters at the earth's surface."† Their alteration and crystallization was compared to that of the mechanically formed feldspathic, silicious and argillaceous sediments just mentioned.

The direct formation of the crystalline schists from an aqueous magma is a notion which belongs to an early period in geological theory. Delabeche in 1834‡ conceived that they were thrown down as chemical deposits from the waters of the heated ocean, after its reaction on the crust of the cooling globe, and before the appearance of organic life. This view was revived by Daubrée in 1860. Having sought to explain the alteration of paleozoic strata of mechanical origin, by the action of heated waters, he proceeds to discuss the origin of the still more ancient crystalline schists. The first precipitated waters, according to him, acting on the anhydrous silicates of the earth's crust, at a very elevated temperature, and at a great pressure, which he estimated at two hundred and fifty atmospheres, formed a magma, from which, as it cooled, were successively deposited the various strata of the crystalline schists.§ This hypothesis, violating, as it does, all the notions which sound theory teaches with regard to the chemistry of a cooling globe, has, moreover, to encounter grave geognostical difficulties. The pre-Silurian crystalline rocks belong to two or more distinct systems of different ages, succeeding each other in discordant strat-

* Geol. of Canada, pp. 577—581.
† Amer. Jour. Sci., II, xxxvii, 266, and xxxviii, 183.
‡ Researches in Theoretical Geology, pp. 297–300.
§ Etudes et expériences synthétiques sur le Metamorphisme, pp. 119-121.

ification. The whole history of these rocks, moreover, shows that their various alternating strata were deposited, not as precipitates from a seething solution, but under conditions of sedimentation very like those of more recent times. In the oldest known of them, the Laurentian system, great limestone formations are interstratified with gneisses, quartzites and even with conglomerates. All analogy, moreover, leads us to conclude that even at this early period, life existed at the surface of the planet. Great accumulations of iron-oxyd, beds of metallic sulphids and of graphite, exist in these oldest strata, and we know of no other agency than that of organic matter, capable of generating these products.

Bischof had already arrived at the conclusion, which in the present state of our knowledge seems inevitable, that "all the carbon yet known to occur in a free state, can only be regarded as a product of the decomposition of carbonic acid, and as derived from the vegetable kingdom." He farther adds, "living plants decompose carbonic acid; dead organic matters decompose sulphates, so that, like carbon, sulphur appears to owe its existence in a free state to the organic kingdom."* As a decomposition (deoxidation) of sulphates is necessary to the production of metallic sulphids, the presence of the latter, not less than that of free sulphur and free carbon, depends on organic bodies: the part which these play in reducing and rendering soluble the peroxyd of iron, and in the production of iron ores is, moreover, well known. It was, therefore, that, after a careful study of these ancient rocks, I declared in May, 1858, that a great mass of evidence "points to the existence of organic life, even during the Laurentian or so-called azoic period."†

This prediction was soon verified in the discovery of the *Eozoön Canadense*, of Dawson, the organic character of which is now admitted by all zoologists and geologists of authority. But with this discovery, appeared another fact, which afforded a signal verification of my theory as to the origin and mode of deposition of serpentine and pyroxene. The microscopic and chemical researches of Dawson and myself showed that the calcareous skeleton of this foraminiferal organism was filled with the one or the other of these silicates in such a manner as to make it evident that

* Bischof, Lehrbuch, 1st. ed., II, 95. English ed., I, 252, 344.
† Amer. Jour. Science, II, xxv, 436.

they had replaced the sarcode of the animal, precisely as glauconite and similar silicates have, from the Silurian times to the present, filled and injected more recent foraminiferal skeletons. I recalled, in connection with this discovery the observations of Ehrenberg, Mantell and Bailey, and the more recent ones of Pourtales, to the effect that glauconite or some similar substance occasionally fills the spines of Echini, the cavities of corals and millepores, the canals in the shells of Balanus, and even forms casts of the holes made by burrowing sponges (Clionia) and worms. The significance of these facts was farther illustrated by showing that the so-called glauconites differ considerably in composition, some of them containing more or less alumina or magnesia, and one from the tertiary limestones near Paris being, according to Berthier, a true serpentine.*

These facts in the history of Eozoön, were first made known by me in May, 1864, in the American Journal of Science, and subsequently more in detail, February, 1865, in a communication to the Geological Society of London.† They were speedily verified by Dr. Gümbel, who was then engaged in the study of the ancient crystalline schists of Bavaria, and soon recognized the existence, in the limestones of the old Hercynian gneiss, of the characteristic *Eozoön Canadense*, injected with silicates in a manner precisely similar to that observed by Dawson and myself.‡ Later, in 1869, Robert Hoffmann described the results of a minute chemical examination of the Eozoön from Raspenau, in Bohemia, confirming the previous observations in Canada and Bavaria. He showed that the calcareous shell of the Eozoön, examined by him, had been injected by a peculiar silicate, which may be described as related in composition both to glauconite and to chlorite. The masses of Eozoön he found to be enclosed and wrapped around by thin alternating layers of a green magnesian silicate allied to picrosmine, and a brown non-magnesian mineral, which proved to be a hydrous silicate of alumina, ferrous oxyd and alkalies, related to fahlunite, or more nearly to jollyte in composition.§

Still more recently, in the course of the present year, Dr. Dawson detected a mineral insoluble in acids, injecting the pores of

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* Amer. Jour. Sci., II, xl, 360, Report Geol. Survey Canada. 1866. p. 231, and Quar. Geol. Jour., XXI, 71.

† Amer. Jour. Sci., II, xxxvii, 431. Quar. Geol. Jour., XXI, 67.

‡ Proc. Royal Bavar. Acad. for 1866, and Can. Naturalist, new series III, 81.

§ Jour. fur. Prakt. Chem., May, 1869, and Amer. Jour. Sci., III, i, 378.

crinoidal stems and plates in a paleozoic limestone from New Brunswick, which is made up of organic remains. This silicate which, in decalcified specimens, shows in a beautiful manner the intimate structure of these ancient crinoids, I have found by analysis to be a hydrous silicate of alumina and ferrous oxyd, with magnesia and alkalies, closely related to fahlunite and to jollyte.* The microscopic examinations of Dr. Dawson show that this silicate injected the pores of the crinoidal remains and some of the interstices of the associated shell-fragments, before the introduction of the calcite which cements the mass. I have since found a silicate almost identical with this, occurring under similar conditions in an Upper Silurian limestone said to be from Llangedoc in Wales.

Gümbel, meanwhile, in the essay on the Laurentian rocks of Bavaria, in 1866, already referred to, fully recognized the truth of the views which I had put forward, both with regard to mineralogy of Eozoön and to the origin of the crystalline schists. His results are still farther detailed in his *Geognost. Beschreibung des östbayerisches Grenzgebirges*, 1868, p. 833. Credner, moreover, as he tells us,† had already from his mineralogical and lithological studies, been led to admit my views as to the original formation of serpentine, pyroxene and similar silicates (which he cites from my paper of 1865, above referred to‡), when he found that Gümbel had arrived at similar conclusions. The views of the latter, as cited by Credner from the work just referred to, are in substance as follows:—The crystalline schists, with their interstratified layers, have all the characters of altered sedimentary deposits, and from their mode of occurrence cannot be of igneous origin, nor the result of epigenic action. The originally formed sediments are conceived to have been amorphous, and under moderate heat and pressure to have arranged themselves, and crystallized, generating various mineral species in their midst by a change, which, to distinguish it from metamorphism by an epigenic process, Gümbel happily designates *diagenesis*.

It is unnecessary to remark, that these views, the conclusions from the recent studies of Gümbel in Germany and Credner in North America, are identical with those put forth by me in 1860.

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* Amer. Jour. Sci., III, i, 379.

† Hermann Credner; die Gleiderung der Eozoischen Formationsgruppe Nord Amerikas. Halle 1869. ‡ That in the Quar. Geol. Jour., XXI, 67.

At the early periods in which the materials of the ancient crystalline schists were accumulated, it cannot be doubted that the chemical processes which generated silicates were much more active than in more recent times. The heat of the earth's crust was probably then far greater than at present, while a high temperature prevailed at comparatively small depths, and thermal waters abounded. A denser atmosphere, charged with carbonic acid gas, must also have contributed to maintain, at the earth's surface, a greater degree of heat, though one not incompatible with the existence of organic life. * These conditions must have favored many chemical processes, which, in later times, have nearly ceased to operate. Hence we find that subsequently to the eozoic times, silicated rocks of clearly marked chemical origin are comparatively rare. In the mechanical sediments of later periods certain crystalline minerals may be developed by a process of molecular re-arrangement — diagenesis. These are, in the feldspathic and aluminous sediments, orthoclase, muscovite, garnet, staurolite, cyanite and chiastolite, and in the more basic sediments, hornblendic minerals. It is possible that these latter and similar silicates may sometimes be generated by reactions between silica on the one hand, and carbonates and oxyds, on the other, as already pointed out in some cases of local alteration. Such a case may apply to more or less hornblendic gneisses, for example, but no sediments, not of direct chemical origin, are pure enough to have given rise to the great beds of serpentine, pyroxene, steatite, labradorite, etc., which abound in the ancient crystalline schists. Thus, while the materials for producing, by diagenesis, the aluminous silicates just mentioned, are to be met with in the mud and clay-rocks of all ages, the chemically formed silicates, capable of crystallizing into pyroxene, talc, serpentine, etc., have only been formed under special conditions.

The same reasoning which led me to maintain the theory of an original formation of the mineral silicates of the crystalline schists, induced me to question the received notion of the epigenic origin of gypsums and magnesian limestones or dolomites. The interstratification of dolomites and pure limestones, and the enclosure of pebbles of the latter in a paste of crystalline dolomite, are of themselves sufficient to show that in these cases, at least, dolomites have not been formed by the alteration of pure limestones.

* Amer. Jour. Sci., II, xxxvi, 396.

The first results of a very long series of experiments and inquiries into the history of gypsum, were published by me in 1859, and farther researches, reiterating and confirming my previous conclusions, appeared in 1866.* In these two papers, it will, I think, be found that the following facts in the history of dolomite are established, viz.: first, its origin in nature by direct sedimentation, and not by the alteration of non-magnesian limestones; second, its artificial production by the direct union of carbonate of lime and hydrous carbonate of magnesia, at a gentle heat, in the presence of water. As to the sources of the hydrous magnesian carbonate, I have endeavored to show that it is formed from the magnesian chlorid or sulphate of the sea or other saline waters in two ways:—first, by the action of the bicarbonate of soda found in many natural waters; this, after converting all soluble lime-salts into insoluble carbonate, forms a comparatively soluble bicarbonate of magnesia, from which a hydrous carbonate slowly separates: second, by the action of bicarbonate of lime in solution, which, with sulphate of magnesia gives rise to gypsum; this first crystallizes out, leaving behind a much more soluble bicarbonate of magnesia, which deposits the hydrous carbonate in its turn. In this way, for the first time, in 1859, the origin of gypsums and their intimate relation with magnesian limestones were explained.

It was, moreover, shown that to the perfect operation of this reaction, an excess of carbonic acid in the solution, during the evaporation, was necessary to prevent the decomposing action of the hydrous mono-carbonate of magnesia upon the already formed gypsum. Having found that a prolonged exposure to the air, by permitting the loss of carbonic acid, partially interfered with the process, I was led to repeat the experiment in a confined atmosphere, charged with carbonic acid, but rendered drying by the presence of a layer of dessicated chlorid of calcium. As had been foreseen, the process under these conditions proceeded uninterruptedly, pure gypsum first crystallizing out from the liquid, and subsequently, the hydrous magnesian carbonate.† This experiment is instructive as showing the results which must have attended this process in past ages, when the quantity of carbonic acid in the atmosphere greatly exceeded its present amount.

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* Amer. Jour. Sci., II, xxxviii, 170, 365; xlii, 49.

† Proceedings Royal Institution, May 30, 1867, and Canadian Naturalist, new series, III, 231.

As regards the hypotheses put forward to explain the supposed dolomitization of previously-formed limestones by an epigenic process, I may remark that I repeated very many times, under varying conditions, the often cited experiment of Von Morlot, who claimed to have generated dolomite by the action of sulphate of magnesia on carbonate of lime, in the presence of water at a somewhat elevated temperature under pressure. I showed that what he regarded as dolomite was not such, but an admixture of carbonate of lime with anhydrous and sparingly soluble carbonate of magnesia; the conditions in which the carbonate of magnesia is liberated in this reaction, not being favorable to its union with the carbonate of lime to form the double salt which constitutes dolomite. The experiment of Marignac, who thought to form dolomite by substituting a solution of chlorid of magnesium for the sulphate, I found to yield similar results, the greater part of the magnesian carbonate produced passing at once into the insoluble condition, without combining with the excess of carbonate of lime present. The process for the production of the double carbonate described by Ch. Deville, namely, the action of vapors of anhydrous magnesian chlorid on heated carbonate of lime, in accordance with Von Buch's strange theory of dolomitization, I have not thought necessary to submit to the test of experiment, since the conditions required are scarcely conceivable in nature. Multiplied geognostical observations show that the notion of the epigenic production of dolomite from limestone is untenable, although its resolution and deposition in veins, cavities, or pores in other rocks is a phenomenon of frequent occurrence.

The dolomites or magnesian limestones may be conveniently considered in two classes; first, those which are found with gypsums at various geological horizons; and second, the more abundant and widely distributed rocks of the same kind, which are not associated with deposits of gypsum. The production of the first class is dependent upon the decomposition of sulphate of magnesia by solutions of bicarbonate of lime, while those of the second class owe their origin to the decomposition of magnesian chlorid or sulphate by solutions of alkaline bicarbonates. In both cases, however, the bicarbonate of magnesia, which the carbonated waters generally contain, contributes a more or less important part to the generation of the magnesian sediments. The carbonated alkaline waters of deep-seated springs often contain, as is

well known, besides the bicarbonates of soda, lime, and magnesia, compounds of iron, manganese, and many of the rarer metals in solution, and thus the metalliferous character of many of the dolomites of the second class is explained. The simultaneous occurrence of alkaline silicates in such mineral waters, would give rise, as already pointed out, to the production of insoluble silicates of magnesia, and thus the frequent association of such silicates with dolomites and magnesian carbonates in the crystalline schists is explained, as marking portions of one continuous process. The formation of these mineral waters depends upon the decomposition of feldspathic rocks by subterranean or subaërial processes, which were doubtless more active in former ages than in our own. The subsequent action upon magnesian waters of these bicarbonated solutions, whether alkaline or not, is dependent upon climatic conditions, since, in a region where the rainfall is abundant, such waters would find their way down the river-courses to the open sea, where the excess of dissolved sulphate of lime would prevent the deposition of magnesian carbonate. It is in dry and desert regions, with limited lake-basins, that we must seek for the production of magnesian carbonates, and I have argued from these considerations that much of northeastern America, including the present basins of the Upper Mississippi and St. Lawrence, must, during long intervals in the paleozoic period, have had a climate of excessive dryness, and a surface marked by shallow enclosed basins, as is shown by the widely spread magnesian limestones, and the existence of gypsum and rock-salt at more than one geological horizon within that area.* The occurrence of serpentine and diallage at Syracuse, New York, offers a curious example of the local development of crystalline magnesian silicates in Upper Silurian dolomitic strata under conditions which are imperfectly known, and, in the present state of the locality, cannot be studied.†

Since the uncombined and hydrated magnesian mono-carbonate is at once decomposed by sulphate or chlorid of calcium, it follows that the whole of these lime-salts in a sea-basin must be converted into carbonates before the production of carbonated magnesian sediments can begin. The carbonate of lime, formed

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* Geology of Southwestern Ontario, Amer. Jour. Sci., II, xlvi, 355.

† Geology of the 3d district of New York, 108–110, and Hunt on Ophiolites, Amer. Jour. Sci., II, xxvi, 236.

by the action of carbonates of magnesia and soda, remains at first dissolved as bicarbonate, and is only separated in a solid form, when in excess, or when required for the needs of living plants or animals; which are dependent for their supply of calcareous matter, on the bicarbonate of lime produced, in part by the process just described, and in part by the action of carbonic acid on insoluble lime-compounds of the earth's solid crust. So many limestones are made up of calcareous organic remains, that a notion exists among many writers on geology that all limestones are, in some way, of organic origin. At the bottom of this lies the idea of an analogy between the chemical relations of vegetable and animal life. As plants give rise to beds of coal, so animals are supposed to produce limestones. In fact, however, the synthetic process by which the growing plant, from the elements of water, carbonic acid and ammonia, generates hydrocarbonaceous and azotized matters, has no analogy with the assimilative process by which the growing animal appropriates alike these organic matters and the carbonate and phosphate of lime. Without the plant, the synthesis of the hydrocarbons would not take place, while independently of the existence of coral or mollusk, the carbonate of lime would still be generated by chemical reactions, and would accumulate in the waters until, these being saturated, its excess would be deposited as gypsum or rock-salt are deposited. Hence in such waters, where, from any causes, life is excluded, accumulations of pure carbonate of lime may be formed. In 1861 I called attention to the white marbles of Vermont, which occur intercalated among impure and fossiliferous beds, as apparently examples of such a process.*

It is by a fallacy similar to that which prevails as to the organic origin of limestones, that Daubeny and Murchison were led to appeal to the absence of phosphates from certain old strata as evidence of the absence of organic life at the time of their accumulation.† Phosphates, like silica and iron-oxyd, were doubtless constituents of the primitive earth's crust, and the production of apatite crystals in granitic veins, or in crystalline schists, is a process as independent of life as the formation of crystals of quartz or of hematite. Growing plants, it is true, take up from the soil or the waters dissolved phosphates, which pass into the skeletons

* Amer. Jour. Sci., II, xxxi, 402.
† Siluria, 4th ed., pp. 28 and 537.

of animals, a process which has been active from very remote periods. I showed in 1854 that the shells of Lingula and Orbicula, both those from the base of the paleozoic rocks and those of the present time, have (like Comularia and Serpulites) a chemical composition similar to the skeletons of vertebrate animals.* The relations of both carbonate and phosphate of lime to organized beings are similar to those of silica, which, like them, is held in watery solution, and by processes independent of life is deposited both in amorphous and crystalline forms, but in certain cases is appropriated by diatoms and sponges, and made to assume organized shapes. In a word, the assimilation of silica, like that of phosphate and carbonate of lime, is a purely secondary and accidental process, and where life is absent, all of these substances are deposited in mineral and inorganic forms.

I have thus endeavored to sketch, in a concise and rapid manner, the history of the earlier rock-formations of eastern North America, and of our progress in the knowledge of them; while I have, at the same time, dwelt upon some of the geognostical and chemical questions which their study suggests. With the record of the last thirty years before them, American geologists have cause for congratulation that their investigations have been so fruitful in great results. They see, however, at the same time, how much yet remains to be done in the study of the Appalachians and of our northeastern coast, before the history of these ancient rock-formations can be satisfactorily written. Meanwhile our adventurous students are directing their labors to the vast regions of western America, where the results which have already been obtained are of profound interest. The progress of these investigations will doubtless lead us to modify many of the views now accepted in science, and cannot fail greatly to enlarge the bound of geological knowledge.

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* Amer. Jour. Sci., II, xvii, 236.

ABSTRACT OF PAPERS READ BEFORE SECTION B.

THE MONOCOTYLEDON THE UNIVERSAL TYPE OF SEEDS.—BY THOMAS MEEHAN.

IT must be evident to those who heard my paper on "Adnation in Coniferæ" at the Chicago meeting of the Association that the observation there detailed, could scarcely be accounted for, if the belief be true which is generally held by botanists, that *the leaf originates at the node from which it seems to spring*. It is not, however, an object with me to attack existing theories, or establish new ones; but simply to present facts as I see them. The origin of the leaf will no doubt prove a question which will in time take care of itself. But this generalization cannot be avoided by the readers of that paper, that the whole plant is originally a unity; and that the subsequent formation of elementary organs, and their complete development, or absorption into one another, is the result of varying phases of nutrition. The leaves in Coniferæ were found to be free or united with the stem in proportion to the vigor of the central axis. Following up the subject I now offer some facts which will show that all seeds are primarily Monocotyledonous; and that division is a subsequent act, depending on circumstances which do not exist at the first commencement of the seed growth.

It is well known that in some species of Coniferous plants the number of cotyledons varies. I have noticed in addition to this that whether the cotyledons are few or many, *there is no increase in the whole cotyledonous mass*. In the Norway spruce, *Abies excelsa*, there are sometimes as many as ten cotyledons, in others only two. In the latter case they are broad and ovate, while in the former they are narrow and hair-like; in short, when in the two cotyledoned state it is not possible to note any difference between a seedling Norway spruce and a Chinese arbor vitæ, *Biota orientalis*, except by the lighter shade of green. The two leaved condition is not common, but specimens of threes and others I exhibited to Drs. Torrey and Gray at the Troy meeting. Any one who will examine sprouting seeds of the Norway spruce will agree to the proposition

that the *cotyledons are not original and separate creations, but a divided unity.* My next observations were on some acorns of *Quercus agrifolia* the division into cotyledons was numerous and irregular. Cut across vertically some representing the letter C, others the letter N, and again, with four cotyledons the letter M. Here again it was clear that whatever the form and number of the cotyledons *there was no increase of the original cotyledon mass.* Examining sprouting peach kernels, the variations in form and number were of the most remarkable character. I need not repeat them in detail here, as they are reported in the April and May "Proceedings of the Academy of Natural Sciences of Philadelphia." In addition to the fact of no increase in the whole cotyledon mass, it was here clear that *when the cotyledons were duplicated, the duplications at least were subsequent to the original ones.* Still so far nothing had been seen to indicate when the first pair of cotyledons were formed. *Quercus macrocarpa* and *Quercus palustris* were silent to my questions. In a large number I found no variations whatever. Each mass was divided smoothly and exactly into two cotyledons. *Quercus robur*, the English oak, however gave some curious evidence. Two germs under one seed coat were numerous and often three, and the cotyledons took on a variety of forms. But there was never any more increase in the cotyledonous mass, than if but two lobes had been formed and there was no more rule in the division than there would be in the sudden breakage of a piece of glass. A detailed account of these will also be found in the "Proceedings of the Academy of Natural Sciences of Philadelphia" for May. *Quercus rubra*, the American red oak, furnished the one link wanting to connect the first division into lobes with the other phenomena. *All* the acorns examined had three or four sutures on the cotyledon mass, and extending all along the longitudinal surface externally, without any reference to cotyledonal divisions. These sutures extended sometimes but a line in depth, at others almost to the centre of the mass, always accompanied by the inner membrane, as is the case in ruminated seeds. The whole mass was divided only in two parts in any that I examined of this species, but the division was always in *the direction of the sutures.* Hence each cotyledon was very irregular. Sometimes one-third the mass only went to one while the other had two-thirds of the whole mass. *It was easier to burst in the weaker line of resistance.* But

the interest for us is to note that originally the cotyledonous mass was a unit — then the sutures or fissures were formed; and ultimately the two divisions of the lobes followed in their direction. *The division was the last condition, not the first.* I know how much we should guard against generalizing on a limited supply of facts, but it requires an effort to believe that oaks, pines, and peaches, as we have seen primordially monocotyledons, are in this respect different from other so called dicotyledonous plants; and if we grant that all seeds are primarily monocotyledonous, may we not ask *why in any case are they divided?* We have seen that there is no increase of mass in the division, the same amount is furnished in one as in many. Would it in any way injure the Indian corn to have its mass divided into two lobes? or would not the plantlet be as well provided for if the acorn were in one solid mass? Division would seem to be a necessity, occurring subsequent to organization, and existing from the position of the plumule alone. In monocotyledons, as we know, the plumule is directed parallel to, or away from the cotyledonous mass, when of course, on this theory it remains an undivided mass. But in the dicotyledonous selection, the plumule is directed towards the apex of the mass and as we know in the case of roots against stone walls, or mushrooms under paving stones, the disposition in the growing force of plants is to go right forward, turning neither to the right nor the left; so in this mass of matter the development of the germ would make easy work of the division; and no doubt often at so early a stage as to give the impression we have been under hitherto, that the division is a primary and essential process.

Prof. GRAY remarked that he was not disposed now, in the absence of Mr. Meehan, and upon the consideration of a paper upon a wholly independent topic, to discuss the author's views upon "Adnation in Coniferæ;" but Mr. Meehan was well aware that they were not quite consistent with the ordinary vegetable morphology. It was more agreeable to be able to say that Mr. Meehan's conclusions, that the apparently polycotyledonous embryo of many Coniferæ is only dicotyledonous, must undoubtedly be regarded as correct. This view was satisfactorily proved by Duchartre, ten or fifteen years ago, and is adopted by Parlatore in the elaboration of Coniferæ for De Candolle's Prodromus, published three or four years ago. But Prof. Gray thought that the appearances in the embryo of oaks, which Mr. Meehan had brought up as evidence that the dicotyledonous embryo was a mere deviation of the monocotyledonous,

and especially that the two cotyledons originated as it were from the splitting up of one, would not be regarded by botanists as in any degree convincing. He presumed that Mr. Meehan perceives that it directly follows from this doctrine that in all opposite leaves the two are organically one, and he would leave to him the undertaking of reconstructing morphology and phyllotaxis upon such a basis.

Dr. T. C. Hilgard remarked, that the whole question came back to the laws of phyllotaxy. The very fact of these "genetic" numbers, as he had called them, required the second element to be derived from the first one; as all radial organs must be derived from their predecessors. The fact itself was apparent in the far too much neglected phenomena of cryptogamous *developments* (or "embryology" of authors). The moss-spore proper (apart from the *Chlorosperme* as true moss-*spawn*), develops into a true land (or aquatic) Conferva. The latter bears a bud at the ends of its thread-like "prothallium." Each of its cells is generated out of a preceding one. A terminal cell enlarges into a conical leaf. *Out of that leaf* springs the second, at its base. It is in fact only on the supposition of radial organs generating their successors at the side of the *rift*—at the centre—alternating from either border (as in the case of the pod-leaves, producing fertile ovules), that the whole of phyllotaxic phenomena, and of organic numbers in general, becomes explicable. The production of new elements, however, takes place in a very embryonic condition. Cotyledons already formed do not *divide*. Lobes of fissures, folds, etc., of cotyledons are no divisions, but are due to unequal enlargement. New elements are not formed by division, but by sprouting.

Mechanism of Flexion and Extension in Birds' Wings.—By Dr. Elliott Coues.

Dr. Coues' proposition is, that flexion of the forearm upon the humerus produces flexion (adduction) of the hand upon the forearm, by osseous mechanism alone, and conversely: extension of the forearm causes extension (abduction) of the hand. The point of the article consists in a demonstration of the fact that, in spreading and folding the wing, the radius slides lengthwise along the ulna to a certain extent. Recapitulating certain points in the anatomy of the elbow and wrist, the author shows that this sliding is produced by the relative size, shape and position of the humeral surfaces with which the radius and ulna respectively articulate: these being such, that in flexion of the forearm the radial surface is nearest the wrist-joint, and in extension the ulnar one; and consequently the two bones of the forearm occupy different relative positions in flexion and ex-

tension. In flexion, the radius is pushed forward, and projects somewhat beyond the end of the ulna, impinging upon the radio-carpal bone (scapholunar), and pushing the pinion around the centre of motion of the wrist-joint so that it is more or less flexed. In extension, the reverse motion takes place, from the pulling back of the radius. The proposition is carefully demonstrated, illustrated with three figures, and likewise shown to be susceptible of ocular proof by direct experiment. Several interesting corollaries are also drawn. Some such mechanism is shown to be an anatomical necessity, from the structure of the wrist-joint, to provide for the extremes of adduction and abduction that take place in the wrist, without straining the joint. Another obvious purpose subserved is equalization of muscular power, by relegating a part of the work, that the hand muscles would otherwise have to perform, to the larger flexors and extensor of the upper arm; and an actual saving of a certain amount of muscular effort, this being replaced by automatic movements of the bones themselves. Having seen no account of this mechanism, the author is inclined to think it may be unnoticed.* It is at any rate a new explanation of the design of the peculiar shape and position of the radial articulating surface of a bird's humerus, far more important than that hitherto assigned, viz.: its causing simply the well-known *obliquity* of flexion of the forearm.

On the Geological History of the Gulf of Mexico.—By Prof. Eug. W. Hilgard.

This paper, accompanied by a geological map, treats of the formations that have gradually filled up the ancient Mississippi embayment, existing after the upheaval of the Palæozoic rocks; whose vertex, a few miles above the junction of the Ohio and Mississippi, is marked by the small Tertiary area in Illinois. The author hopes that a close comparison of these deposits with those of the Far West, with which they were and partly still are connected, may lead to the more accurate parallelization of the latter with the marine deposits of more distant regions. Most of the subject

* It is indeed not mentioned in the works of Cuvier, Meckel, Tiedemann, Wagner, and other distinguished authors; but Dr. Bergmann, of Gottingen (*Archiv. für Anat.*, 1839, 296), speaks of essentially the same thing, although the results of the mechanism are not so fully shown.

matter here referred to is embraced in the author's publications for ten years past.*

The most ancient shoreline of this embayment is formed chiefly by the Carboniferous rocks. The oldest formation cropping out within these limits is the Cretaceous, which east of the Mississippi traverses the states of Alabama, Mississippi and Tennessee, reaching a short distance into Kentucky, along the Carboniferous ridge which borders the Tennessee river. The dip is 20-25° at right angles to the trend of the formation, which in its southerly portions is very distinctly subdivided into three chief groups, whose equivalents seem to be readily traceable in the Northwest. But towards the northern, narrow end of the outcrop, the distinctions become less defined, and the character more or less lignitic.

West of the Mississippi, in Arkansas, the outcrop does not extend so far north by some one hundred and fifty miles. It there corresponds to the middle group, the lowest not having thus far been recognized; while the upper one appears to be represented in the series of Cretaceous outliers existing in Louisiana, forming, apparently, a Cretaceous "backbone" to that state, whose southernmost point is, probably, the rock-salt mass of Petite Anse. The sulphur and gypsum of Calcasieu, likewise, seem to belong to this epoch, but their precise mode of formation can at present only be guessed at.

During the Tertiary period, the shoreline receded from its extreme head in southern Illinois, to near the latitude of Baton Rouge, running nearly parallel to the present one. This seems to show comparative shallowness; and this point is confirmed by the predominantly lignitic and lignito-gypseous character of the deposits, especially in the upper part of the embayment, where small outliers only of a marine character exist. The lignitic feature repeats itself throughout the predominantly marine deposits of the later times; less so in Alabama than in Mississippi, while in Louisiana it largely predominates, owing probably to the presence of the Cretaceous "backbone." In general each marine group has its lignitic equivalents; and since lignitic outliers connect across Texas, with the great basins of the interior, a close study of their flora (and possibly fauna) may, it is hoped, enable

*Rep. on the Geology and Agriculture of Mississippi, 1860. Am. J. Sci. May 1866; Ibid. July 1866; Ibid. Nov. 1866; Ibid. Jan. 1867; Ibid. Jan. 1869; Ibid. Nov. 1869. Rep. U. S. Engin. Dept. 1870; Am. J. Sci. March, April and May, 1871.

us to determine the equivalents in time of the marine Tertiary groups.

The Vicksburg series of rocks, ends the marine Tertiary of the Southwest; the transitions between its fauna and the older Eocene are so cogent as to render any great separation in time or space inadmissible. The Vicksburg deposits are rather of a deep-sea character, less lignitiferous than the stage next below. But the Miocene and Pleiocene deposits, observed on the Atlantic coast, are unrepresented on the waters of the Gulf, save by beds equally devoid of a marine or fresh water fauna, and with but very few and poorly preserved remains of plants. A single fragment of a turtle has been found in a clay stratum filled with calcareous concretions, possibly the remains of a fauna destroyed by maceration. These "Grand Gulf" beds lack all analogy outside of the Gulf basin, unless it be in the interior, perhaps, in the Bad Lands of Nebraska, whose analogues have now been found so much farther south than heretofore supposed, that a connection may have been possible; the lithological resemblance is very great —at all events, since the Grand Gulf rocks alone represent the period between the Eocene and Drift, they include the equivalents in time of the White river beds as well as others.

It seems impossible to account for the character, thickness and position of these beds, without assuming that after the close of the Eocene period, the Gulf was either cut off from the Atlantic, or communication was so slight as to cause the continental waters to freshen the brine so much as to destroy the marine fauna, without rendering it fit for fresh water life. An upheaval of the northern border of the Caribbean would even now readily produce such an isolation, were it not for the deep channels excavated by the Gulf stream, in the straits of Yucatan and Florida. Since on the farther Antilles Miocene and Pliocene beds have been found, it is evident that this state of things was confined to the Gulf basin. The geology of Cuba and Yucatan is too little known to determine how far they were concerned in the same.

The Grand Gulf as well as the older rocks are almost everywhere overlaid by the "Orange Sand" or stratified Drift: while on the Palæozoic territory it is more or less localized in conformity with the larger valleys. On the area under consideration, it forms a huge delta-shaped mass, consisting mainly of ferruginous and variegated sand and subordinate clay beds, and traversed by

several pebble streams, the largest of which occupies the axis of the embayment. Its beds disappear beneath those of the Port Hudson era almost concurrently with the Grand Gulf rocks.

The phenomena offered by these deposits, as heretofore shown, require the assumption that prior to its deposition the Gulf coast suffered an elevation of at least four hundred and fifty feet above its present level, accompanied by a much greater one at the head of the waters. Then there occurred a slow depression to about twice that amount, and finally, during the Terrace epoch, a reëlevation to at least the extent of four hundred and fifty feet. The northern derivation of the pebbles, their size, and the extensive plowing-up of older beds, prove a southward flow of waters, of considerable violence.

These events were of no local character: they are intimately connected with, and the complement of, the Drift phenomena of the Northwest. It is time that the facts of the case were generally understood and taken into account by American geologists, and that the Ohio should cease to be proclaimed the southern limit of the Drift. Its southern representative has mostly, heretofore, been erroneously associated with contiguous formations of every age.

An understanding should be come to as to what is meant by the word "Drift." In New England it means chiefly moraine material; in the West, what is presumed to be iceberg drift: in the South, materials clearly stratified and transported almost exclusively by water. All are properly included in the *Drift Epoch*, defined as embracing the time between the termination of the Tertiary, and the beginning of the Champlain era of quiet deposition and slow depression.

The next succeeding formation is the Port Hudson series of swamp, lagoon, fluviatile, estuarian and littoral deposits, formed during the slow depression of the continent. It underlies not only a wide littoral belt, now partially covered by the waters of the Gulf, but also the entire alluvial area of the lower Mississippi, Red, and other larger rivers, then constituting extensive fresh water estuaries: their general valleys having, evidently, already been impressed upon the surface during the later Drift period, though not always coincident with their present ones. Late observations made in the Yazoo and Tensas bottoms confirm the statement, made by Gen. Humphreys in 1860, that the Mississippi

and its bayous have mostly cut their channels into a clay formation foreign to the alluvium, from which some of the best soils of these bottoms are also directly derived; the alluvium being, on the whole, of little thickness.

These clays form the lower division of the Port Hudson beds. The upper consists chiefly of yellow and whitish silts which at some points form a terrace along the edge of the bottom; while on the hilltops of the adjoining uplands lies the calcareous, silty loam (Loess), of the Bluff formation, differing from its equivalents farther north by the total absence of stratification, and the exclusive prevalence of terrestrial fossils. How this state of things was brought about, it is not easy to imagine, unless perhaps the tidal flow was instrumental therein.

Above the Loess we find usually a stratum of loam or brick clay, which near the larger rivers is sometimes 15–20 feet in thickness. It is devoid of stratified structure as well as of fossils, and forms the sub-soil of most of the uplands of the Gulf States.

The Terrace epoch has not left any marks in the way of beach lines or terraces distinctly referable to that era. As regards the modern epoch, the Mississippi Delta presents the anomaly of progressing, not by simple alluvion, but through the singular agency of the Mudhumps, discussed in a paper lately published.*

Col. CHARLES WHITTLESEY said he was gratified to find so many facts conspiring to sustain a theory of his own and a favorite theory of fifteen years standing, that the Quaternary of the Lower Mississippi is cotemporary with the later epochs of the Northern Drift.

He thought it was now demonstrated that the bluff or Loess beds of the upper and lower Mississippi are identical. At the north there are instances of coarse transported materials overlying and underlying the Loess. The blue, variegated, and red clays of the upper beds are closely allied in age with the Loess and are probably cotemporary with it and the Champlain clays.

This Loess or bluff stratum extends from above the Falls of the Mississippi to below Natchez, and forms a connecting link between the gulf deposits and those of the north. He suggested that there was a reasonable explanation of their common origin when we consider that the Glacial period was one of great length, and also considering the state of things as it was gradually drawing to a close. Such a vast accumulation of ice and nevè, exceeding two thousand feet in thickness, required a long period for its dissolution, and in dissolving produced a vast fresh water sea, covering a country nearly flat, but having a drainage to the south.

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* Am. Jour. Sci., March, April and May, 1871.

The currents must have been broad, powerful and deep, and operating always in one direction, were capable of transporting materials of considerable coarseness a thousand miles. Hence mud, loam and clay would be carried indefinitely. Agates and cornelians, whose home is in trap rocks above the Falls of St. Anthony, are found scattered along the valley to the mouth of the Ohio. If they travel at the rate of only a rod in a year, three hundred and twenty years would find them advanced a mile gulfward, and ten thousand years more than thirty miles. A current of four miles an hour, extending from the western base of the Cumberland Mountains in Tennessee to the foot of the Ozark Mountains in Missouri would fill up a space equal to a large state in a century.

It appeared to the speaker that here is a simple and sufficient explanation for the translation, in the later parts of the ice period, of so much northern gravel sand, loam, and even of small boulders to the vicinity of the gulf and into it.

Below the states north of the Ohio, pieces of the native copper of Lake Superior are not found in the Quaternary gravel. The water forces were not equal to the transportation of so heavy a material, nor of magnetic iron boulders and gravel. Both the copper and the heavy iron ores of Lake Superior are common in the Drift of the Lake country, but they required the propelling force of moving ice to send them along. Beyond the ice or glacier field, deep and persistent currents of water were able to take up and move forward the lighter materials to places many hundred miles distant, provided the element of time is sufficiently great.

In this way we may synchronize the whole field of the Quaternary of the United States east of the Rocky Mountains and perhaps that of the Pacific slope.

Dr. C. A. White was much interested in the able paper of Professor Hilgard, especially as hitherto so very little has been brought out concerning the phenomena of the Post-tertiary period in that latitude. While conceding the facts observed, and the conclusions arrived at by him there, I must, nevertheless, maintain that we of the Upper Mississippi valley have not been mistaken in ours. In Iowa we have a very different set of Post-tertiary phenomena, and yet I believe true explanations of both may, and ultimately will be, completely harmonized by careful study of the broad region intervening between those that he and I have respectively studied.

The Post-tertiary deposits of Iowa consist of the true, unaltered, unstratified Drift, so well known in that region and elsewhere, through the more or less distinctly stratified gravelly or sandy drift observable in the valley sides above the reach of floods, to the alluvium of their flood-plains. Besides this, we have, in Western Iowa, that very interesting deposit resting upon the drift which Professor Swallow has called the Bluff deposit. This deposit, doubtless, had essentially the same origin as that to which Professor Hilgard has given the same name in Louisiana, namely, in the muddy waters of the Missouri river, although the deposit, doubtless, never had direct continuity, but was interrupted by broad

barrier elevations of the surface, through which the river cut its valley during the Terrace epoch, as I have defined it for our region. I have been able to recognize there only two epochs of the Post-tertiary period, namely, the Drift and Terrace epochs; but, at the same time, I fully concede all that is claimed for the existence of phenomena upon the sea-coasts upon which the Champlain epoch is based. The Drift epoch, with us, is understood to have ended with the disappearance of the ice, and the Terrace epoch to have continued from that time to the present. The terraces I understand to be parts of flood-plains abandoned from time to time as the valleys were deepened by the action of the waters of their own streams, for I can see no evidence that they were produced, even in part, by any elevations or depressions of that part of the continent. At the close of the Drift epoch, we may assume that Iowa had a nearly level surface, averaging, as it does now, about eight hundred feet above the level of the sea, the highest point being about seventeen hundred feet above, and the lowest, the southeast corner, four hundred and forty-four feet above that level. The valleys have all been eroded out of this general level by their own waters, and this is believed to be quite sufficient to account for the existence and character of the terraces. These terraces are found in the Bluff deposit as well as in the altered Drift, showing that the Bluff deposit must have originated early in the Terrace epoch. The deposit was formed in a large lake-like expansion of the Missouri river, caused by a broad depression that was left in the surface of the Drift at the close of the Drift epoch, and became filled with the silt of the muddy stream that flowed into and from it, which, finally deepening its valley below, had only to sweep out a part of the silt, which became the **Bluff deposit, leaving the terraces, as it did, in the Drift.**

Professor A. WINCHELL felt prepared to corroborate fully Dr. Hilgard's views in reference to the absolute continuity of the upper portion of the Drift deposits in the Northern and Southern States. He had studied these deposits from the Gulf of Mexico to Lake Superior, and in the Southern States, especially along the Black Warrior and Alabama rivers, and had expressed the conviction to Prof. Tuomey as long ago as 1852, and had published it in the "Cleaveland Proceedings of the Association" in 1853, that he found no grounds for assigning the semistratified deposits of the Southern States to a different age from the so-called "altered Drift," of the North. They all seem to be composed of similar materials (modified certainly by local circumstances), and to have been transported from the higher lands of the continent at the same time, and by agencies of a similar character.

Dr. G. LITTLE had studied this subject for a quarter of a century. When a small boy it was his custom with his playmates to "fight rocks;" one boy would take one of these pebbles from the immense gravel beds on which the city of Tuscaloosa, Alabama, is located and attempt to break another chosen by his companion. Although ignorant of mineralogy, he soon discovered that those pebbles which were clear and glass-like (Quartz) proved the hardest to break — they were sometimes half as

large as a boy's head, more frequently of the size of the fist — very smooth on the surface, and often egg-shaped. It was a matter of curiosity to him to inquire whence these rocks came and how they became rounded and polished.

Some years later he was so fortunate as to become a pupil of Prof. M. Tuomey in the University of Alabama. That excellent geologist, at that time, twenty years ago, attributed the gravel beds, on which Tuscaloosa and several of the capitals of the Southern States (Milledgeville, Ga., Columbia, S. C., Richmond, Va.), are situated, to the same agency whose action was described in the north as producing the Drift phenomena.

At a still later period, as State Geologist of Mississippi, Dr. T. traced these beds from Tuscaloosa to Columbus, Miss., to Eastport, Tenn., and along the edge of the Carboniferous to the Ohio. The same beds he saw along the northern lakes. From these high northern latitudes came then the materials of what is called Drift in the Southern States by Dr. Hilgard, in his paper. Quartz, from its hardness, furnishes the largest pebbles and the sand grains. The coloring matter of the Red Clay which forms so much of the surface of the Gulf States comes from the iron beds of Lake Superior.

Professor PERRY, having recently made a somewhat detailed examination of the principal geological formations in Mississippi, was happy to be able to say that he had not become acquainted with a fact which militates against the main views advanced by Professor Hilgard.

While all geologists are familiar with the three series of Cretaceous formations in Alabama and Mississippi, it may be proper for me to mention that Cretaceous deposits of peculiar interest have been recently discovered by Professor Kerr, at Snow Hill in North Carolina. Under his guidance, I had the pleasure of visiting the locality, last spring, shortly after their discovery. They appear to be of about the same age as the Ripley group of Mississippi, and are equally rich in organic remains: while they contain according to Professor Conrad a large number of genera and species new to science. The discovery is destined, no doubt, to add a new chapter to the history of the American Cretaceous.

After a rather careful investigation of the Tertiary beds of Mississippi, I have found no occasion to take exception to the main conclusions reached by Dr. Hilgard and published in his Geological Report of the State. Of the uplift to which he refers in his report and in the paper read, running about west-north-west and east-south-east, which was first mentioned by Professor Tuomey, I found abundant evidence in both Alabama and Mississippi.

In regard to the existence of Mississippi Drift, the subject of more especial interest at this time, I may say that I find no room for doubt. The prominent features of this formation, as it occurs in Mississippi and Alabama, I had opportunity to study between the years 1847 and 1850. I then became acquainted with the phenomena, while their explanation has been only gradually reached by the continued studies of subsequent years.

During the past season, I desired, as occasion was afforded, to verify or disprove, by an actual list of facts, the previous views in regard to the question of southern Drift. Taking the circuit of the Atlantic and Gulf States, and thence proceeding up the valley of the Mississippi, I discovered at almost every step what to me is unmistakable evidence of glacial agency, all the way around from Virginia to Illinois. I have studied the Drift of New England for years, I think I know it in its main features —typical Drift and modified Drift in most of its varying forms. Now, in all the states referred to, I found that which I could not distinguish, after making the necessary allowance for local differences, from New England Drift.

As to the direction in which the agency worked, I find variations which were, no doubt, eagerly determined by the face of the country; variations which indicate that the deposits assumed the form which they now have, in what was the closing part of the Glacial period, in the Southern States. The beds seem to go out in rays from the Appalachian mountains, from the Blue Ridge towards the Atlantic, in the Gulf States for the most part southward, and in the Basin of the Mississippi towards the southwest.

Reference having been made to a supposed elevation and depression of the country, I would suggest that the facts relied on as evidences are perhaps susceptible of another and more simple explanation. Remembering that, in the formation of the immense ice-mass that spread over much of the continent, there must have been a considerable depression of the ocean: also that the thawing of the extended mass of ice at the close of the Glacial period must have produced immense floods of water, we have what was no doubt equivalent to a moderate elevation and depression, and a cause sufficient to account for all the manifestations of glacial agency with which we meet.

Prof. E. C. ANDREWS said that in the prosecution of the geological survey of the State of Ohio by Prof. Orton, he found in the Drift deposit, buried beneath eighty feet of drift material, a peat-bed and a buried forest containing wood, plants and mosses in their original position, and so perfectly preserved that a number of living species have been identified. That is in the very midst of our drift material in Montgomery county, in Southern Ohio. The formation there is coarse gravel and drift material, and I think not stratified.

Prof. RICHARD OWEN mentioned that it has not been adverted to, that on the north shore of Lake Superior the rocks which have furnished the Drift that we find in the whole Mississippi Valley are in sight. Then, as we go south, these detached boulders are found at first in large, then in smaller and constantly smaller fragments, ranging in size from those of many hundred tons weight down to a ton or two in this region, and finally, south of the Ohio river, weighing only perhaps from one hundred to one hundred and fifty pounds and those giving place in turn to deposits in the form of sand, ending finally in beds of sand on the shores of the Gulf of Mexico. Now, without stopping to advert to the great theory as

to the elevations which brought up the Apallachians and the Rocky Mountain ranges and sent this Drift centrifugally through. I will merely say that there are portions of Indiana in which, when we go through that gravel, we find rocks that have been polished off and then grooved in a north and south direction, which proves that from the rocks away north of Lake Superior, the northern and southern Drift are continuous, becoming smaller as you go south, borne there by the oceanic currents, and afterward, as the land rose, dropped in the form of fresh water deposits, accounting for the large boulders in the north, the beds of gravel in the south, the beds of peat and all the varied phenomena that have been observed in connection with the subject of the Drift.

Professor HILGARD remarked, in reply, that, in the South at least, the Drift epoch was easily defined as reaching from the termination of the latest Tertiary period to the beginning of the deposition of the Port Hudson beds (equivalent to those of Dana's Champlain period); when all deposits that could properly be designated as "drifted," ceased to be formed outside of river channels. Where the Champlain depression had not caused submergence, it might be marked by subaërial deposits, such as had been observed in an apparently corresponding position, by Dr. Edmund Andrews, of Chicago. He thought the southern stratified Drift corresponded to the "modified Drift" of the West, though on a very large scale; but it would not do to call it by that name, which could apply only to a small portion in the axis of the embayment. Elsewhere it was modified Carboniferous, Cretaceous and Tertiary; the materials of these formations having been simply plowed up and redeposited farther south by the Drift waters. No name could be altogether distinctive and characteristic, yet in this case the stratification was so to a very great degree, and he thought the name of "Stratified Drift" might properly be made to embrace the southern Drift as well as the "modified" Drift of the Western States.

At the present time, the winter ice of the Mississippi frequently runs past Vicksburg. How much more must the ice-floes and bergs of the Glacial period have reached at least that latitude, down to which we find, even though rarely, boulders of northern derivation, too ponderous and too little worn to have been transported by water alone. Quartzite pebbles of a couple of pounds weight occur even at the island of Petite Anse, together with other smaller ones of northern rocks; and a profusion of those derived from the Grand Gulf rocks, whose nearest outcrop lies about sixty miles due north.

In reply to a question as to what he now thought of the age of the rock-salt deposit of Petite Anse, Prof. HILGARD stated that he thought it of the Cretaceous age. It was older than the Drift, by which it was overlaid; and its great thickness and purity, as well as the absence of analogy, militated against its connection with any of the Tertiary stages. On the other hand, the Cretaceous of northern Louisiana was preëminently salt-

bearing, and Petite Anse lay right in the line of a series of Cretaceous outliers indicating an axis of upheaval, Cretaceous limestone occurring within sixty miles of Petite Anse. Moreover, the limestone and gypsum of Calcasieu, between which lies the sulphur bed, are distinctly represented in the Cretaceous of northern Louisiana, while totally foreign to any of the Tertiary stages; and although the great gypsum bed has not been reached at Petite Anse, it lies in the proper line of dip, and seems to form a complement to be looked for, of the great rocksalt bed. These probabilities fall short of proof, it is true, but weigh heavily when we consider the simplicity of the geological structure of the Mississippi embayment; where departures from the general rule are so unlikely as to throw the burden of proof upon whosoever maintains their existence.

On the Carpal and Tarsal Bones of Birds.—By Prof. Edward S. Morse.

The author stated that he had followed with great interest the work of Huxley, Cope, and others in tracing out the ornithic characters in the Dinosauria. While following these relations he had noticed a marked difference in the characters of the carpus and tarsus of the two classes. It seemed strange that a group of bones so persistent in the reptiles as well as in the mammalia should be so obscure or wanting in birds. Owen objects to the term tarso-metatarse as he believes the existence of a tarsus has not been demonstrated. W. S. Parker, in 1861, on the osteology of Balæniceps, questions if the lower articular portion of the tibia is not the homologue of the mammalian astragalus and not an epiphysis. Gegenbaur has now shown that in one stage of the young bird there is a proximal tarsal ossicle, and a distal tarsal ossicle, the first one anchylosing with the tibia, the distal one likewise anchylosing with the metatarse. Thus, the term tarso-metatarse is quite proper. While this was a great step toward a proper understanding of these parts, Mr. Morse believed that a nearer relation would be found in the discovery of another proximal tarsal bone. In those reptiles he had examined, whatever the number of tarsal bones, there were always in the proximal series one corresponding to the tibia, and another corresponding to the fibula. He had found this feature in birds. In studying the embryos of the eave swallow, bank swallow, king bird, sand piper, black bird, cow black bird, blue bird, chirping sparrow, yellow warbler, and Wilson's thrush, he had found three distinct tarsal bones, two in the proximal series answering to the tibia and fibula, and one in the

distal series. The first two early anchylose, and present an hour-glass-shaped articular surface as Prof. Cope has described in the astragalus of Loelaps. The final anchylosis of these conjoined ossicles with the tibia, formed the bicondylar trochlea so peculiar to the distal end of a bird's tibia. The distal tarsal ossicle became united with the proximal ends of the metatarse as has been shown. In the carpus he had found four perfectly distinct ossicles, the distal carpal bones becoming united to the base of the mid- and outer metacarpals, the other two remaining free, though the ulnar carpal in some cases anchylosed with the ulna. In the king bird and yellow warbler, he had found a fifth carpal on the radial side.

Mr. Morse also described the pelvic bones of an embryo sparrow, though he supposed these had already been worked up.

When Professor Morse mentioned his doubt about the natural position of the ischium of a certain saurian with reference to a lateral process of the same, Dr. T. C. Hilgard remarked that every pelvis consisted, besides the sacrum, of five, not three only, separate bones on either side: the *crista ilei* being, in mammals (*i. e.* young dogs), a separate, crescented rim, sutured to the hip-blade; and, in a like manner, the *tuberositas ischii* was related to the *ischium*. They are the fourth and fifth elements, which by the genetic law of numbers, ought actually to have sprung from the first (ischium) and second (ileum), respectively, to which they adhere. The third bone was the *os pubis*. In birds, the tuberositas forms a gristle, which, in "spring-chickens," is seen ossified as a bone or process, etc., connecting the ischium sidewise with the rearward prolongation of the ileum, and forming a recess for the attachment of a pelvic muscle. In chickens this bone takes the shape of a boomerang, and perhaps the Polynesians found that instrument ready made in the "spring-dimorphis." It forms various processes according to the first location of its nucleus.

Dr. C. A. White, asked if no attempt had been made to specially homologize these carpal and tarsal bones of birds. Since those adjacent both distally and proximally had been thus homologized, it seems as if it would not be very difficult to do the same for the smaller bones of the carpus and tarsus. Perhaps they may, just before they anchylose, present pseudoarticular facettes that will give a valuable clue to their special homologies by comparison with similar parts of limbs of mammals.

On the Characteristics of the Primary Groups of the Class of Mammals. By Dr. Theodore Gill.

At the last meeting of the Association, the author made a communication on the classification of mammals, based on facts in part already become the common property of science, and in part hitherto unpublished. An abstract giving the conclusions arrived at has been published in the American Naturalist and in the Proceedings of the Association. Continued researches into the same subject have confirmed the propriety of the ordinal groups and the limits then admitted, but have necessitated a different combination of those groups.

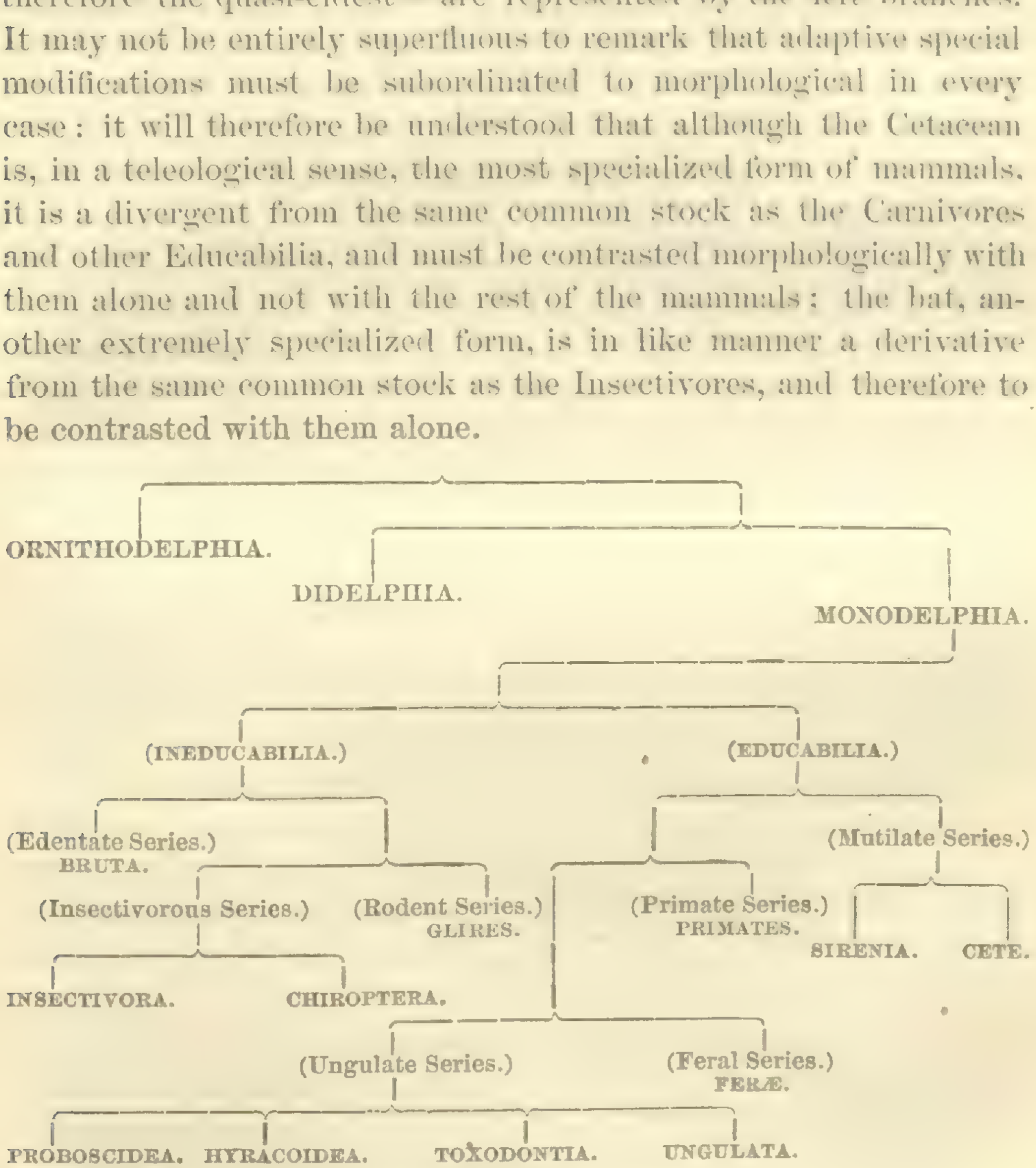
The divisions into sub-classes first solidly established by Huxley are retained.

The Placental or Monodelphian mammals are with more propriety combinable into two major groups which correspond; on the one hand, to the Educabilia of Bonaparte, the combined Archencephala and Gyrencephala of Owen, and the combined Archonts and Megasthenes of Dana; and on the other hand, to the Ineducabilia of Bonaparte, the Micrencephala of Owen and the Microsthenes of Dana. The characters hitherto used to distinguish those groups are however either vague and difficult of application, not characteristic, or generally regarded as erroneous. But positive and easily recognizable characters appear to exist in the brain which confirm those groups, but which have not hitherto been regarded, at least in respect to their systematic application.

There has also always existed cause to deplore the insufficiency of the characters assigned in the diagnoses of some of the orders of mammals. After an attentive study of most of the known forms, the author believes that he has succeeded in finding characters which at the same time confirm the groups already recognized and supplement the teleological characters (sometimes of doubtful application or entirely failing) by morphological characters of more constancy. The revised diagnoses of the orders and other primary divisions are submitted in advance of a work now being printed by the Smithsonian Institution; that work will give the characters, contrasted in dichotomous tables, of all the groups of mammals as low as subfamilies and lists of the genera, recent and extinct. While the author has been dependent, for the most part,

on the collections of the Smithsonian Institution for his investigations, he has also visited the museums of the Academy of Natural Sciences of Philadelphia, the Peabody Academy of Science of Salem, the Boston Society of Natural History, and the Museum of Comparative Zoology at Cambridge.

The relations of the several primary groups of the class may be more readily understood from a glance at the subjoined table, which will also serve as a genealogical table for those who accept the doctrine of evolution. The more generalized forms—and therefore the quasi-eldest—are represented by the left branches. It may not be entirely superfluous to remark that adaptive special modifications must be subordinated to morphological in every case: it will therefore be understood that although the Cetacean is, in a teleological sense, the most specialized form of mammals, it is a divergent from the same common stock as the Carnivores and other Educabilia, and must be contrasted morphologically with them alone and not with the rest of the mammals; the bat, another extremely specialized form, is in like manner a derivative from the same common stock as the Insectivores, and therefore to be contrasted with them alone.



CLASS MAMMALIA.

Abranchiate Vertebrates with a brain whose cerebral hemispheres are more or less connected (and in nearly inverse ratio) by an anterior com-

missure, and a superior transverse commissure (corpus callosum); the latter more or less roofing in the ventricles: the lungs and heart in the thorax and separated from the abdominal viscera by a muscular diaphragm: aorta single and reflected over the left bronchus: blood with red non-nucleated blood-corpuscles undergoing a complete circulation; entirely received and transmitted by the right half of the quadrilocular heart to the lungs for aeration (and thus warmed), and afterwards returned by the other half through the system. Skull with two condyles, chiefly developed on the exoccipital elements (one on each side of the foramen magnum): with the malleus and incus superadded as specialized auditory ossicles: and the lower jaw (composed of a pair of simple rami) articulated directly by convex condyles with the squamosal bones. Dermal appendages developed as hairs. Viviparous: fœtus developed from a minute egg: young nourished after birth by a fluid (milk) secreted in peculiar glands (mammary) by the mother.

SUB-CLASS MONODELPHIA.

Brain with the cerebral hemispheres connected by a more or less well-developed corpus callosum composed of a body as well as a folded psalterial portion, and a reduced anterior commissure; with a well developed septum. Sternum with no element in front of the manubrium or presternum. Coracoid not connected with the sternum, but early anchylosed with and developed as a simple process of the scapula. Oviducts debouching into a single vagina. Testes variable in position, but the vasa deferentia open directly or indirectly into a distinct and complete uretha. (and not into a cloacal cavity). Ureters discharge directly into the bladder the renal secretion, which thence passes into the uretha. Mammary glands with well developed nipples. Young retained within the womb till of considerable size and nearly perfect development, and deriving its nourishment from the mother through the intervention of a "placenta" (developed from the allantois) till birth. Scrotum never in front of penis.

Super-Order Educabilia.

Brain with a relatively large cerebrum, behind overlapping much or all of the cerebellum, and in front much or all of the olfactory lobes; corpus callosum (attypically) continued horizontally backwards to or beyond the vertical of the hippocampal sulcus, developing in front a well-defined recurved rostrum.

(*EDUCABILIA QUADRIPEDIA.*)

Posterior members and pelvis well developed. Periotic and tympanic bones articulated with the squamosal.

(*Primate Series.*)

I. ORDER PRIMATES.

Members almost or entirely exserted outside of the common abdominal integument. Digits with corneous appendages developed as claws (i. e.

compressed) or, attypically, as nails (i. e. depressed). First digit (great toe) of hind foot (pes) enlarged, opposable to the others (in man, resuming parallelism with them), always furnished with a nail. Clavicles completely developed. Brain with a well-developed calcarine sulcus, giving rise to a hippocampus minor within the posterior cornu of the ventricle by which the posterior lobe of the cerebrum is traversed. Teeth of three kinds (canines of second set exceptionally atrophied), all encased in enamel; molars rooted. Incisors four in each jaw: etypically, two — or all — in upper jaw suppressed. Placenta deciduate, discoidal.

Contains eight families, representing two sub-orders: ANTHROPOIDEA, with five families, and LEMUROIDEA with three families.

(*Feral Series.*)

II. ORDER FERÆ.

Legs with the proximal joints (humerus and femur) more or less inclosed in the common abdominal integumen. Digits with corneous appendages developed as claws: first digit of hind foot attypically reduced or atrophied: etypically hypertrophied (e. g. *Pinnipedia*). Clavicles none, or rudimentary. Brain with no calcarine sulcus. Teeth of three kinds, all encased with enamel: canines specialized and robust; molars attypically adapted for carnivorous diet, one $(\frac{P.\ m.\ 4}{m.\ 1})$ or more in each jaw being sectorial, followed by tubercular ones. Incisors archetypically six in each jaw, exceptionally two or more suppressed. Placenta deciduate, zonary. Scaphoid and lunar consolidated into one bone.

Contains twenty families, representing two sub-orders: CARNIVORA or FISSIPEDIA, with seventeen families, four of which are extinct, and PINNIPEDIA with three families.

(*Ungulate Series.*)

Legs with the proximal joints more or less inclosed in the common abdominal integuments. Digits with corneous appendages developed as hoofs. Clavicles entirely absent. Teeth of three kinds (canines and incisors of second set exceptionally in part undeveloped), all encased in enamel: molars attypically with grinding surfaces. Scaphoid and lunar separate.

III. ORDER UNGULATA.

Incisors (archetypically $\frac{6}{6}$: often, especially in the upper jaw, reduced in number or wholly suppressed: implanted by simple roots, with incisorial crowns. Feet with inferior (or, rather, posterior) surfaces with a hairy skin continuous with the rest of the integument; carpal bones in two interlocking rows: cuneiform, narrow, and affording a diminished surface of attachment forwards for the ulna (which is retrorse beside the radius); uniform and lunar articulating with each other and interposed between the cuneiform and magnum: hind foot with the astragalus at its anterior portion scarcely deflected inwards, articulating more or less with the cuboid as well as navicular: toes (not more than four — d 2 to d 5 — completely developed) with terminal joints encased in thick hoofs. Placenta non-deciduate (diffuse or cotyledonary).

Contains twenty-nine families, representing two sub-orders; ARTIODACTYLI, with nineteen families, of which eight are extinct, and PERISSODACTYLI with ten families, of which seven are extinct.

IV. ORDER TOXODONTIA.

Incisors ($\frac{6}{6}$ or $\frac{4}{6}$, variable as to insertion), with incisorial crowns. Feet? carpal bones? hind foot with the astragalus at its anterior portion inclined obliquely inwards, articulating in front only with the navicular; (calcaneum with an extensive upwards surface for the articulation of the fibula, and with a large lateral process articulating in front with the astragalus. Molars of upper jaw, broad and extending into an externo-anterior angle; of lower jaw, narrow and continuous, in a uniform row).

Contains two families, both of which are extinct.

V. ORDER HYRACOIDEA.

Incisors ($\frac{4}{4}$) of upper jaw next to symphysis (with persistent pulps) long and curved; those of lower jaw straight and normal. Feet with inferior surfaces furnished with pads (as in Rodents and Carnivores): carpal bones in two interlocking rows: cuneiform extending inwards (and articulating with magnum), and affording an enlarged surface of attachment forwards for the ulna (which is antrorsely twisted); unciform and lunar separated by the interposition of the cuneiform and magnum: hind foot with the astragalus at its anterior portion extended, and, as a whole, much deflected inwards, articulating in front only with the navicular; toes (four to the front feet, three to the hind) with terminal phalanges encased in hoofs (inner nail of hind foot curved). Placenta **deciduate, zonary.**

Contains one family.

VI. ORDER PROBOSCIDEA.

Incisors ($\frac{2}{0}$, or, in extinct forms, $\frac{2}{2}$ or $\frac{0}{2}$. renewed from persistent pulps,) developed as long tusks curved outwards. Feet with palmar and plantar surfaces invested in extended pad-like integuments, which also underlie the toes: carpal bones in two regular (not interlocking) rows, broad and short; cuneiform extended inwards—broad, and furnishing an enlarged surface of attachment forwards for the ulna (which is antrorsely produced). Unciform directly in front of cuneiform, and magnum directly in front of lunar: hind foot with the astragalus at its anterior portion very short (convex.) and not deflected inwards, articulating in front only with the navicular: toes (five to each foot, in known forms,) encased in broad shallow hoofs. Placenta deciduate, **zonary. Snout** produced into a very long proboscis. Legs mostly exserted outside the abdominal integument; and with the proximal and succeeding joints extensible in the same line.

Contains two families, one of which is extinct.

(*EDUCABILIA MUTILATA.*)

(*Mutilate Series.*)

Posterior members and pelvis more or less completely atrophied; the

form of the body being fish-like, furnished with a horizontal tail, and specialized for progression in the water. Periotic and tympanic bones anchylosed together, but not with the squamosal.

VII. ORDER SIRENIA.

Brain narrow. Skull with the foramen magnum posterior, directed somewhat downwards: supra-occipital nearly vertical and not extending forwards, the parietals meeting and interposed between it and the frontal. Periotic with a posterior irregularly rounded part; tympanic annuliform. Lower jaw with well-developed ascending rami and normal transverse condyles and coronoid processes. Lateral teeth molar, and adapted to trituration of herbage. Neck moderate; second cervical vertebra with an odontoid process. Anterior members moderately long, flexed at the elbow; with carpal bones and phalanges directly articulated with the adjoining ones; and with normal digits. Mammæ two, pectoral. Heart deeply fissured between the ventricles.

Contains four families one of which is certainly, and another probably, extinct.

VIII. ORDER CETE.

Brain broad. Skull with the foramen magnum entirely posterior, directed somewhat upwards: supra-occipital very large, sloping forwards, and (attypically) extending forwards over or between the frontals. Periotic attenuated backwards; tympanic solid, entire. Lower jaw with no ascending ramus, with its narrow condyles at the posterior extremities or angles of the rami, and with only rudimentary coronoid processes. Teeth (lateral) conic or compressed. Neck attypically very short; second cervical vertebra with no odontoid process. Anterior members (attypically) abbreviated, extended backwards in a continuous line: with carpal bones and phalanges often separated by cartilage; and with the second digit composed of more than three phalanges. Mammæ two, inguinal.

Contains ten families, representing three sub-orders: ZEUGLODONTIA with two families, both extinct; DENTICETE with six families, one of which is extinct; and MYSTICETE with two families.

Super-Order Ineducabilia.

Brain with a relatively small cerebrum, leaving behind much of the cerebellum exposed, and in front much of the olfactory lobes: corpus callosum extending more or less obliquely upwards and terminating before the vertical of the hippocampal sulcus, with no well defined rostrum in front.

(*Insectivorous Series.*)

Teeth encased in enamel: incisors (very variable as to number) without persistent pulps: canines present (but sometimes modified in form): molars attypically with pointed cusps. Lower jaw with condyles transverse, received into special condyloid sockets. Placenta discoidal deciduate.

IX. ORDER CHIROPTERA.

Anterior members adapted for flight: the ulna and radius being united, and the metacarpal bones and phalanges —2d to 5th—much elongated: the whole sustaining a very thin leathery skin arising from the sides of the body, and extending backwards on the hind members, down to their tarsi. Mammæ pectoral.

Contains nine families representing two sub-orders; FRUGIVORA with one family, and INSECTIVORA with eight families.

X. ORDER INSECTIVORA.

Anterior as well as posterior members adapted for progression on land: the ulna and radius entirely or partly separated: metacarpal bones and phalanges normally developed. Mammæ abdominal.

Contains ten families referable to two sub-orders; DERMAPTERA, with one family, and GRADIENTIA, with nine families, one of which is extinct.

(Rodent Series.)

XI. ORDER GLIRES.

Teeth encased in enamel: incisors ($\frac{2}{2}$; exceptionally, also two supplementary posterior teeth,) continually reproduced from persistent pulps, and growing in a circular direction: canines null: molars attypically with ridged surfaces. Lower jaw with condyles longitudinal, and not received in special condyloid cavities, but gliding freely backwards and forwards. Members and feet ambulatorial. Placenta discoidal deciduate.

Contains sixteen families, representing two sub-orders: SIMPLICIDENTATI, with fourteen families, and DUPLICIDENTATI, with two families.

(Edentate Series).

XII. ORDER BRUTA.

Teeth (when developed) not encased in enamel: incisors typically absent (lateral present in Dasypus): molars variable: members and feet ambulatorial (modified often for grasping and digging). Placenta variable (discoidal deciduate in *Orycteropodidæ* and *Dasypodidæ*; diffuse deciduate in *Manididæ*; and coyledonous non-deciduate? in *Bradypodidæ*).

Contains nine families, representing five sub-orders. VERMILINGUIA, with one family; SQUAMATA, with one family: TODIENTIA, with one family; TORDIGRADA, with two families, one of which is extinct, and DORICATA, with three families, one of which is extinct: also one extinct family of undetermined affinities.

SUB-CLASS DIDELPHIA.

Brain with the cerebral hemispheres chiefly connected by a well-developed anterior commissure, the corpus callosum being rudimentary, and with a moderately developed septum. Sternum with no element in front of the manubrium. Coracoid not connected with the sternum, but early anchylosed with and developed as a simple process of the scapula. Oviducts debouching into separate vaginas. Testes chiefly abdominal: vasa

deferentia opening into a distinct urethra. Ureters discharge directly into the bladder the renal secretion, which thence passes into the urethra. Mammary glands with well developed nipples. Young born when of very small size and imperfect development; never connected by a placenta with the mother, but attached by her to the nipple when born, from which the milk is forced by herself into the mouth of the young. Scrotum in front of penis.

XIII. ORDER MARSUPIALIA.

Only order of the sub-class. Contains thirteen families, referable to four sub-orders: Rhizophaga, with one family; Syndactyli, with seven families, two of which are extinct; Sarcophaga, with two families; and Chiropoda with one family; also two extinct families of doubtful affinities.

SUB-CLASS ORNITHODELPHIA.

Brain with the cerebral hemispheres chiefly connected by a well developed anterior commissure, the corpus callosum being very rudimentary, and with no defined psalterial fibres; with the septum very much reduced in size. (Flower.) Sternum with a peculiar T-shaped bone (the episternum or interclavicle) in advance of the manubrium or presternum. Coracoid extending from the clavicle to the sternum, and only towards maturity anchylosed with the scapula. The oviducts, enlarged below into uterine pouches, but opening separately from one another, as in oviparous vertebrates, debouch, not into a distinct vagina, but into a cloacal chamber, common to the urinary and genital products, and to the faeces. Testes abdominal in position throughout life, and the vasa deferentia open into the cloaca, and not into a distinct urethral passage. Ureters pour the renal secretion, not into the bladder, which is connected with the upper extremity of the cloaca, but into the latter cavity itself. Mammary glands with no distinct nipples. (Huxley.)

XIV. ORDER MONOTREMATA.

Only order of the sub-class. Contains two families.

On the Relations of Anomia.—By Prof. Edward S. Morse.

This peculiar genus of Lamellibranch mollusks included also Terebratula according to the early writers on the subject. Misled by external characters, Linnæus, Lamarck and others believed these two forms closely related. While not the slightest ground existed for bringing them together, yet the mere fact of these two animals being enclosed within a limy shell composed of two pieces, held to the rock by a process which passed out through that element of the shell which was below, was sufficient proof of their kinship, at least to those who were ready to judge everything

by external characters. The whales among fishes, the barnacles among mollusks, were only some of the many blunders made by this superficial way of comparison. And now after the structure of Brachiopods is well known, and all admit the valves to be dorsal and ventral, while the valves of Anomia are right and left, and after the splendid memoirs of Lacaze-Duthiers on the anatomy of Anomia has shown that the nearest relations are with the oyster and pecten, there are still several zoologists who vaguely imagine that some sort of relationship exists between Terebratula and Anomia. This brief communication is made to settle the question with those who never care to go more than shell deep in the subject, for unfortunately the author had only the empty shells to work upon. It will also verify the statement made by Forbes and Hanley in their standard work on the British Mollusca, where the shelly plug which escapes from the sinus in the flat valve to hold the body to its base of attachment is compared to a byssus. They say "When the very young fry of this genus shall have been carefully observed, we believe they will be found spinning a byssus, which passing through this sinus fixes the shell in the first instance, before a portion of it becomes attached, eventually becomes detached with a part of the adductor muscle and forms the opercular process." Lacaze-Duthiers in his examination of the adult form refers to these statements and expresses his belief in their correctness.

In examining some sea-weed collected by a friend last spring I found a lot of the young of Anomia. In these the sinus was not closed, but open toward the anterior margin. The nucleus presented an elongate oval shell larger behind; the beaks nearer the anterior, and no sign of a perforation. The shape was more like that of Montacuta, and the lines of growth were regular and distinct. On the right valve at its lower margin was seen a slight notch, and the few last incremental lines indicated that the notch was made in the last stages of the nucleus. It can only be conceived that the animal before this was a rover, that it then commenced to fix a byssus, the animal dropping to one side and the notch caused by the lowermost valve growing around it, the other valve showing no signs of this notch. So soon however as the shell rested upon one side a different growth took place, a loose-textured, colorless deposit rapidly formed, the outline becoming gradually circular and the lowermost or right valve growing rapidly

behind and downward, then forward and upward, the byssal attachment soon became enclosed in a wide foramen, this extension ultimately reaching the umbones of the larval shell to which it unites. From these facts it will be seen that it presents not even the remotest resemblance to the Brachiopods, but that the young shell has all the proportions of a Bimyarian, and its affinities may be quite remote from Ostrea or Pecten. A study of the early stages of these last named genera would easily settle all these points.

On Eozoon Canadense in the Crystalline Limestones of Massachusetts. By L. S. Burbank.

The limestone deposits here referred to, occur in the band of granitic gneiss which extends in a southwesterly direction from near the mouth of the Merrimack river through the entire breadth of the State, and includes the well known mineral localities of Bolton, Boxboro' and Chelmsford.

Soon after the discovery of *Eozoon Canadense* by Mr. Bicknell, in the serpentine limestone of Newbury, it was also identified by Dr. Dawson in specimens collected by me at Chelmsford; as noticed by Dr. Hunt in the "American Journal of Science" for January, 1870. The specimens then examined were not from the rock in place, but were obtained from some outlying masses near one of the quarries. These discoveries led me to make a further examination of several of the old limestone quarries in the same formation. The eozoonal rock was then found in place at several of the quarries, and its position in relation to the other rocks observed.

At all the quarries the limestone has been so thoroughly exhausted, that the limits of its extent at the surface can be readily traced. The relations of the limestone to the enclosing rocks can thus be easily seen.

By the careful study of these relations, and by reference to many specimens collected and facts observed, the following conclusions have been reached.

1. *These limestones are not true stratified rocks laid down with the gneiss, but are subsequent deposits of a vein-like character.* The fact that some of the deposits appear to be interstratified with the gneiss, and also are found along a line apparently coinciding with the strike of the strata, may seem to indicate that

they are parts of original strata included in the gneiss; but their position may also be explained in accordance with another theory, in support of which I shall offer some evidence.

2. *The principal deposits occur along the line of an anticlinal, filling cavities produced by the folding and the falling down of portions of the included strata of the gneiss.* The anticlinal position is most clearly shown at Chelmsford, where there are four veins or masses of the limestone, in two lines coinciding with the strike of the gneiss.

These lines are about half a mile apart, extending in a northeast and southwest direction; the strike, as observed by the compass, being north 65° east. The strata of the gneiss dip in opposite directions from these lines; toward the northwest at an angle of about 65°, to the southeast at an angle varying from about 70° to a nearly vertical position.

The deposits are all of very limited extent, the largest being at the surface not more than two hundred and twenty feet in length, and about sixty feet in width, including the intervening bands of gneiss.

The aggregate length of all the limestone deposits that occur along a line of some twenty-five miles in length, is probably less than one thousand feet.

The vein-like character of the limestone is most plainly shown in one of the abandoned quarries in Chelmsford. The deposits here occur in two principal veins extending in the direction of the strike of the strata to about two hundred feet in length. The structure here plainly shows that cavities which have become filled with the limestone were formed by the folding and faulting of the strata of gneiss. The masses of limestone are separated by strata of gneiss which are also folded and arched over, enclosing cavities filled with the limestone.

At one of the quarries it can be seen that the limestone rested against the irregularly fractured ends of strata of gneiss, which fill a small space in one of the excavations, completely dividing the limestone into two masses.

That the limestone was deposited in cavities mostly closed at the top, which have since been uncovered and exposed at the surface by the denuding action of the drift, seems to me a reasonable deduction from the facts observed.

It is worthy of note that the gneiss of the enclosing walls of

the cavities, and that of the dividing bands and the projecting masses nearly enclosed by the limestone, — is all of the same character with that of the surrounding strata not adjacent to the quarry.

In the direction of the strike of the strata also, at a few yards distance from the quarries, the common rock of the region is found with apparently no traces of calcareous matter. In the line along which most of the quarries occur, there are intervals of several miles where no traces of limestone have been found, though the ledges are exposed at the surface in numerous places.

The central and principal part of the mass which filled the veins and pockets.and constituted the bulk of the deposit, was *a coarsely crystalline magnesian limestone, homogeneous in structure and showing no traces of stratification.* In examining numerous specimens of this limestone from the different quarries, I have found in it no traces of the eozoonal structure.

The various silicates which form the large number of distinct minerals for which these localites are noted, occur only *attached to, or near, the enclosing walls of the cavities*, and generally in bands or layers, though sometimes irregularly distributed. They are found generally in pretty regular succession. A network of interlacing crystals of actinolite, with smoky quartz, calcite and phlogopite, may be seen attached to the walls; and passing inward there are found pyroxene, scapolite, apatite, boltonite, fine fibrous tremolite, etc.: and also green serpentine in irregular bands or layers, traversed by narrow seams of chrysotile: or scattered through the rock in irregular rounded grains and masses, with intervening spaces filled with calcite.

In these portions of calcite are found the radiating and branching forms that have been identified and described as belonging to the structure of Eozoon. The granules of serpentine are sometimes arranged quite regularly in concentric lines, but more commonly appear irregularly scattered and varying indefinitely in form and size.

Some of the specimens from Chelmsford show masses of the serpentine intersected by narrow seams of chrysotile, and attached to portions of the rock in which the decalcified spaces show the tubuli in great abundance, *attached to the serpentine grains as if growing out from their surfaces.* Some of the grains are surrounded by a fibrous layer, closely resembling the "true cell

wall" of Eozoon as I have seen it in the Canadian specimens. The surfaces of many of the grains are covered with acicular crystals penetrating the calcite. Some of these, as they extend into the calcite, become rounded and curved, losing the acicular character.

In nearly all the specimens examined, bundles of acicular fibres, apparently of tremolite, are scattered abundantly in the calcite.

In some portions of the rock the serpentine appears embedded in the limestone in definite crystalline forms, apparently pseudomorphs of chrysolite, or boltonite. In the quarries of Boxboro' and Carlisle, cinnamon garnet is abundant, associated with scapolite and green pyroxene or coccolite, with calcite. I have examined the calcite of many of these specimens for traces of the eozoonal structure, but, so far, with negative results. In fact, so far as I have observed, the tubuli invariably occur in the rock associated with serpentine.

Some facts have been stated in this communication for which I offer no theories in explanation. I do not claim a sufficient knowledge of the Foraminifera to found any argument upon the microscopic appearances that I have observed, nor do I mean now to enter into a discussion of the general question as to the true character of the *Eozoon Canadense*, as described by Carpenter and Dawson.

I am unable, however, to reconcile the facts here stated with the theory that the form in these rocks which have been identified as belonging to the structure of Eozoon, are of organic origin.

On the other hand, it appears to me not unreasonable to infer that the so-called "tubuli" that are so abundant in these rocks, *are semi-crystalline forms that have been deposited with the serpentine and other minerals on the walls of the cavities*, by infiltration of waters charged with mineral matters.

Professor PERRY said:—I desire to bear testimony to the general correctness of the statements made by Mr. Burbank.

In addition to the evidence given by him, I would refer to the fact that the limestones under consideration exactly conform with breaks and other irregularities in the enclosing mass of gneiss. I may also state that in some places calcareous veins which evidently proceeded from the main masses of limestone, may be seen ramifying portions of the walls that form the cavities.

As geologists have generally supposed that all limestones are stratified rocks, a few words may be needful on this point, especially, as serving to

meet the objection in this direction which is likely to occur to many minds. Dr. Emmons, as most no doubt are aware, endeavored to show that limestones occur as intrusive masses as well as in stratified beds. Commencing my study of the limestones connected with the foliated series of rocks in the light of this view, I finally became convinced in 1861, and during the same year set forth in a series of lectures, that some of these limestones have a vein-like structure, and should be regarded as true vein-stones.

Such limestones are to be met with in association with the foliated rocks both of eastern and western Vermont, and in various parts of Massachusetts. They also occur among the Adirondacks. Limestones of this character, hand-specimens of which cannot be distinguished by the naked eye from specimens of stratified Silurian limestones, are likewise found in Vermont and elsewhere in the form of dikes. In most of these cases close examination shows that the dike-like masses were formed in the vein-like way by gradual deposition extending from the enclosing walls toward the centres of what once were cavities. Similar masses of calcareous vein-stone are to be met with in St. Lawrence County, N. Y., and in some other places, penetrating beds of sandstone.

These, and similar cases which might be readily cited, are suited to remove the objection that limestones are always stratified rocks. At the same time the occurrence of undoubled *Eozoon Canadense* in calcareous vein-stones of eastern Massachusetts tends not only to disprove the animal origin of the specimens from the localities under consideration, but also to involve in doubt the organic character of the Eozoon generally.

On the Eozoon Limestone of Eastern Massachusetts. — By Prof. J. B. Perry.

Having about ten years ago, made out that some of the limestones associated with the foliated rocks in Vermont and New York, are vein-stones, I have ever been skeptical in regard to the supposed organic nature of the Eozoon. As I had more recently satisfied myself that limestones in Stoneham, Newbury, and several other places in eastern Massachusetts are also vein-rocks, I at once, on the announcement of the discovery of Eozoon in the limestones of Newbury, discredited its assumed organic character, on the ground of its occurrence in calcareous masses of a vein-like origin. On hearing of a like discovery in Chelmsford, and seeing a specimen, I had a similar conviction; and this I immediately expressed in one of the lectures which I was then delivering in course, and was able fully to confirm by personal examination, on visiting the quarry a few months later, in company with my friend Mr. Burbank, of Lowell, who had before and has since

devoted himself assiduously to the study of the rocks in his neighborhood.

The limestones in which the so-called Eozoon is found, as should be borne in mind, do not occur in a continuous line, as is usual in stratified rocks. They are isolated masses, often having a lenticular shape, and are found only at irregular intervals. Those at Chelmsford occupy, or rather occupied (for they have been largely removed) cavities, or oven-shaped spaces, formed by the disturbance of the overlying gneiss. In places, the gneiss now so overarches some of the cavities, and it evidently once so overarched them all, as to make it impossible that fossils, or any other solid foreign bodies, could have been carried in and deposited in a continuous series, beneath the summits and all along the sides of the arches.

Again, these calcareous masses have that banded structure which is peculiar to veins. There is, moreover, connected with this structure a succession of minerals, showing that the deposition must have taken place gradually, one layer succeeding another from the sides of the cavities toward the centres, until the central spaces were finally filled. Once more, these layers exactly conform with the most abrupt irregularities of the enclosing gneiss, while portions of the limestone in given instances clearly ramify, in a vein-like way, the walls which form the cavities.

Such are some of the points characteristic of these calcareous vein-stones. That the limestones of Chelmsford have truly a vein-like structure should be evident from what has been said, and especially, from an examination of the same and of similar rocks as they occur in place. The question as to their origin, whether by infiltration, segregation, or sublimation, I leave undiscussed for the present.

Now it is a fact, that genuine Eozoon — Eozoon which is recognized as genuine by those who hold to its organic nature — actually occurs in these limestones.

Thus, an enigma is asking for solution — an enigma involving difficulties not easily answered, and imposing a task not readily performed, in consistency with the commonly received views of this strange fossil form. Indeed, the fact that genuine Eozoon occurs in these calcareous vein-stones, under the conditions indicated, raises an important question which I leave those conversant with Eozoon structure to solve as best they are able. While it in-

dicates that the so-called Eozoon of Chelmsford is not of animal origin, it at the same time casts discredit upon the organic character of the "Eozoon" generally, and fixes the burden of proof upon its advocates. It also certainly suggests that the resemblance which the "Eozoon" has to animal structure is, like that of Dendrites to vegetable forms, merely the result of chemical agency.

Remarks on the Geological Map and Section of the Rocks of Missouri.—By Prof. G. C. Swallow.

It was his object to put on record some of the general results of the Geological Survey of Missouri made by himself and his able assistants (one of whom, Dr. B. F. Shumard, is now dead.) Since the interruption of the survey by the late civil war there has been no opportunity offered for the publication of the results.

The survey was most minute and carefully made, and the results the same as represented by the section and map before us. The boundaries of the formation save in eight or thirteen counties are accurate and all the formations are as delineated by the section running through all the great systems known to American geology.

Some of the results in Economical Geology were mentioned.

There are twenty-seven thousand square miles of Coal Measures containing at least twenty coal beds, one at least of the block coal. Large deposits of specular, hæmatite, bay and spathic ores were mentioned. The mineral regions containing mines of lead, zinc, cobalt, nickel and copper cover an area of about eight thousand square miles; all but two hundred square miles in the Magnesian Limestone series (of the Potsdam and Calciferous ages) and two hundred square miles at Granly in the lower Carboniferous rocks. Lead and zinc often cut the coal beds in their vertical veins.

The Potsdam Sandstone rests nonconformably upon the Azoic stratified slates of Pilot Knob. Hence Pilot Knob.

Prof. E. W. Hilgard inquired of Prof. Swallow whether the chalky siliceous beds in southeastern Missouri, conjectured to be of cretaceous age, did not occasionally contain grains of glauconite, black sand and obscure casts of shells.

Upon Prof. Swallow replying in the affirmative, Prof. Hilgard stated that while such materials were altogether foreign to the Cretaceous beds of the adjoining states of Arkansas, Tennessee and Mississippi, a narrow

belt of precisely such deposits frequently bordered the lignitic Tertiary of the two latter states. Occasionally, they expand into larger outliers and exhibit the lithological character and fossils of the Buhr-stone group, the lowest of the marine Eocenes which he considers as the equivalent in time, of the lignitic beds of Tennessee, Arkansas and North Mississippi.

The Great Mound on the Etawah River, near Cartersville, Georgia.—By Col. Charles Whittlesey.

This mound is situated on the river bottom, on the north bank, about three miles below where the railroad from Chattanooga to Atlanta crosses the Etawah river. Its base is an irregular figure, five hundred and eighty-five poles in circumference, covering about three acres. The bottom on which it stands is elevated eighteen to twenty-three feet above low water, and is seldon invaded by high water in any part. The mound is truncated, nearly flat on the top, which embraces about an acre of ground. This area is elevated fifty feet above the base, and seventy-three feet above low water. There is no high land within a quarter of a mile on either side of the river. Its slopes are very perfect and steep. Bushes, grass, vines, shrubs and trees grow luxuriantly on its sides and the level space on the top is annually planted in corn or cotton. There is a broad ramp or road fifty feet wide, commencing at the southeast corner which winds around the southerly face bending to the right, and reaches the summit on the west side. It has an easy grade for footmen and horses, but is too steep for vehicles. The mass of this mound I estimate at about one hundred and twenty thousand cubic yards, or about four-fifths of the contents of the British earth pyramid raised on the field of Waterloo. Rising over the alluvial valley where it is isolated it has an impressive aspect, like that of the pyramids of Egypt on a sandy desert. This valley, however, is everywhere rich and beautiful.

Like some of the larger pyramids it has two smaller ones which appear to be tenders. One is a square, truncated pyramid which stands one hundred feet east of the foot of the ramp and is twenty-two feet high, its flat top being about eighty feet on a side; its slopes, steep and perfect like the great mound. To this one there is no ramp or place of ascent.

The other is about one hundred feet due south of the southwest corner of the great mound, and is of about the same dimensions

but has on its east side a ramp or graded way by which to ascend to the flat space on the top. Its sides and that of the other tender are from five to ten degrees west of the magnetic meridian.

All of this group are composed of the rich black alluvial earth of the adjacent bottom, with occasional lumps of red clay which constitutes the base of the river terraces that border the valley. About two hundred yards from the mounds on the north there are the remains of a ditch which has been mostly obliterated by cultivation and which encircles the group in a circular form a distance of about one-fourth of a mile, coming to the river below but not above. Within and without the trace of this ditch which the owner says had an interior embankment, there are low mounds partly plowed down. Near its upper or the easterly end, there are two large, oblong pits from which a part of the earth of the mounds may have been taken.

There are other small mounds in the valley below on both sides of the river. The valley is bordered by limestone bluffs about two miles apart which rise two hundred to two hundred and fifty feet above the river. On a rocky summit about two miles west of the great mound is what is called the "Stone Fort." It consists of a wall or heap of loose blocks of limestone surrounding the summit in an oval form, the largest diameter of the enclosure being two hundred and twenty poles. There are numerous openings in it at irregular intervals, some of them fifty feet broad. The space around the crown of the hill is clear of loose stones and this explains the existence of the wall, which has the appearance of a stone fence fallen down.

It does not have the appearance of a fort or stronghold, but of a high place dedicated to imposing ceremonies to which the people came up in all directions through the openings or passes in the line of stones. Probably, it was then as now covered with oaks. The crown of the hill is about fifty feet above the encircling wall, and presents from its summit a view of the valley and the country opposite that is hardly equalled for scenic beauty.

It is probably the work of the red man of our times and has no connection with the great mound or its builders.

Professor W. C. KERR said there is a mound quite similar to the one just described by Col. Whittlesey, in the valley of the Tennessee river, in Macon County, N. C., with sides equally steep, and outlines equally well preserved, of its use, date of construction, or its builders there

exists no tradition in the region. Its form is the frustum of a cone, whose base is about seventy-five feet in diameter, and top about fifty, and its height thirty or forty feet. It stands on the alluvial river-bottom, and was doubtless built of the same material, although all signs of excavation for this purpose have been entirely obliterated by subsequent deposition. On digging into this pile, nothing was found which could throw any light on its history.

Prof. G. C. SWALLOW remarked that Hon. Godfrey Lesceur, grandson of the first Spanish commandant at North Madrid, Mexico, says the old Indians had a curious tradition respecting the mound builders. They said: "We did not build the mounds, we came to this (Mississippi) valley from the northwest. Here we found a quiet, peaceable people cultivating the soil and living in communities, and having mounds for the Great Spirit and burial. They begged us to leave them, as there was country to the northeast. We went, but found the country poorer, and after a time returned and drove out the mound builders, who went to the southwest. We burnt their wigwams and possessed the country." He remarked that no warlike implements had been found with the real mound builders, and there is ample evidence that their temples were destroyed by fire; at least those in North Madrid, Mexico, as remains of the charred wood-work still exist in the mounds.

ANCIENT ROCK INSCRIPTIONS IN OHIO. — BY COL. C. WHITTLESEY.

SEVERAL diagrams were presented to the section representing rock sculptures in Ohio, that are presumed to be ancient and to have some significance. The largest is a tracing made by Dr. J. H. Salisbury, of Cleveland, with the assistance of Mrs. Salisbury, from a mural face of conglomerate, near the famous "Black Hand" in Licking County, O. Once there was a space of ten or twelve feet in height, by fifty or sixty feet in length, covered by these inscriptions. Most of them have been obliterated by the recent white settlers.

In 1861, Dr. Salisbury took copies from a space about eight by fifteen feet, by laying a piece of coarse muslin over them, and tracing such as remain uninjured, life-size, on the cloth. In this space there are found to be twenty-three characters, most of which are the arrow-head or bird-track character. These are all cut on the edge of the strata, presenting a face nearly vertical, but a little shelving outward, so as to be sheltered by the weather.

Another copy of the remnants of similar inscriptions was taken by Col. Whittlesey and Mr. J. B. Comstock, in 1869, from the "Turkey Foot Rock," at the rapids of the Maumee, near Perrys-

burg. These are on a block of limestone, and in the course of the twenty-five past years have been nearly destroyed by the hand of man. What is left was taken by a tracing of the size of nature.

On the surface of a quarry of grindstone grit at Independence, Cuyahoga County, Ohio, a large inscribed surface was uncovered in 1854. Mr. B. Wood, Deacon Bicknell, and other citizens of Independence, secured a block about six feet by four, and built it into the north wall of a stone church they were then building. Col. Whittlesey presented a reduced sketch, one-fourth size of nature, taken by Dr. Salisbury and Dr. J. M. Lewis, in 1869, which was made perfect by the assistance of a photographer. Some of the figures sculptured on this slab are cut an inch to an inch and a half in the rock, and they were covered by soil a foot to eighteen inches in thickness, on which large trees were growing. Like all of the others they were made by a sharp-pointed tool like a pick, but as yet no such tool has been found among the relics of the mound-builders or of the Indians. The figures are very curious. Among them is something like a trident, or fish-spear, a serpent, a human hand, and a number of track-like figures, which the people call buffalo-tracks, but Dr. Salisbury regards as a closer representation of a human foot covered by a shoe-pack or moccasin. Another figure somewhat resembles the section of a bell with its clapper.

Near the west line of Belmont County, Ohio, Mr. James W. Ward, then of Cincinnati, now of New York, in 1859, took a sketch of two large isolated sandstone rocks, on which are groups of figures similar to those already noticed. Here are the bird-track characters, the serpent, the moccasin or buffalo-tracks, and some anomalous figures. These are plainly cut, with a pick, into the surface of the rock, which, like the Independence stone, is substantially imperishable. Here we have also the representation of the human foot, and the foot of a bear. Another figure, which appears to be the foot of some animal with four clumpy toes. Professor Cope thinks may be the foretrack of a Menopome. One peculiarity of these sculptured human feet is, a monstrously enlarged great-toe joint, even greater than is produced by the modern process of shoe-pinching. This has been observed in other ancient carvings of the human foot upon the rocks near St. Louis, Missouri. These feet range in size from seven to fifteen inches in length. Of all these representations, the bear's foot is closest to

nature. The bird-track, so called, presents six varieties, none of which are anatomically correct. The human hand is more perfect than the foot.

Dr. Salisbury finds, on comparison of these symbolical figures with the Oriental sign-writing, or hieroglyphical alphabets, that there are many characters in common. Some 800 years before Christ, the Chinese had a bird-track character in their syllable alphabet. The serpent is a symbol so common among the early nations, and has a significance so various, that very little use can be made of it in the comparison.

These inscriptions differ materially from those made by the modern red man. He is unable to read that class of them which appears to be ancient.

Lieut. Whipple has mentioned in the "Government Report on the Pacific Rail Road Surveys," an instance of the bird-track character inscribed upon the rocks of Arizona. Professor Kerr, of North Carolina, states that he has noticed similar characters cut in the rocks of one of the passes of the Black Mountains, at the head of the Tennessee river.

These facts indicate wide-spread universality in the use of this style of inscription, and it indicates something higher than the present symbolical, or picture writing of the North American Indians.

Professor W. C. KERR said it may be a matter of some interest in this connection to state that on a recent tour among the mountains of North Carolina, I found, at the foot of the Black Mountain, at an elevation of some 2800 feet, in a gap which was doubtless traversed by an Indian trail, a slab of chloritic rock, about six feet by three and a half, which is covered all over with carvings, representing the tracks of the animals which formerly inhabited the region. Among these I took note of the following: the bear (one track being larger than any specimen known to the modern hunter), buffalo, elk, deer, panther, wolf, fox, rabbit, turkey and snake. There is a second slab of smaller size, at a little distance, with similar markings. These foot-prints are very distinct, and readily identified, although, doubtless, the lines are not so sharp as when first cut.

Professor COPE remarked that one of the representations on the diagram had a close resemblance to the hind foot of the Menopoma or water-dog. He also remarked that what had been regarded by some archeologists as a representation of the head of the mammoth, found in Central America, and which had been brought forward as proof of the contemporaneous existence of man and that now extinct animal, was in fact but a rude figure of a human head.

Colonel WHITTLESEY stated that the representations of Central American sculptures that he had seen were unquestionably elephantine in their character, and could not be tortured into an outline of anything human. He could not say, however, how true to the originals the copies were.

WESTERN COAL MEASURES AND INDIANA COAL.—BY PROFESSOR E. T. COX.

THE study which I have given to the geology of the West, has led me to conclude that the Carboniferous rocks embracing the coal beds, both of the Appalachian and Western coal fields, were formed in two great depressions that gave rise to large inland seas. These seas communicated on the south and west with the ocean, which then extended far up the Mississippi valley and covered most of the southern states as far north as the thirty-fifth parallel.

A high ridge or plateau of Silurian rocks, capped in places with the Devonian, and lying in a northeasterly direction across the states of Tennessee and Kentucky, and along the western border of Ohio and the eastern border of Indiana, separated these two seas from each other, and spreading out over the northern portion of the two latter states, extended into Pennsylvania on the east, and Illinois and Iowa on the west, forming an almost unbroken chain along their northern shores.

In these seas were formed the Sub-carboniferous rocks, and, as the water became shallow from the accumulated sedementary material that went to build them up, a barrier was formed, which shut out the ocean and cut off the source of salt water supply. Facilitated, also, by the drainage from a large surface area, the waters of these seas became less and less brackish, and the conditions necessary for the accumulation of the coal vegetation were, in this way, brought about so gradually that many marine forms of life continued to exist and by degrees accommodated themselves to the new condition of things.

That marine forms of life are brought to adapt themselves to fresh water habitudes, under favorable conditions, has been shown by the researches of Dr. William Stimpson, who found by deep dredgings in Lake Michigan, species of marine crustacea in great abundance; and similar discoveries had previously been made of marine forms of life by dredging in the large fresh water lakes of Europe.

From this, we may readily infer that the North American lakes communicated at one time with the ocean, and that their fauna and flora, were to a certain extent brought to accommodate themselves to the gradual change from salt to fresh water.

The position of the oceans, relative to the land, and the great preponderance of water on the American continent, during the Carboniferous epoch, must have had a decided influence in modifying the temperature and increasing the humidity of the atmosphere, thereby rendering it in every way adapted to the luxuriant growth of the tropical plants which furnished the carbon so providentially stored away in the fossil fuel, for we find that many of these coal producing plants, whose dwarfed prototypes are now confined to the tropics, flourished then as far north as the arctic zone.

There could have been no necessity for any increase of carbonic acid or other material change, as some have supposed, in the composition of the atmosphere beyond a slight increase in its humidity, and the probability is that none existed.

The two great coal fields being separated from each other from the very beginning, as I have endeavored to show, by a barrier of rocks, which present no evidence of any subsequent submergence, and which long antedate the carboniferous era, renders it difficult to comprehend how an equivalency in the coal beds of the Appalachian field, can be found in those of the West, as many of our eminent geologists have maintained.

It is true that the fluctuations in level which served to build up the various strata, may have been, and in all probability were, synchronous over the two basins, but the special requirements for the production of coal beds could hardly have proved uniform over districts so widely separated.

Though once a firm believer in the equivalency of coal seams throughout the Western coal measures, I have seen much of late to shake my faith in the possibility of determining an entire agreement in the coal beds, even in the limited area of the coal fields of Indiana.

From a marked irregularity in the thickness of the Carboniferous beds over any great extent of territory, we have good reason to believe that these inland seas, like all other great bodies of water, were of unequal depth, and consequently, did not present at all times, over their entire area, the conditions

alike favorable for the formation of coal, and that, while the ocean was excluded from the Appalachian sea, where the material for coal beds was forming. The sea on the Western side was still filled with salt water, where the sediment was accumulating which was subsequently changed to rock, and the conditions favorable to the production of coal had not yet been reached. Such a state of things will serve to account for the great discrepancy in the aggregate thickness of the strata in the two coal fields. The Appalachian, being estimated at twenty-five hundred or three thousand feet, whereas, in the Western coal field, the greatest depth will hardly exceed one thousand feet; and in Indiana, not more than seven hundred feet, if so much; though we include, in the latter estimate, every stratum from the Archimedes limestone upward.

From observations made in the Western coal field, during the past three years, extending over portions of southern Illinois, western Kentucky, and Indiana, so many errors have been found in the sections of the coal strata given in the third Kentucky Report, and which were pretty generally copied by other geologists in more recent reports, that I have found it necessary to make an **entirely new classification of the coals in the west.**

In the connected section of the Western coal beds, given at pages 18–24, 3d vol. Ky. Report, the measures are divided into upper and lower coal measures, and this arrangement, with some local modifications, has, until recently, been generally adopted by geologists. Now, so far as my observations go, either in Kentucky, Illinois or Indiana, I can find neither lithological nor palæontological evidence which can be relied upon for cutting up the Western coal measures into separate epochs. The Anvil Rock sandstone, which was brought into requisition for this purpose, can hardly be depended upon as a horizon, beyond the small district in which it was first discovered, and the equivalency of the Mahoning sandstone of the Pennsylvania geologists, as designated by Owen and Lesquereux, has also proved totally unreliable as a basis for division, even though it should be found necessary to establish one.

In the 3d vol. Ky. Report, and in the Report of a Geological Reconnoisance of Indiana, 1859, the latter stone is at one place referred to the horizon of the Anvil Rock sandstone, and at **another locality to that of the Millstone grit.**

Indeed, so unfortunate has been the effort to transplant the Mahoning sandstone of Pennsylvania into our western coal measures.

that I can recall no prominent locality where it is distinctly referable to one or the other of the above sandstones. For the equivalency of sandstones in the Western coal field I have, as yet, been unable to find any lithological or palæontological evidence which can be relied upon as a guide to identity.

In the Indiana Report by Prof. Richard Owen, 1859–60, Prof. Lesquereux refers, from palæontological evidence, the sandstone above the "Knob" coal in Spencer county, to the Mahoning sandstone, and appears undecided, whether the position of the "Martha Washington" sandstone, which forms the bluff at Rockport and presents a vertical face of thirty to fifty feet on the side fronting the river, should be referred to the Mahoning or the sandstone above coal No. 2 of his general section given at pages 299–305. (column No. 1 of diagram). At these localities, from my own examinations, I find the Rockport Sandstones to be the Millstone grit, and the "Knob" coal to be coal L of my general section of the coals in Clay county (column No. 3 of the diagram). Consequently, the sandstone which overlies it, in the hill, if referred at all to an equivalency in the Kentucky section, will be at least about the place of the Anvil Rock sandstone.

At Washington, in Daviess county, Mr. Lesquereux found a paucity of palæontological evidence, nevertheless it was believed to be sufficient to warrant him in referring the main coal of that place to No. 1, B, of his section. In his account of the measures, in Daviess county, no mention is made of the heavy bed of sandstone, two miles northeast of Washington, which is overlaid by the "Washington Coal" which he refers to No. 1, B. This sandstone is quite a marked feature in the geology of this part of Daviess county and is underlaid by two workable beds of coal—the upper three feet thick, and the lower three to six feet thick; the space between the two, varying from twenty to forty feet. The lower coal has usually a limestone over it; and being the second coal, in the descending order, below the "Washington coal" is represented as K in my section. A coal fourteen miles north of Washington, overlaid by limestone, is, from its position, referred by him to coal No. 1, C. I suppose the coal in the bed of the river below Edwardsport, in Knox county, is the seam here referred to; if so, it is the second seam below the "Washington coal." Now the "Washington coal" is at least as high up in the measures as coal L of my section. The first coal below L, in

Daviess county, was not recognized in Clay county, and at the time of making my section it was thought that no coal would be found intervening between L and K, consequently, I am now compelled to make an interpolation of a letter and provisionally designate this coal as X; the coal, with the limestone above it, as K, and the five foot coal bed near the top of the hill at Edwardsport, which is equivalent to the "Washington coal" as L.

Passing on northward into Clay county, coal I, of my section, refers to No. 1, A, and K to No. 1, C, of Lesquereux' section.

Now it is clearly demonstrated in this county that there are two workable block coal beds in a space of fifty to sixty feet below the seam reported by Mr. Lesquereux as No. 1, A, or the lowest workable seam.

At Garlick and Collins' mine, on Otter creek, in Clay county, coal K is seen in the side of the hill in the road cut; I, is worked by a drift, and G is worked by a shaft sunk at the foot of the hill on the bank of Otter creek. Both I and G are here loaded in the cars from the same coal tip.

In my first report, 1869, I pointed out the existence of a second workable seam of block coal below the seam then generally worked; its position in the column was determined from imperfect outcrops, and for a time, an error was committed in confounding it with a still lower seam F. Previous to my survey of Clay county, no other person who had examined the ground, dreamed of finding another workable bed of coal below what was called the "Brazil seam" (I). On the contrary, it was universally believed that the strata at Brazil, indicated the latter seam to be the lowest workable coal in the coal measures proper, and, consequently, that no seam of any economical value could be found below it. Since the publication of my first report, the second seam has been reached by shafts and worked at a number of localities in the county, and the existence of the third seam is fully proved by bores.

At Highland, two miles west of Brazil, L of my column, is the principal coal worked, and probably the only seam in the basin, at that locality, which is of a suitable thickness to be mined with profit.

Notwithstanding the high position which it undoubtedly occupies in the measures, we find that it is referred by Mr. Lesquereux to No. 4 of his column, the same seam at Williams' to No. 3, and the sandstone which is seen above the coal at Highland he refers.

without doubt, to the Mahoning sandstone. In fact, the misplacing of coal seams, and confounding of sandstones at all levels with the Mahoning sandstone, of Pennsylvania, and the Anvil Rock sandstone of Kentucky, I might continue to trace throughout the entire coal field of Kentucky, Indiana and Illinois. In the Kentucky reports, and the Report of a Geological Reconnoissance of Indiana, 1859, as well as in the reports of other geologists, who have written on the western coal measures, the distinguished authors appear to have satisfied themselves that the western coal beds and sandstones are synchronous with the Appalachian strata, and that the Mahoning sandstone, there a conspicuous horizon, must, as a matter of necessity, have a place in the western field, and divide here, as there, the measures into upper and lower coal measures, and that the coal beds should conform thereto.

Having pointed out a few of the errors committed in the stratigraphy of the Indiana coals, at localities where their position can be proved beyond a doubt, I will now proceed to show some of the errors that exist in the Kentucky column, from observations made at the same localities that furnished the data upon which it was constructed, and which column has heretofore served as a basis for the arrangement of the coal beds and sandstones of all other districts in the west.

The column of the coal measures given at pages 18–24, 3d vol., Geology of Kentucky, presents us with thirteen hundred and fifty feet of strata, above the Millstone grit or Careyville conglomerate. From the sandstone under coal No. 18, down to the Anvil Rock sandstone, there is a repetition of the strata, including the latter rock, probably as far down as No. 7. This part of the column was constructed from bores that started on the Carthage limestone, which, in Union county, Kentucky, is, I now believe, the equivalent of the limestone over coal No. 11. Though the details of strata passed through in these bores can hardly be relied upon, and in no two instances do they fully agree, as to the character of the rocks, still the place of the coals, and probably their full thickness, is given with considerable accuracy. Therefore, in the arrangement of this part of the column, it was erroneously assumed that the bottom of the lowest bore in Union county, starting from the horizon of the Carthage limestone, stopped just before reaching coal No. 11. From No. 17 down to No. 13 by ref-

erence to the diagram you will observe the close agreement in the spaces between the coals above, and those below No. 11. In the former, they are thirty-five, one hundred and two, one hundred and fifteen, and seventy-seven feet respectively, while in the latter they are forty-six, sixty-seven, eighty-six and one hundred and twenty-seven feet; the aggregate distance from No. 17 to No. 13 being three hundred and twenty-nine feet, and from No. 11 to No. 6, three hundred and twenty-six feet. In giving the space from No. 8 to No. 6, I have omitted No. 7, which, at best, is but a streak of coal, and has no existence in Union county, where the principal data for the section was obtained. We are thus carried down to about the place of the "little coal" at Mulford's, now Shotwell's mines, or No. 6 of the Kentucky column.

From No. 5, passing down, there is but one thin coal seam in the space intervening between it and Bell's coal or No. 1, B.

The Curlew sandstone that is referred to a horizon just below the Mahoning sandstone of Pennsylvania, is the equivalent of the Anvil Rock sandstone. No. 4 coal is No. 11, and No. 3 is the equivalent of No. 1, B, or Bell's coal, which lies just above the Millstone grit or Caseyville conglomerate. In Union county, Kentucky, there is a thin coal in the conglomerate below Bell's coal, but there appears to be no workable seam.

The total thickness of the strata in the Kentucky column, exclusive of the Millstone grit, is thirteen hundred and fifty feet: now strip it of the above errors of repeated strata, and we have, as the depth of the Carboniferous rocks in Union county, Kentucky, only six hundred and twelve feet, including the Millstone grit.

The above errors are, in a great measure, to be attributed to too great a reliance on palæontological evidence, and to an apparent desire to make the measures conform to the Pennsylvania sections of the Appalachian coal field.

Though there are some striking analogies, so far as relates to the character and peculiar arrangement of their accompanying rocks, which were first pointed out by myself in a lecture on the western coals in 1857, between the Pittsburgh seam of Pennsylvania, and the mammoth seam of western measures (No. 11 of Owen's, and which may prove to be K of my column), yet, from the undoubted disconnection of the two fields while the coals were being formed, it is difficult to conceive how any reliable equivalency can be established.

More especially are we led to doubt the equivalency; if we take into account the great preponderance of coal measure strata in the Pennsylvania district, which goes to show that the conditions necessary for the production of coal extended over a much greater period of time in the Appalachian, than in the western field.

Though I have assumed that the greatest depth of coal strata in the western measures will not exceed one thousand feet, in Indiana it will not be found greater than six hundred and fifty feet, including the Millstone grit. In a few localities in this State there are one or more very thin seams of coal below the Archimedes limestone, but no coal of any economical value has yet been found lower than the base of the Millstone grit.

There are in Indiana two well defined zones of coal, the eastern and western zone, and though an equivalency in some of the seams is clearly traced, from one to the other, yet the quality of the coal is quite distinct in each.

The area of the eastern zone is about four hundred and fifty square miles, or two hundred and eighty-eight thousand acres, and the included coals belong to the bituminous variety characterized as *non-caking* or *free-burning*.

The *cherry-coal* or *soft coal* of England is a non-caking coal, but the non-caking coals of Indiana differ somewhat in physical structure from the English coal and from a similar class of coals found in the Mahoning valley, Ohio, and the Shenango valley, Pennsylvania; the latter two being the only other localities in the United States where non-caking coal is formed in any quantity. The Indiana coal from this zone has received the local name of *Block coal;* a name given to it by the miners on account of the facility with which it can be mined in blocks as large as it is possible to handle. The beds are crossed nearly at right angles by joint seams that greatly facilitate the operation of mining, which is usually carried on without resort to blasting. Blocks are taken out the full depth of the seam and leave a zigzag, notched outline, on the face of the mine, resembling a Virginia worm fence.

Block coal has a laminated structure and is composed of alternate thin layers of vitreous, dull black coal, and fibrous, mineral charcoal. In the direction of the bedding lines it splits readily into thin sheets like a slate, but breaks with difficulty in the opposite direction, and when struck with a hammer emits a sound

like that given by wood. Chemically it does not appear to differ from the caking-coals, but in burning behaves quite differently. Unlike the latter, it does not swell and shoot out jets of gas, nor form a cake by running together, neither does it leave an ash mixed with clinker, but retains its shape like hickory wood, until entirely consumed to a small quantity of white ash, which contains no trace of clinker. I have not yet had time to make an ultimate analysis of the block coal, but I believe that, when so examined, its superior heating properties which have been determined in practice by actual work done, though mainly due to its physical structure, will be found partly owing to its containing less oxygen and relatively more hydrogen than is commonly found in bituminous coals. The block coal, in a great majority of the mines that have been opened, is remarkably free from sulphur and phosphorus.

A specimen, taken from Garlick and Collins' new shaft, coal G of my section and which has a specific gravity of 1.232, gave in one hundred parts: Water, 2.10, Gas, 37.35, Fixed Carbon, 57-95, Ash, white, 2.40, Phosphorus, 0.22, Sulphur, 0.073.

At the White River Valley Rolling Mills, in this city, I was informed by the Superintendent, Mr. Sims, an experienced iron master from Pittsburgh, Pa., that it not only required a less quantity of block coal than of any of the coals in use around Pittsburgh to make a ton of wrought iron, but that they were likewise enabled to bring off the heats in a much shorter space of time, and the resulting iron is of a superior quality—three important advantages that cannot be overlooked by iron-masters: and it must be conceded, that the good behavior of a coal in the puddling furnace is one of the very best tests of purity and effective heating properties to which it can be subjected; for, here, its good qualities are brought into requisition, and the bad ones are soon made manifest in the poor quality of the iron produced.

Though the Blast furnaces of Clay county cannot be looked upon as filling all the requisites of an iron furnace best adapted to the use of block coal, still they are enabled to make a ton of No. 1 foundry iron that will, in quality, compare favorably with charcoal iron, by the use of less than two tons of coal: and I feel fully satisfied that by materially increasing the width of these furnaces across the bushes, and raising the temperature of the blast to 1200°–1500°, the *make* will be greatly increased and the consumption of coal very much reduced.

In the Block-coal zone of the Indiana coal field, there are as many as eight seams of non-caking coal, four of which are of good workable thickness over a portion of the field. These are I, G, F and A, which, together, have a maximum thickness of fifteen feet, and by including the other four seams, we have six feet more, making a total of twenty-one feet of block coal.

The superior excellence of the block coal for smelting, and working iron and steel, in all the varied departments of their manufacture, has been fully established by practical tests. Pig iron made with this coal is in every respect equal to charcoal iron made from the same ores; it is a soft gray iron of a highly crystalline structure, contains a large percentage of combined carbon, with but a mere trace of sulphur and phosphorus; properties which render it admirably adapted to the manufacture of Bessemer steel.

For steam and household purposes it likewise has an unrivalled reputation. It burns under boilers with a full and uniform flame that spreads evenly over the exposed surface, thus securing a more uniform expansion of the boiler plates and greater freedom from leaks that are so common when caking coals are used. No clinkers are formed, and owing to its freedom from sulphur it has but little detrimental effect upon the boilers, grates or fire boxes.

The western zone of coals in Indiana comprises by far the greatest area of measures, being somewhat over six thousand square miles, and contains three or more very thick beds of coal, besides a number that are too thin for working. Its eastern boundary, which is formed by the zone of block coal, is irregular in outline, and with my present knowledge of the geology of the country, it cannot be well defined. It is evident, however, that the block coal beds, as we go west, are changed in character and pass into caking coal. The lower members thin out, and are no longer of workable thickness, even before reaching the Wabash river. Of this we have abundant proof by the three deep bores at Terre Haute.

These bores commence about forty feet above low water of the Wabash river, and after passing a few feet of alluvium deposit, were in strata of gravel, sand and hard pan, peculiar to the drift epoch, for a depth of about one hundred and fifty feet, and though they penetrate the Silurian rocks, the records show that but five seams of coal were passed; only the top one being of workable thickness, while the lowest is but two hundred and ninety-three and three-quarters feet below the surface.

Two and a half miles east of Terre Haute, coal N, which is worked by a shaft at Seebyville, crops out; this indicates a rise of the strata to the west, and, as a still further means of accounting for the absence of the upper part of the coal measures in these bores, it is possible that the great bed of drift which is found on the east bank of the Wabash river, at Terre Haute, filled up a ravine or valley from which some of the upper coal beds were removed by abrading forces.

On the west bank of the river, coal L is mined in a number of places from shafts, thirty to fifty feet deep.

From the foregoing data, therefore, I am enabled to correct the error into which I fell in my First Report, 1869, of making the top coal in the Terre Haute bores, coal L., and now place it at least as far down as coal I.

Though from the records that were kept of these bores, it is difficult to point out the base of the coal measures, or that of the Millstone grit, with any degree of accuracy, it is, nevertheless, my opinion, that the latter epoch commenced at about the depth of five hundred feet.

This thinning out of the coal seams as we go west towards the centre of the basin, is a remarkable feature which I first pointed out in 1867. A few miles west of the Indiana line in Clark county, Illinois, bores have been made in searching for petroleum, to the depth of eight hundred feet, without passing a single workable seam of coal, and the two or three thin seams reported, in some of these bores, are in the upper part of the measures.

Judged by the dip of the coal on both sides of the river, the Wabash runs on a slight anticlinal axis, and I believe this to be the case from Attica, in Fountain county, to its mouth in Posey county, and that along its course it cuts through the same strata of rocks, from the bluffs at Merom to its confluence with the Ohio river.

Near the eastern boundary of the zone of caking coals, in Indiana, we find K and L, and sometimes N, of good, workable thickness, averaging from four to eight feet, and in one locality at Pike county, there is a bed not yet studied, but thought to be K, that attains to the thickness of ten feet or more. Taken all together, the maximum thickness of these beds may be estimated at twenty feet, and will yield an average, over the greater part of the district, of ten feet of coal. At some localities the caking coal is of

inferior quality, and largely contaminated with pyrites, which is so generally disseminated through the seam that it is impracticable, in mining, to entirely separate it from the coal. In many of the counties, however, within this zone, the caking coals will compare very favorably with the caking coals of the Pittsburgh, Pa., district.

From her geographical position, and more especially on account of the extent and value of her coal beds, and the peculiar adaptation of this coal to the metallurgy of iron and steel which now forms one of the leading industries of the world, we can safely predict for Indiana a bright future as a manufacturing state. The commerce of the new far west, which is increasing with a rapidity unprecedented in the growth of empires, will just as naturally look to Indiana for its supply of iron and steel, with which to keep up the system of railroads traversing the great plains to the Pacific Ocean, as the old west formerly looked to Pennsylvania. In Indiana we find the last great belt of timber, suitable for manufacturing purposes, and after crossing her borders, thence to the Pacific ocean, no coal has yet been found that can successfully be used in the manufacture of iron.

Professor A. H. WORTHEN remarked, we have found the same difficulty in Illinois in reconciling our section of the Coal measures strata with those of Kentucky, that has been alluded to by Professor Cox, in the paper just read, as occurring with him in Indiana. On attempting to synchronize our coals with those of Dr. Owen's published section, I very soon found that it could not be done, and that if the Kentucky section was correct, no parallelism could be drawn between them. From further examinations I became satisfied that the Kentucky section was erroneous, and that by giving distinct names to different outcrops of the same sandstone, in its outcrops at different localities, they had duplicated the number of their workable coals, and also the thickness of the coal strata. This was shown in the first chapter of the third volume of the Report on the Geological Survey of Illinois, published in 1866, where, by placing these two sandstones on the same geological level, it was found that the strata underlying them formed sections, as nearly identical as they could be made anywhere in the coal series, at points twenty miles asunder. By reducing their section in this way, we find there a general correspondence between the strata in Illinois and Kentucky, as nearly complete, perhaps, as could be expected in opposite portions of the same coal-field. The coal-seams of Western and Northern Illinois are usually continuous over large areas, as much so indeed as the limestones, shales, and sandstones, with which they are associated.

Professor SWALLOW remarked that he had greatly enjoyed the examina-

tion of the Indiana "Block Coals." He believed they would become sources of vast wealth. But his friend Prof. Cox must not be sure other states would not furnish the same quality of coal.

He had for many years burned a coal which is so much like Indiana Block Coal, that Prof. Cox himself could not distinguish them.

But no opportunity had been offered for publishing the results of the Missouri Survey.

NUMERIC RELATIONS OF THE VERTEBRATE SYSTEM.—BY DR. T. C. HILGARD.

THERE are five (not four only) complete neural rib arches to the cranium of all vertebrate animals, to wit: (1) The condylar or sensitive belt with the condyle plates for side ribs and the lower arch of the *transversely bipartite* occiput for its vault piece: (2) the petrosal or *acoustic*, containing the auditory nerves in its side beams (easily detected by removing the ear drum of Felines, etc.), and overarched by the anterior belt of the occipital squama: (3) the parietal belt originally containing the true gustative nerve of fixed tastes (sour, sweet, salt and bitter, the glosso-pharyngeal), in an incision; from which it is, however, soon crowded out by the internal carotid artery and the overlapping "acoustic rib blade." The next (4) is the optic or frontal, visibly succeeded, in fishes, by (5) the ethmoidal or olfactory vertebra. The rest of the cranium is formed by its "extremities" or prehensile appendages.

The same numeric law which pervades the entire vegetable kingdom reoccurs in the human fabric in a very marked manner.

The number of "radiating elements" in a coil or whorl, or of whorls in a cycle, or in cycles generally speaking, as in pine cones and flower buds, etc., are the following:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, etc., progressing by the summation of the last two numbers.

The bands or parallel coils of flowers or scales in pine cones, sunflower discs, etc., embody these numbers successively, as they grow steeper and steeper, alternately on the right and left. The vertical bands, or columns, give the number of parts of the cycles involved.

The explanation heretofore given by me is this, that one element generates the other.

The elements are radial; they are bilateral rays, with a rift, so to speak, on the opposite side. It is there, where, in a like manner

as the seed-leaves of flowering plants produce prolific "ovules," new radial organs are developed from the preceding ones—laterally at alternate heights and toward the wider spaces.

This process, referred to the radial organs of plants in an early stage, will yield:

1. The *numbers* of parts in question, successively.

2. The peculiar law of *interpolations* or of "divergence," viz.: by a number of interstices represented by the second preceding one of each cyclar number.

3. It will *conclude* the cycles, if it be supposed that the activity of each junior member depends on that of its progenital one; as in all cases of simple branch developments.

These numbers occur in like manner in the human frame, as follows:

Inclusive of the terminal (ossified or gristly) coccygeal element, we have exactly thirty-four spinal vertebræ.

Classifying nerves by their *work*, or "function," we find—

3 pairs of cervical nerves (neck).

5 pairs of bracchial nerves (arms).

8 pairs of pedal nerves, composed of 3 crural (lumbar) and 5 ischiadic (sacral) ones.

13 pairs of nerves to the rump.

5 specific ones of the cranium.

—

34 in all; whereas the number of the spinal vertebræ, which inclose the spinal cord is exactly 21..

There are five pairs of "extremities," organized after a common plan: (1) the lower, (2) the upper, (3) the temporal, (bearing the lower jaw for a "member.") (4) the palate-facial, with the upper jaw for its "member," (5) the opercular or hyo-tympanic one, forming the gill-lid in fishes or the tympanic ossicles in man: and the digital extremity of which is gradually converted into the (hand-like) crimped (external and internal) cartilages of the ear.

The five pair of hæmal arches of the cranium, *i. e.*, the gill arches of fishes, are gradually transformed into the gristles of the gullet, etc.

The main variation consists in the varying, but "cyclar" number of "rays,"—fingers, etc.; the varying cyclar number of their joints (1, 2, 5, 8, 13 respectively, in a dolphin, with five carpals, instead of eight, as in man) and the varying cyclar number of

"loose" ossicles, such as *carpals*, *tarsals*, *teeth*, etc. The number of spinal vertebræ, is also variable, but not that of the cranial ones.

The vertebral blocks, as well as the ribs, are the product of the primitive axial series of (intervertebral) discs, which, when completely arrayed, each bear five branches, viz.: two pair of hæmal arches, two pair of neural arches, and a fascicle of parallel cleets, so to speak, which being *cemented* together, both in the front and rear, by the superficial ossification of the discs at either end are fused into the block pieces, as found, *e. g.*, in the young hog: the cementing slab covering the big neural rib head likewise, and not only the pentagonal prismatic block. The first discoform ossification we find in the corals, forming cribrose ethmoidal discs, such as the closely set "sigillate impressions" of the Astræa, and afterwards left behind as the coccyx, *e. g.*, of Cyathophyllum.

On the Earthquake of October, 1870. — By Col. Charles Whittlesey.

The writer confined his attention to what he pronounced the only remarkable feature of the earthquake, which was its occurrence at far distant points almost at the same moment of absolute time. Out of thirty odd observations made at as many different points in the United States, four were known to be accurate to within fifteen seconds, so that the total error could not exceed thirty seconds. Making the necessary allowance for difference of longitude, it occurred at Cleveland, Ohio, at 10 hours 43 minutes 30 seconds; at Albany, New York, 10 hours 43 minutes 9 seconds; at Boston, Mass., at 10 hours 43 minutes and 25 seconds; and at Bangor, Maine, at 10 hours 43 minutes and 19 seconds. The difference, therefore, was only in seconds. The ordinary rate of progression of earthquakes is from twenty to thirty miles an hour; while this one, if it progressed at all, must have moved at the rate of a thousand miles an hour. The paper was intended to raise the question: What kind of an earthquake was it?

Professor McChesney asked whether the author of the paper had given any attention to the subject in connection with the repulsion theories of Dr. Winslow of Boston.

Colonel Whittlesey stated that he had made very little progress toward a theoretical explanation of the phenomenon; he believed, however, that

the earthquake in the case in question was not progressive at all, but that it was produced by some force within the earth, acting outward.

Professor ANDREWS stated that he had observed the earthquake at Columbus, Ohio, and was struck by the fact that the motion, instead of being a sudden shock or jar, as is commonly the case, was like the gentle undulation of a boat in the water. He thought if the earthquake had been the result of a sudden explosion directly beneath, there would have been a sudden jar instead of this undulatory motion. It might possibly be accounted for by the fact that there is a blanket of drift material from eighty to one hundred feet in thickness underlying Columbus, which might serve to break the force of the concussion.

Professor WINCHELL thought the suggestion of Professor Andrews would be applicable to the phenomena in connection with this earthquake, if those phenomena had not had an existence over so wide an area. It seemed incredible that anything like an earthquake wave should have been transmitted from any superficial location along the earth's surface with anything like the rapidity that was indicated.

There must have been a deep-seated force exerted, the results of which reached the surface at remote points nearly at the same time. It would seem to indicate that the seat of earthquake activities is at some point within the earth, far removed from its surface. He thought evidence might possibly be found in this phenomenon, tending to corroborate the theory of some geologists in reference to the fluid condition of the earth's interior, and the comparative thinness of the solid crust upon which the mountains have been reared.

ON THE EXTINCT TORTOISES OF THE CRETACEOUS OF NEW JERSEY.

BY PROFESSOR E. D. COPE.

His object was to explain two cases of "generalized groups," such as are not common, comparatively speaking, and are of much importance in the history of life. Generalized or synthetic groups of naturalists were explained to be those which combined the characters of others. They were generally found in earlier geologic time, while the more widely differing groups occurred later in time. The cases were as follows. It was explained that the existing division of the marine turtles (*Chelonidæ*) possess sternal bones united by but few sutures, or with wide intervals: straight humerus and femur, and flat limbs, with truncate finger-bones incapable of flexion. It was shown that the existing snapping tortoises possess a narrow cross-shaped sternum with the bones everywhere united to each other, the femur and humerus curved, and the toes with hinge-jointed phalanges capable of much flexion. It was then pointed out that in the New Jersey Green

sand a type of turtles is found, embracing several genera and species, in which the sternum has the elements generally united by sutures, except two central fontanelles, being thus intermediate between that of the *Cheloniidæ* and that of the Chelydras (snappers) ; that the femur and humerus are curved, as in the snappers, but the limbs are oar-like bodies with truncate phalanges, as in the sea-turtles. This family he called the *Propleuridæ*.

The second case was presented by tortoises of a character like those now inhabiting fresh waters. The *Emydidæ*, or common river tortoises of the northern hemisphere, were shown to possess ten horny shields on the plastron (or lower shell), had a pelvis freely suspended from the carapace (upper shell), and a series of cervical vertebræ which can be curved in an S, and the head thereby drawn into the shell in a vertical plane. The southern hemisphere division of the *Pleurodira*, possesses eleven scuta of the plastron, a pelvis, of which the pubis and ischium unite by sutures with two corresponding elevations of the plastron, and a neck which can not be sigmoidally flexed, but is thrown round to one side, like that of a bird, when it is necessary to conceal the head.

It was shown that in the Cretaceous of New Jersey there existed a family (the *Adocidæ*) which combined the features of these groups. It had eleven scuta of the plastron (the extra one being large and anterior), but the lower bones of the pelvis were not coössified with the plastron, though the latter rose in two corresponding elevations. The latter were evidently rudiments of the articulating knobs of the *Pleurodira*.

Professor Cope stated, moreover, that the *Adocidæ* possessed a row of scuta across "the bridge," within the marginal row, such as existed in modern times in the sea-turtle, and in the Mississippi snapper, thus adding very much to the generalized character of the *Adocidæ*.

Turning to the tortoises of the Eocene beds of Fort Bridger, Wyoming, he showed that these were true *Emydidæ*, but that many of them retained the inter-marginal series of scutes, above-mentioned (*Baptemys*, etc.), so far resembling the *Adocidæ*. Among existing typical *Emydidæ*, but one genus presents the character, viz., the *Dermatemys* of Mexico.

The value of these generalized groups was pointed out as consisting in their correction of our views derived from the great

constancy of specific characters. These, he showed, remained unaltered throughout great extents of time and space, and other slight structural characters endured through many geologic ages. Hence the value of cases where the association of characters is evidently in a transitional condition.

THE EMBRYOLOGY OF CHRYSOPA, AND ITS BEARINGS ON THE CLASSIFICATION OF THE NEUROPTERA.—BY A. S. PACKARD, JR., M.D.

IN a paper presented at the Burlington meeting of the Association in 1867, I gave a brief sketch of the embryology of Diplax, especially in the later stages. Those observations, with the far more carefully elaborated studies of Brandt * on Calopteryx, another member of the family Libellulidæ, have made us acquainted with the embryology of the type of one important division of Neuroptera, and now I have to offer a partial history of Chrysopa, the representative of another important division of the group. I did not observe the formation of the blastoderm, but the blastodermic skin ("amnion") of Chrysopa, is of the same structure as in Calopteryx. At the posterior end of the egg the round nucleated cells are crowded together in the same way as in Calopteryx. The primitive band is of the same general form, and floats in the yolk as in Calopteryx, but more as in Aspidiotus, though it rests more on the outside of the yolk than in those genera, and the end of the abdomen rests on the outside of the yolk, rather than rolled in within the yolk; but that the germ is an endoblast (so far as that condition has any special significance) is shown by the fact that the ventral side of the primitive band points inwards towards the centre of the yolk, as in the Libellulidæ, the Hemiptera, and some Coleoptera (Telephorus and Donacia) in contradistinction to the Phryganeidæ and the Poduræ (Isotoma) in which the germ or primitive band floats entirely on the outside of the yolk. After the procephalic lobes and rudiments of the appendages of the head and thorax have begun to develop, a second moult (visceral layer) of the blastoderm is made, which envelops the head and under side of the body much as in the Libellulidæ and Hemiptera. At this time the embryo is much like that of the last named insects. The germ does not revolve in the egg, as

* Beiträge zur Entwicklungsgeschichte der Libelluliden und Hemipteren. St. Petersburg. 1869.

in the Libellulidæ, but the head remains throughout embryonic life next the micropyle. At the next stage observed, the appendages of the limbs had appeared, the embryo being situated on the outside of the yolk, the end of the abdomen curved around on the opposite side of the yolk. At this time the inner or "visceral layer," forming a second moult of the blastoderm, envelops the germ, much as in the Libellulidæ, and Hemiptera, and Coleoptera (Donacia). It is evident that this *faltenblatt* of Weismann (or visceral layer of Brandt) is shed at a later stage than the "amnion" proper. This stage corresponds with that of Calopteryx figured by Brandt (Pl. 1. fig. 11). At this time the germ of Diplax and Calopteryx (Libellulidæ) floats within the yolk, but this difference I would regard as having no special importance, as in the Hemiptera the germ at the same stage of development rests on the outside of the yolk in Corixa, while in the Pediculina, according to Melnikow's researches, the germ floats within the yolk, and we shall see farther on that in the Curculionidæ (Attelabus) the germ rests on the outside of the yolk (ectoblast), while that of Telephorus is a decided endoblast, *i. e.*, floats in the interior of the yolk. After this period, the embryo of Chrysopa exactly corresponds to that of all the Libellulidæ whose development is known (Agrion, Calopteryx, Perithemis, and Diplax.)

The embryogeny of Chrysopa is identical, then, with that of the Libellulidæ. What becomes, therefore, of the distinction between the "Pseudoneuroptera" and "true" Neuroptera, insisted on by some of the leading entomologists, since Erichson's day? Never believing that the differences were great enough to separate the Linnæan Neuroptera into two independent orders or suborders (whichever we may choose to call them), I now ask if embryology does not give independent testimony as to the close alliance at least of the Libellulidæ and Hemerobidæ, even if we go no farther?

The only Coleoptera with whose development we are acquainted is Donacia, worked out more carefully by Melnikow than any one else. During this summer I have studied *Telephorus fraxini* and *Attelabus rhois* in nearly all their embryonic stages. They are developed in the same manner as in Donacia. There is a parietal ("amnion") and a visceral membrane in Attelabus: (it was not observed in Telephorus, though it doubtless exists), as in Donacia. In Attelabus, however, the primitive band rests on the outside of the yolk, while in Telephorus it floats in the yolk, and forms a

sigmoid band, extending back to the posterior pole of the egg. But after the rudiments of the limbs appear, the embryology of both genera accords with that of Donacia. I have found that the embryology of *Gastrophysa cœruleipennis* in its later stages also agrees with that of Donacia, (both being Chrysomelids.) A study of the development of *Nematus ventricosus*, shows us that its embryology accords with that of *Apis mellifica*. The formation of the blastoderm is as described by Bütschli in Apis,* and quite unlike that of the Formicidæ as studied by Ganin. It also agrees with that of the Diptera in most particulars.

There is indeed a remarkable uniformity in the mode of development of the Hexapoda, as much so perhaps as in the Crustacea (Malacostraca), and it is difficult to determine what embryological characters may be set down as distinguishing even the different suborders. These characters, whatever they may be, do not probably reside in the embryonal membranes, or in the relation of the primitive band to the yolk. Perhaps they will be found in the form of the advanced embryos. For example, we now know that the embryos of the Isopod Crustacea only differ from those of the Amphipods while in the egg by having the end of the abdomen bent over the back, while in the latter (Amphipods) it is curved beneath the body, as pointed out by Fritz Müller. The spiders and scorpions also pass through a similar course of development, and the Mites (Acarina) are developed in a manner either identical with the spiders in some genera, or more like the Hexapods in others. We know almost nothing of the embryology of the Myriapods, but Newport's observations on Julus indicate that it is developed in an entirely different mode from the Hexapoda or Arachnida, a remarkable feature being the persistence of the larva in its inner (?) embryonal membrane (*faltenblatt* of Weissmann) for many days after it is hatched.

There are, however, two modes of development in the Hexapoda, depending on the position of the primitive band in relation to the yolk. The Hymenoptera, Diptera, and certain Coleoptera (Curculionidæ), and the Phryganeidæ and Poduræ (Isotoma) are *ectoblasts*,† while the Hemiptera and certain Neuroptera (Libellulidæ

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*Dr. O. Bütschli. Zur Entwicklungsgeschichte der Biene; Siebold and Kolliker's Zeitschrift. 1870. p. 519.

†I omit any reference to the Lepidoptera, which Dr. Dohrn regards as endoblasts but which I am inclined from some eggs (probably of an Arctian) I have studied to regard as developing like the Hymenoptera and Diptera.

and Hemerobidæ) are *endoblasts*, to use Dr. Dohrn's terms. On inquiring how far these two modes correspond to the degree of development of the insect on leaving the egg, and the degree of metamorphosis of the insect before becoming adult, it seems that the endoblasts occur in those ametabolous insects (Hemiptera and Neuroptera) with flattened, leptiform larvæ, and also in those Coleoptera with similar larvæ, as distinguished from the weevils, which have eruciform larvæ, *i. e.*, resembling the maggots of Diptera and Hymenoptera. The two modes of development, then, do not fully accord with the two different degrees of metamorphosis of insects, but more probably depends simply on the form of the larva when hatched. Now there are two forms of insectean larvæ which are pretty constant. One we may call *leptiform*, from its general resemblance to the larvæ of the mites (Leptus). The larvæ of all the Neuroptera, except those of the Phryganeidæ and Panorpidæ (which are cylindrical and resemble caterpillars), are more or less leptiform, *i. e.*, have a flattened or oval body, with large thoracic legs. Such are the larvæ of the Orthoptera and Hemiptera, and the Coleoptera (except the Curculionidæ; possibly the Cerambycidæ and Buprestidæ, which approach the maggot-like form of the larvæ of weevils). On the other hand, taking the caterpillar or bee larva with their cylindrical fleshy bodies, in most respects typical of the larval forms of the Hymenoptera, Lepidoptera and Diptera, as the type of the *eruciform* larva, we find that those insects with such larvæ are ectoblasts. (The Poduræ which, as in Isotoma, are ectoblasts, and are certainly leptiform when hatched, form an apparent exception.) Thus the two modes of development (ectoblastic or endoblastic) perhaps simply depend on the form of the insect when hatched, and its mode of life.

The leptiform larvæ of insects may be compared with the nauplius form of Crustacea, and in a much less degree the eruciform to the zoea form. The three higher suborders of insects may be compared to the Malacostraca with their zoeæ form larvæ, and the four lower suborders (Coleoptera, Hemiptera, Orthoptera and Neuroptera) with the Entomostraca,* in which certain forms, as in some Phyllopods, and Limulus, and the Trilobites, are hatched in a subzoea condition (corresponding to the eruciform larvæ among the Neuroptera and Coleoptera). The larvæ of the earliest insects

* The terms Malacostraca and Entomostraca are used for convenience, not that they are entirely natural divisions.

were probably leptiform, and the eruciform condition is consequently an acquired one, as suggested by Fritz Müller.* His suggestion, followed up by Brauer, that the insects have descended from some zoea does not seem of much value, as the leptiform larva more exactly parallels the nauplius of the lowest Entomostraca (Copepoda). We have already suggested that the Insects and Crustacea probably arose by two distinct lines of development from the worms, rather than that the Nauplius gave rise to the Insects. as Müller has suggested; an important reason for this view being that the three pairs of appendages of the Nauplius do not homologize with the distinct cephalic and three thoracic appendages of the Leptus.

The Organic Identity of the Albumen and Endopleura of all the Phanerogamæ.—By T. C. Hilgard, M. D.

All seeds of the flowering plants (the net-leaved, blade-leaved and the pine tribes) are collectively described as consisting of a *germ* or "embryo," enclosed within *two separate seed-coats*.

A great many seeds, like those of the mustard, nasturtium, buck-eye, bladder-nut, the ailanthus, sumach, china-tree, orange, camellia; the gum-pod ("gumbo"), hibiscus, the cocoa-bean, almond, pea and rose-tribes, the brazil-nut, walnut, chestnut; the cockle-bur, sun-flower and melon all conform to this description, and the natural tribes to which they belong form a connected region of the flowering plants generally speaking.

It is likewise understood that a great many seeds have their germ proper imbedded in a bulky, nutritive lump called the "*albumen*": which thus forms the main bulk of the seed, *e. g.* of the ivory-nut, the date-kernel, the cocoa-nut, the pepper, paw-paw and nutmeg, and all the grains no less than the well known coffee-bean. In water, the latter will swell and protrude its stubble-like embryo out of one end of its horny, enveloping mass, or "*albumen*."

It has, however, hitherto remained an unnoticed fact that all seeds which have *two* so-called seed-coats, are all alike *destitute of*

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* "It is my opinion that the 'incomplete metamorphosis' of the Orthoptera is the primitive one, *inherited* from the original parents of all insects, and the 'complete metamorphosis' of the Coleoptera, Diptera, etc., a subsequently acquired one."—*For Darwin.* Eng. Trans. p. 121.

an "albumen;" and that all seeds *provided* with an albumen, have only one *solitary seed-coat, aside from the albumen itself.**

In many other seeds, as in those of the Osage orange (Maclura) and several Cactaceæ, etc., the albumen is thinned out, in some places, into a so-called "endopleura" or interior seed-coat, while in other parts of the seed the sheet of this self-same "internal seed-coat" thickens up into a bulky albumen, conformably to the configuration of the germ it encloses and of the *testa* which contains both.

An inspection of the *immature seed* of all the so-called *ex*-albuminous forms, *i. e.* those which, like the pea-nut, peach, and almond, are destitute of an albumen, discloses the fact, that in this juvenile condition, all these seeds, have, like all the rest (viz. the "albuminous seeds") a large *succulent albumen-zone*, wherein the germ ("embryo sac" etc.) is developed, at the expense of the former. During the process of ripening, in all the *nutty*, or "*ex*-albuminous" seeds, the primitive albumen becomes gradually *exhausted*, leaving its entire cell-tissue compressed and empty behind, as the delicate endopleura or internal seed-coat. In all the other seeds, on the contrary, this succulent albumen-zone remains the storehouse for the germinating seed to draw its substance from. In the honey-locust and the allied coffee-nut tree (Gymnocladus) in germination, the flinty albumen dissolves into a sort of gum, like gum arabic.

In point of fact, the "endopleura" and the "albumen" are one *identical organ*.

This evident identity of the original albumen and subsequent second seed-coat, settles at once the old and perplexed question about the erroneously supposed "*gymnospermism*," whether of Labiatæ, Coniferæ and their allies, the Taxineæ, Gnetaceæ, Casuarinæ and Cycadeæ.

Since we now know, what *parts* all seeds *consist of*, these tribes are by no means to be considered as "abnormally" or even "monstrously" organized (as a prevalent theory still holds) but that *e. g.* all the *edible pine-nuts* contain, each, a *complete seed*: which loosely adheres to the capsule (like the mature cocoa-nut

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* The testa, or exterior seed-coat, frequently exhibits a diversified structure of external and internal surfaces. In the seed of the magnolia, that of the grape, etc. the exterior surface of the otherwise bony seed-coat, which encloses the albumen, is fleshy: as is the entire testa of the blue cohosh (Caulophyllum.)

kernel) and is encased within a one-seeded pistil, as is the case *e. g.* with all grasses, grains and the knot-weeds; their true ovules being mostly sessile (as in the entire orders of Polygonaceæ and Nyctaginaceæ, with only few exceptions) and considerably coherent with the true pistil (or stigmatiferous "utricle"). In the above-mentioned coniferous tribes, these one-seeded pistils are provided with a pervious, "open" stigma; a case correspondingly represented in the duck-weeds (Lemnaceæ) which however have their seeds borne upon a *funiculus*.

The seed itself, of Coniferæ, is a complete one, consisting (1) of a germ; (2) an (oily) albumen and (3) one thin, brown, membranaceous seed-coat (the *testa*), readily separating from the utricle or nut-shell which surrounds it, as in the well-known cases of the pine-nuts of California, Italy and that of Switzerland (*Pinus lembra*).

Thus, it is clear that the pine-*scales* are only a woody cup or *cob*, of indurated "saucers" or involucres (as with acorns) that arise in the axils of delicate and sometimes colored bracts. Similar involucral cups we find in the harsh cones of the alder, and in the sterile aments of the wild hemp tribe.

The wing-like appendages of the pine-nuts represent so many *palece* or *floral chaff* (like that of grains and bulrushes, etc).

In the remarkable case of Welwitschia, the "kettle-drum pine" of western tropical Africa, no such indurated scales, but only the purpureous bracts, as are those of flowering larch-trees, are developed. The true *perianth*—judging by Dr. J. D. Hooker's plate viii—being here a delicate, foliaceous two-winged one, epigynously concrete with the nut, as is the chaff of pines and two-seeded capsules of Araucariæ. Nevertheless, the same identical organ is erroneously styled "a pericarp" on the preceding plates, by a *lapsus calami* of the same author, on the uncritical bias of *so-called* "gymnospermism." * The so-called gymnosperms have *closed pistils!*

It is thus clear, that there is *no "break"* in the vegetable kingdom: all forms uniting into a complete, connected and harmonious

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*The untenable theory, here referred to, considers the pine-*scale* as a "pistil:" destitute, however, of any of the *distinctive attributes* of a pistil, being without a suture, without a stigma, and without any fructification through its instrumentality.

The true (one-seeded, *pluri-ovulate*) pistil, or "utricle," was wrongly regarded as an (abnormally "*naked*") "ovule"; with an *abnormally rostrate* "exostome," viz: the (open) stigma! Next follows (after this *pseudo* "testa") the true seed-coat under the

system of mutual typical affinities or correlations, to be discussed in detail in a subsequent paper.

Inequilateral Leaves.—By Professor W. J. Beal.

The leaves of most plants, such as those of the white oak, sugar maple, and tulip tree are equilateral, *i. e.*, the right and left sides are of the same size and match each other, as the two sides of the

Fig. 100.



Compound leaf. After Spencer.

nose and chin, or the right hand and foot match the left. Some simple leaves and many leaflets of compound leaves show a marked

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denomination of an "endopleura",—and an "*albumen*" *besides*, which contains the embryo.

The true solitary seed-coat adhering to the pistil, the shrunken albumen will often be found lying loose inside.

The contended fruit of the well-known yew-tree contains (1) an embryo, imbedded within (2) an albumen, which is surrounded (3) by a tawny seed-coat. The latter loosely adheres to a thickish *capsule*, which is itself *covered by a thick, calycine layer*'—in the exact likeness of an acorn, a hazelnut, or the nut of the sweet gale (Myrica: the wax-myrtle or bayberry) which indeed seems to reproduce the true *epigynous* structure of the former on a reduced scale; as the (Composite) *Polymnia Uvedalia* or "nutted leaf-cup."

The cup of the yew-tree thus remains to be properly interpreted as a fleshy cup partly of dry scales, like those of the acorn and wax-myrtle on the one, and the succulent Euphorbia-involucres on the other hand.

want of symmetry in their lobes. The *Begonia* is often cited as an example. The hickory, bean and poison ivy, may illustrate the same thing in compound leaves. In figure 100. "The homologous parts a, b, c, d, while they are unlike one another, are, in their main proportions, severally like the parts with which they are paired. And here let us not overlook a characteristic which is less conspicuous but not less significant. Each of the lateral wings has winglets that are larger on the one side than on the other; and in each case the two sides are dissimilarly conditioned. Even in the several components of each wing may be traced alike divergence from symmetry, along with a like inequality in the relations to the rest; the proximal half of each leaflet is habitually larger than the distal half." (Herbert Spencer, Principles of Biology, fig. 65, p. 31.)

A. P. De Candolle says, "This inequality generally exists only in alternate leaves, and I cannot find in my memoranda any example of an inequilateral opposite leaf. This fact tends to prove, that this inequality ought to be referred to the position of the leaf upon the plant favoring the development of one of its sides more than the other; and in this case, it is always the lower one which is developed most. This law is still more evident in the leaflets of pinnate leaves . . . . the side most developed is always the lower, the upper being narrower and less prolonged. The same observation may be made upon the stipules, which are very frequently irregular. In opposite leaves, there has been presented a curious example of inequality in *Ruellia anisophylla*; — one of two opposite leaves is very small and narrow, and, as it were, abortive in comparison with the other; but symmetry is also met with in this irregularity, for on comparing the successive pairs, the small leaf is found alternately on both sides. Stipules [sometimes] present analogous phenomena."

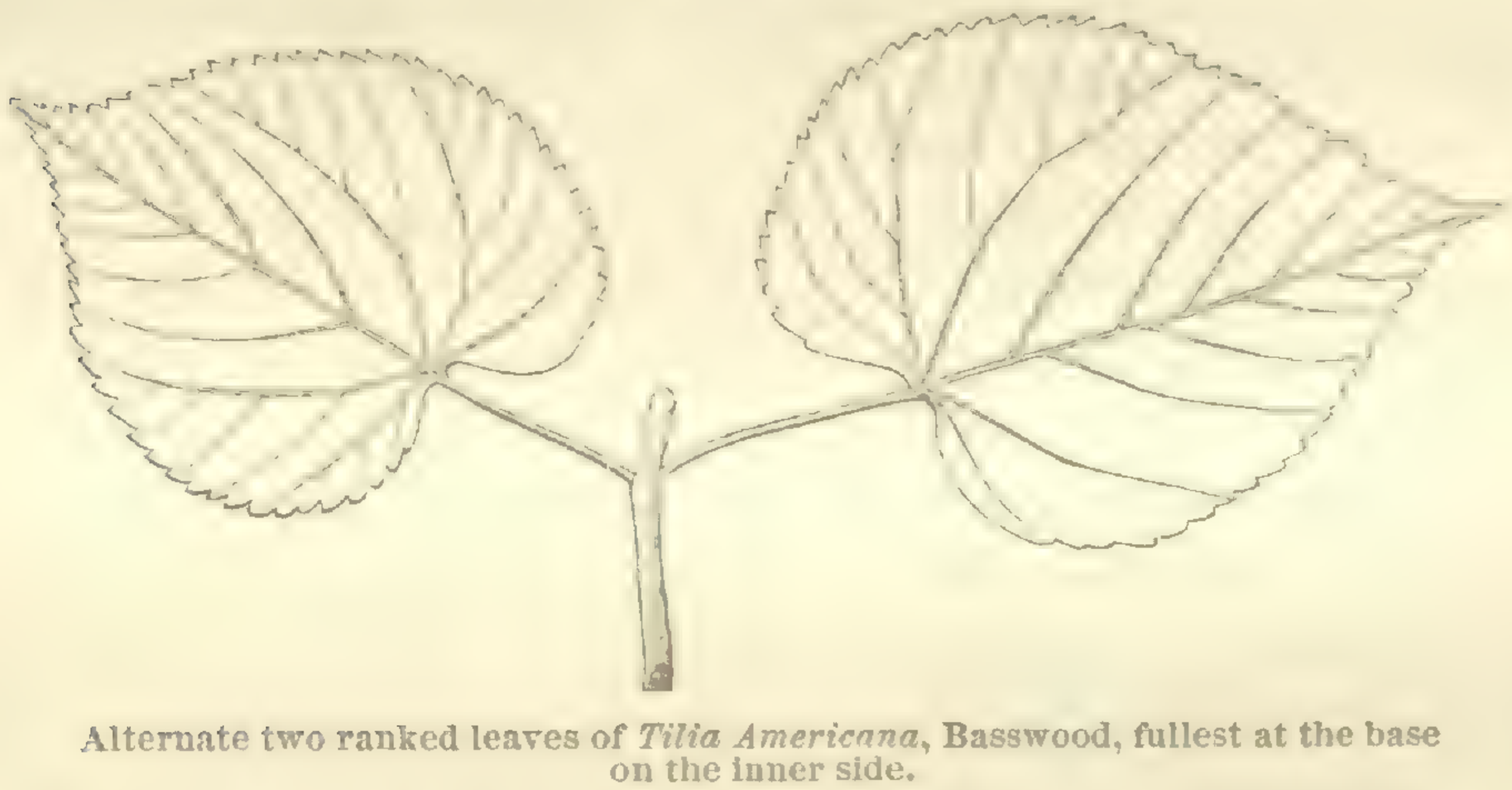
Dr. Wilder has shown that "Elm leaves have the *inner* or *upper* side much larger," thus upsetting De Candolle's theory that the inequality is due to the position of the leaf upon the stem. Various other reasons have been assigned for this inequality, all of which seem to fail when applied to numerous examples in their various stages of development.

Schleiden believes that this want of symmetry is due to unequal pressure in the bud. Spencer seems in doubt about the true cause, for he says, "How far such differences are due to the positions of the parts in the bud; how far the respective spaces

available for the parts when unfolded affect them; and how far the parts are rendered unlike by unlikenesses in their relations to light, it is difficult to say. Probably, these several factors operate in all varieties of proportion." He attributes the want of symmetry in the leaves of the Lime tree or basswood to the shading of the smallest lobes. That this cannot be the case is proven by an examination of the conduplicate leaves of the basswood and elm while in the bud. When less than half an inch in length, the lobes are plainly unequal. When much less than a fourth of an inch long they are nearly or quite equal lobed. Since noticing these facts, the writer was pleased to find the same views recorded by Dr. Wilder.

On the basswood, the leaves are alternate and two ranked, having the upper lobe fullest. This is the case even where the

Fig. 101.



Alternate two ranked leaves of *Tilia Americana*, Basswood, fullest at the base on the inner side.

full lobe is shaded or where the whole leaf is well exposed to the light. Spencer gives an illustration showing the arrangement of basswood leaves, exposing nearly all their upper surface to the light. If he should turn a young branch over, of this or almost any other plant, he might be surprised to see how soon the leaves would turn back again, and how nicely they would adapt themselves to each other, economizing all the available space. The leaves of red elm and the American elm are sessile, broad at the base, two ranked with the upper lobe fullest. The same is true of the blue beech, *Carpinus Americana*, though the lobes are often equilateral. *Celtis occidentalis* has two ranked leaves with petioles half an inch long. The upper lobes of the leaves are very full when compared with those of the elm. Begonia leaves are two

ranked with the upper lobe fullest, no matter whether they are nearly sessile or on petioles a foot in length. The witch hazel has two ranked leaves with a broad base on short petioles and the lower lobe much the fuller. The common beech, hazel, mulberry, and grape have two ranked, equal lobed leaves.

Fig. 102.

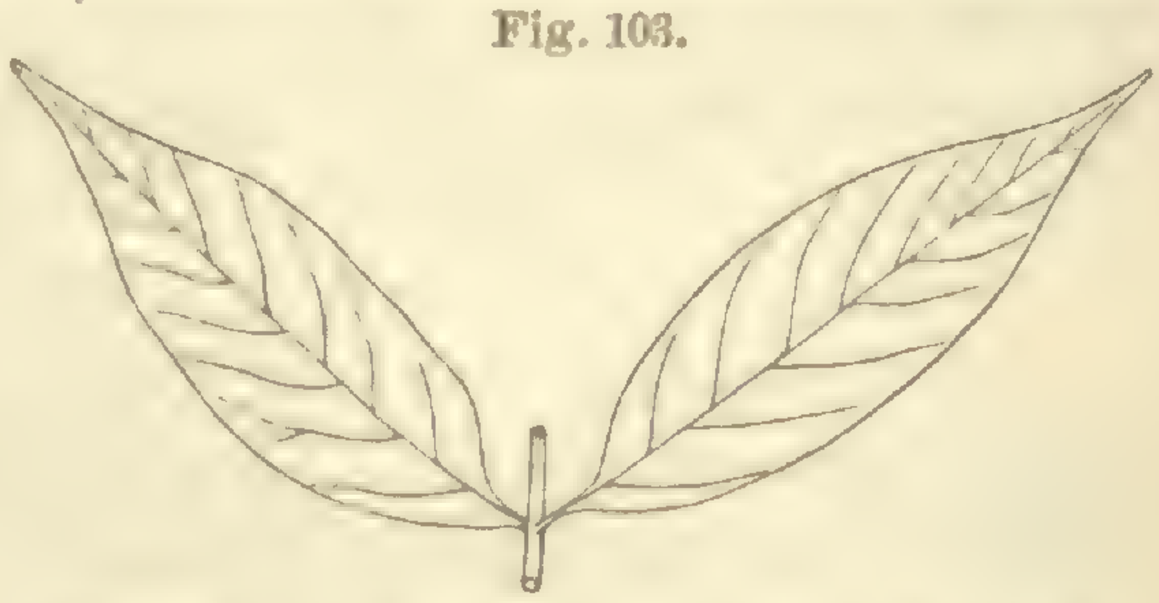


Alternate two ranked leaves of *Hamamelis Virginica*, Witch Hazel, fullest at the base on the lower side.

It is a very common thing to see a want of symmetry in the lobes of leaflets of compound leaves. The reader will remember that De Candolle says, "The upper edge of such is always smallest."

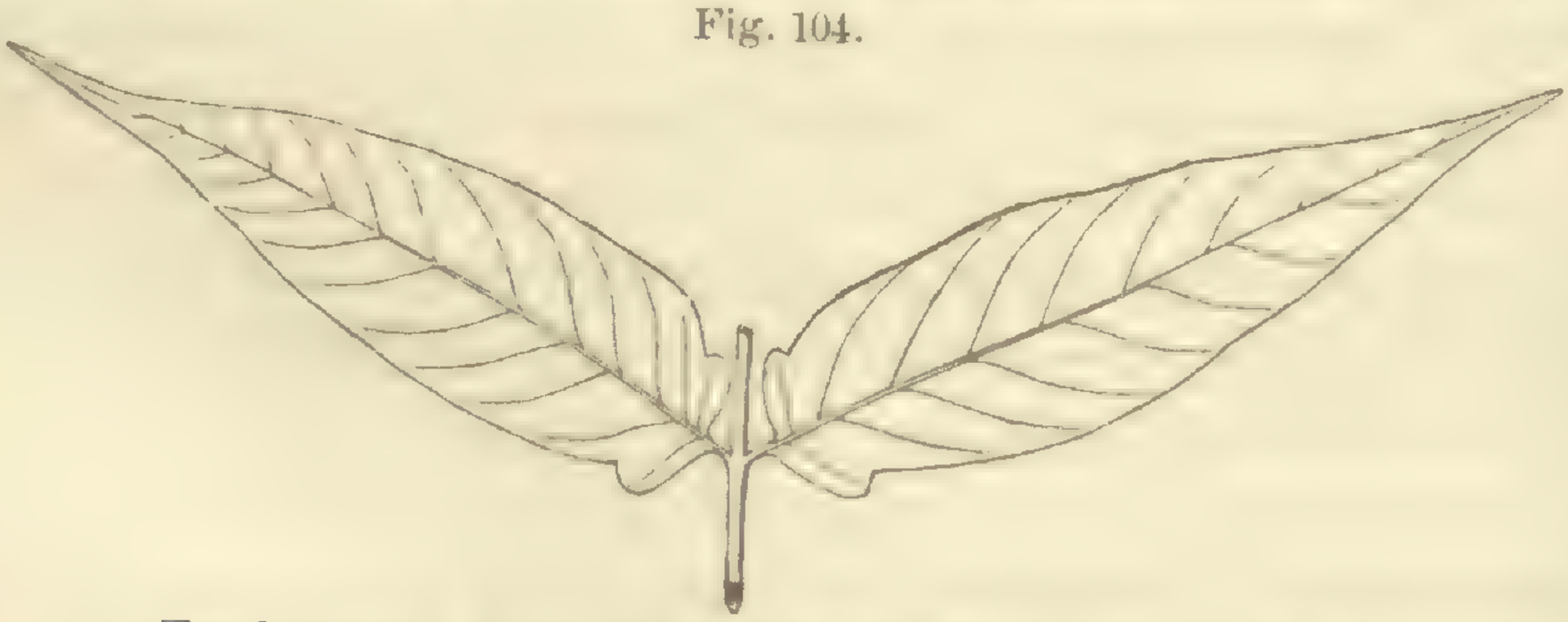
Of this character, we find the black ash, the hop-tree (*Ptelea*). bean, hickory, elder, bladder-nut (*Staphylea*), strawberry, poison ivy, fragrant sumach, and Jack in the pulpit (*Arisæma*). The ultimate divisions of the decompound leaves of Hercules club are fullest on the lower side, while the leaves of the Kentucky coffee-tree reverse the above example. The leaflets of Ailanthus are broad at the base, and raised on very short

Fig. 103.



Two leaflets of *Fraxinus sambucifolia*, Black Ash. fullest on the outer lobes.

Fig. 104.

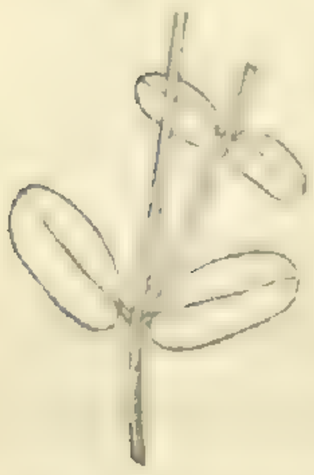


Two leaflets of *Ailanthus glandulosus*, fullest on the inner side.

pedicels. The upper edge of their leaflets is much the fuller. Leaflets of the Southern prickly ash are fuller on the upper side.

while those of the Northern prickly ash, of the same genus, are usually fuller on the lower side. *Rhus toxicodendron* has the lower edge of the side leaflets fuller: *Rhus copalina* has the upper edge fuller. For some time, I thought as De Candolle wrote (though I had not then read his book on the subject), that the unequal lobed leaves were all alternate; and further, I thought they were all two ranked along the stem, and thus set off against each other, as leaflets in a compound leaf. I was not much surprised, however, though much interested to find that the opposite leaves of *Cornus Florida* were fuller on the lower edge, as they were all turned horizontally on the side branches. On the 4th of July, the two terminal leaves were about half grown and generally equal lobed at the base, though not always so. I find the opposite leaves of several of our Euphorbias, as noticed in Gray's manual, are fuller at the lower edge as they are turned down horizontally. In a somewhat similar manner are the two parts of the involucre of *Carpinus Americana*. These stand with the fuller edge away from the axis. The two edges of each are unequally serrate, more serrate on one edge than on the other, so the involucral leaves match as well as the corresponding fingers on our two hands. In the greenhouse of the Michigan State Agricultural College, is a plant unknown to me, presented by Dr. Gray. The leaves are on petioles three-fourths of an inch in length; they are probably three ranked (certainly not two ranked). As the leaves droop, the upper lobe is much fullest and the midrib considerably curved as in *Begonia*.

Fig. 105.



Two opposite leaves of *Euphorbia maculata*, fullest on the lower side.

Fig. 106.



Involucre of *Carpinus Americana*, Blue Beech, the upper or inner lobe narrower which grew next the axis.

So we have unequal lobed leaves on stems where they are two, three or four ranked. The common sheep sorrel often has one lobe longer and larger at the base, but I am unable to find any rule with regard to this fact.

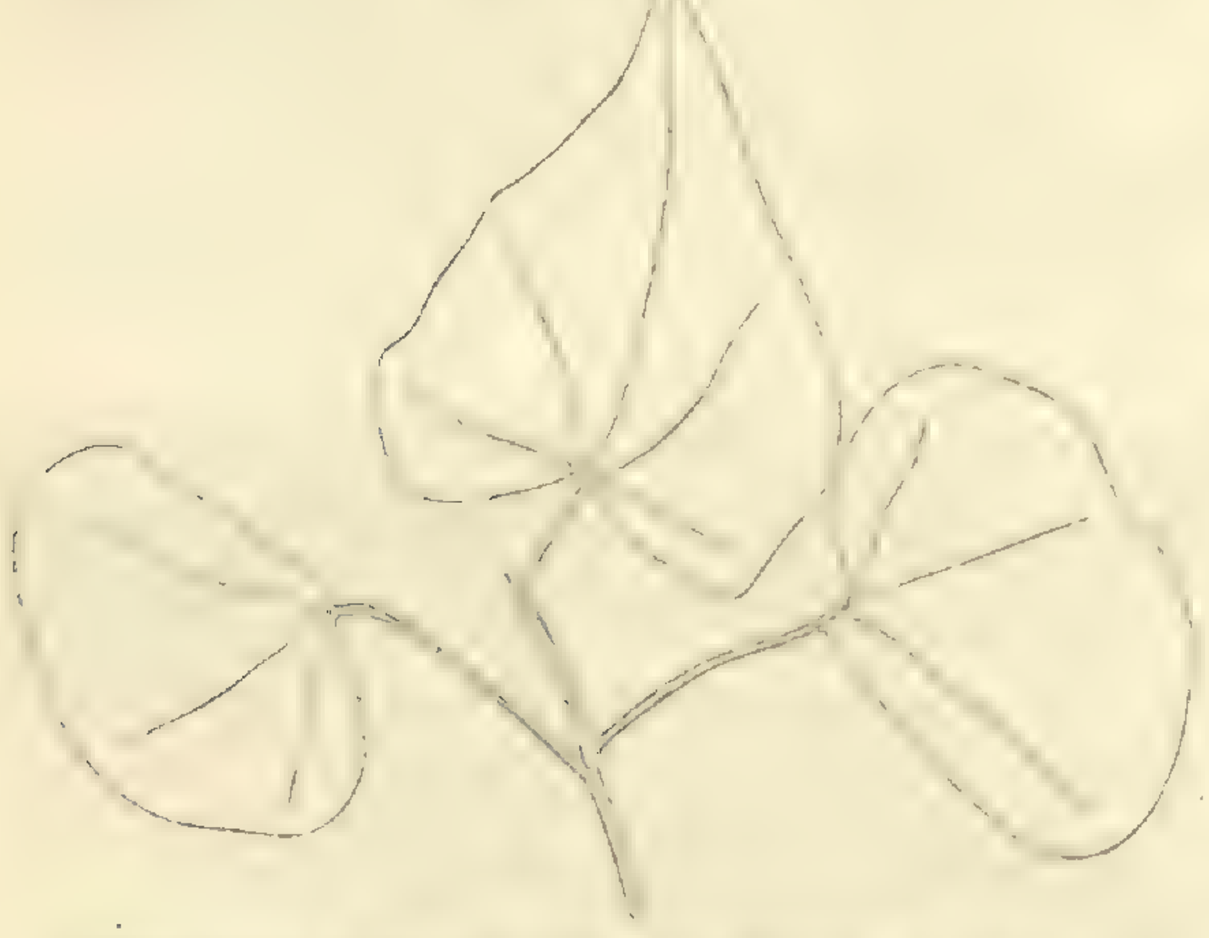
The four o'clock of our gardens *Mirabilis* has opposite leaves, and when of proper size, terminates each axis with a flower. The axillary bud on each side develops into a branch terminating

in the same manner by a flower. Thus we have four leaves in two pairs closely sitting about a flower. As thus arranged spreading each way they are all fuller at the base on the side next the flower, where there is least light and least room. This is contrary to what we should expect according to De Candolle and Spencer. An examination of the plant for a moment will make it clear.

Every botanist is familiar with the unsymmetrical petals on the sides of the pea flower, violet, lobes of mint blossom, and those of other plants.

The strangest thing under *want of symmetry* that I have seen in plants, is found in the cotyledons of our cultivated buckwheat. While in the seed, they are pressed together, and rolled up from one edge. When the cotyledons have acquired their full growth, they have petioles about half an inch long; *each* cotyledon is fullest on its *left* side, so they would not match each other without turning one of them over. Perhaps this is a puzzle analogous to homologizing the hand and foot on the same side of the body. All our theories so far read or imagined, such as influence of heat, light, gravitation, number of ranks on the stem, length of petiole, pressure, natural selection, do not satisfactorily explain all these peculiarities.

Fig. 107.



Cotyledons of *Fagopyrum esculentum*. Buckwheat, each fullest on right lobe.

So far, we agree with Dr. Wilder, "That such peculiarities are true and original characteristics of the plants, and that they are produced by the so-called vital force acting in a definite way."

On the Oil Wells of Terre Haute, Indiana.—By Dr. T. Sterry Hunt.

In previous publications, I have endeavored to show that the source of the petroleum in southwestern Ontario, and probably in some other localities, is to be sought in the oleiferous limestones of the Corniferous and Niagara formations, both of which abound

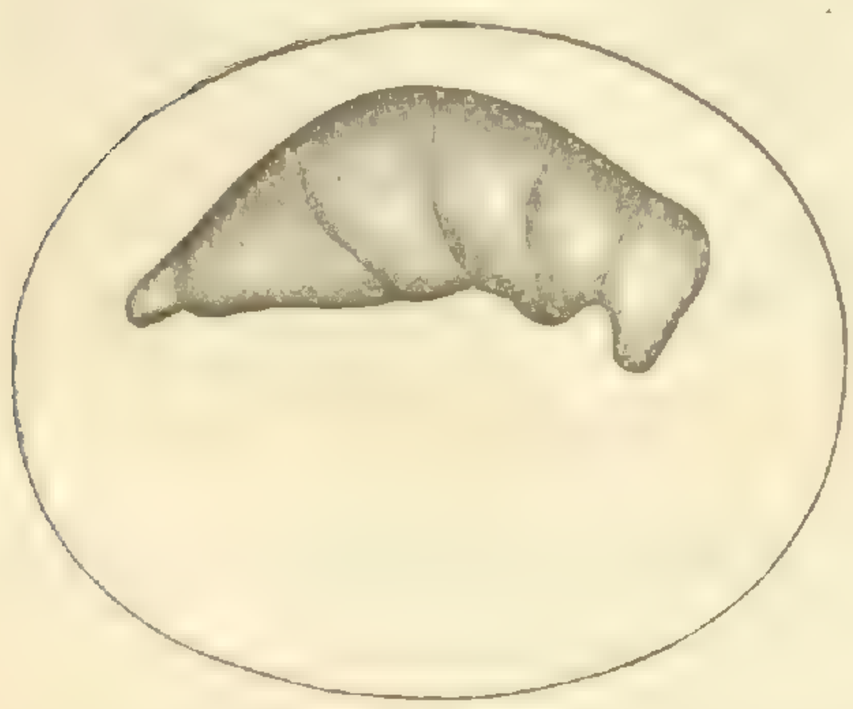
in indigenous petroleum. I have, moreover, expressed the opinion that the overlying sandstones of Pennsylvania are also truly oleiferous. In a paper read to this Association last year, I showed that the Niagara limestone at Chicago holds imprisoned in its pores an enormous quantity of oil, and remarked that the reservoirs which supply the wells in other districts are fissures along anticlinals, which fissures, though sometimes occurring in strata above the oil-bearing horizon, in Ontario frequently occur in the Corniferous limestone itself. Hence the view held by some that the source of the oil in that region is to be sought in the overlying strata, is negatived. In Ontario, there intervenes between the Corniferous and Niagara formations the great saliferous series known as the Onondaga or Salina formation. This, however, is wanting to the westward, where the first two formations come together, and, according to Prof. Cox, where exposed at North Vernon, Indiana, are both oleiferous.

A well lately sunk at Terre Haute, Indiana, in search of fresh water has shown the existence of a productive source of oil in that region. It was carried nineteen hundred feet, and yields about two barrels of oil daily. A second well, a quarter of a mile east of north from the first, now gives a supply of twenty-five barrels of oil daily. After passing through one hundred and fifty feet of superficial sand and gravel, the boring was carried to a depth of sixteen hundred and twenty-five feet, where oil was struck. According to Prof. Cox, the strata passed through are as follows: Coal measures, seven hundred feet; Carboniferous limestones with underlying sandstones and shales, seven hundred feet: black pyroschists regarded as the equivalent of the Genessee slates, fifty feet. Beneath, at a depth of twenty-five feet in the underlying Corniferous limestone, the oil-vein was met with. The oil in the first well was found at the same horizon. A third well about a mile to the westward, was carried to two thousand feet, but only traces of oil were found. This locality, on the Wabash river is, according to Prof. Cox, on the line of a gentle anticlinal or uplift, which is traced a long distance to the west of south. This relation of productive oil-wells to such anticlinals was pointed out by Prof. Andrews and by myself in 1861.

THE DEVELOPMENT OF AMBLYSTOMA LURIDA SAGER.—BY DR. P. R. HOY.

THIS, the largest of the North American salamanders, affords superior facilities for studying the habits and embryonic changes from the egg to the perfected reptile. The adult female of this species is from eleven to twelve inches in length. The male is rather less. They excavate holes in the ground in which they conceal their bodies, the head only being visible. Thus they lie in wait for stray slugs and insects on which they subsist. Late in the fall they stray about seeking a hiding place in which to hibernate, at which time they frequently find their way into cellars to the great consternation of the household.

Fig. 108.



Egg of *Amblystoma*, at 13th day
Lower figure of natural size.

Early in the spring they repair to neighboring ponds, in which to deposit their eggs, which they place in packets of from twenty to fifty on blades of coarse grass. The eggs are one half inch in diameter, the albumen has considerable firmness, the yolk is one eighth of an inch in diameter, color, greenish olive, paler beneath. I will here omit reciting the development of the embryo previous to the escape of the tadpole from the egg, as there is no essential difference between the development within the egg of the salamander and that of the fish which has been so repeatedly studied with great care and the results recorded with minute exactness.

Fig. 109.



Young of *Amblystoma*, 10th day from the egg. Lower figure of natural size at time of escaping from egg.

The tadpole of this salamander emerges from the egg in twenty-five days. April 25. length one-half inch, color olive, eye spots visible, two short holders, gills rudimentary. May 5, tenth day. eyes developed, irids golden, color greyish olive, with three faint, transverse bands of a darker hue, gills plumed, no holders, fore legs starting; is now active, and feeds voraciously on aquatic insects. May 25, thirty days from the egg, fore feet tridactylous, consisting of thumb, forefinger, which is greatly elongated, and

middle finger a little longer than the thumb. If there should be an arrest of development at this stage, the track would be bird-like. Next, the fourth finger makes its appearance, and, on the hind feet, the fifth comes still later. What is especially interesting is that when the legs or feet have been amputated, which frequently occurs, the operation being performed by those miniature fresh water sharks, the larvæ of dragon flies and water beetles, the development of the toes is precisely in the same order, first the three toes, then the fourth, and on the hind feet the fifth. The gills are now beautifully plumed and when closed reach to the centre of the entire animal; hind legs starting. June 20, fifty-six **days, hind feet developed.**

As the lungs increase the gills wither and are gradually absorbed, so that by the middle of August the gills have all disappeared. The time consumed in the wonderful process is a little **over one hundred days.**

Observations on the Systematic Relations of the Fishes.—By Prof. Edward D. Cope.

I. PRELIMINARY.

The system of fishes as at present adopted in this country, is the result of the labors of many naturalists, but chiefly of Cuvier, Agassiz, Müller and Gill. Without going into the history of the subject at present, it will be proper to point out the principal modifications of Cuvier's system, introduced by his three successors. The orders of Cuvier were the *Chondropterygii*, *Malacopterygii*, *Acanthopterygii*, *Pleetognathi* and *Lophobranchii*.

Professor Agassiz, under the name of *Placoids*, adopted the first division; the second he called the *Cycloids*, the third *Ctenoids*, and then created a fourth order under the name of *Ganoids*, which should embrace a portion of Cuvier's *Chondropterygii* (the sturgeons), a portion of the *Malacopterygii Abdominales* (the bony gars, etc.), and the two last orders of Cuvier. Professor Müller following, with a still more complete anatomical investigation, especially into the soft parts, discerned three *sub-classes* in Cuvier's *Chondrostomi*, which he named the *Leptocardii* (lancelet), *Dermopteri* (lamprey, etc.), and the *Selachii* (sharks, etc.). In the then recently discovered Lepidosiren he saw a fourth sub-class, *Dipnoi*.

Having instituted an investigation of Agassiz' Ganoids, in an able memoir he purged it of the *Plectognath* and *Lophobranchiate* divisions, which are obviously not related to it. These with the *Malacopterygians* and *Acanthopterygians*, he erected into a sixth sub-class, the *Teleostei*. This sub-class containing the greater part of existing fishes, embraced six orders, viz.: *Acanthopteri* (Cuvier's Acanthopterygians), *Anacanthini* (new, for the Cod family, etc.); *Pharyngognathi* (new, for fishes with connate inferior pharyngeal bones); *Physostomi* (Malacopterygians of Cuvier, nearly); *Plectognathi* and *Lophobranchii* of Cuvier. The great number of facts in the anatomy of fishes added by Müller, constitute him the father of modern ichthyology.

Professor Gill, in 1861, adopted many of the divisions of Müller, and rejected some; others were newly proposed. But four sub-classes were recognized, the *Dermopteri*, which includes also Müller's Leptocardii; the *Elasmobranchii*, equivalent to Müller's Selachii; the *Ganoidii*, including here Müller's Dipnoi; and the *Teleostei*. Six orders were attributed to the last sub-class, which were quite different from those of Müller.

Subsequent to this publication, important contributions to the system have been made by Kner, Lütken, Gill, Huxley, etc., which will be noticed at the proper time.

The writer having been engaged in an examination of the osteology of the bony fishes, and general anatomical studies of the whole, has proposed to point out some further modifications of the received system, which he believes will render it a closer reflection of nature. There are some portions of the skeleton which have been to a great extent overlooked in seeking for indications of likeness and difference of types, and the estimation in which many known characters are held, may be much altered on the study of extended material. The skeletons on which the present study is made, are one thousand in number, two hundred belonging to the Academy of Natural Sciences of Philadelphia, and eight hundred to the writer, being the collection made by Professor Joseph Hyrtl, the distinguished anatomist of Vienna. This collection has been long known to anatomists in Europe as the most beautifully and reliably prepared in existence, and as valuable as any for study, on account of the fulness of the representation of the various types.

II. SPECIAL ON THE GANOIDS.

Recurring to Müller's system, the writer adopts, as characterized beyond dispute, his sub-classes, or orders of LEPTOCARDII, DERMOPTERI, SELACHII and DIPNOI, and confines himself at present to the recent *Ganoidea* and *Teleostei*. I have shared in the doubts occasionally expressed by ichthyologists, as to the essential distinction of these latter divisions, and an examination into the osteology, with reference to this point, confirms the doubts raised by a study of the soft parts. As is well known, Müller distinguished the Ganoidea by the muscular bulbus arteriosus containing numerous valves, and the connection of the optic nerves by commissure rather than by decussation. He added several other characters, knowing them, however, to be shared by various other orders and sub-classes, and I have selected the only two which seemed to be restricted to the division. Their restriction to it, however, is only apparent, and Kner points out that the peculiarity of the optic commissure is shared by some *Physostomi*, and that the difference between the number and character of the valves of the bulbus in Lepidosteus and Amia, is quite as great as that existing between Amia and some of the *Physostomi*. After an examination of the skeleton it is obvious that in this part of the organism also, there is nothing to distinguish this division from the *Teleostei* of Müller. It is true that each of the genera referred to it possesses marked skeletal peculiarities, but they are either not common to all of them, or are shared by some of the *Physostomi*. If, on the other hand, we compare these genera with each other, differences of the greatest importance are observable, which at once distinguish two divisions, one represented by Polypterus, the other by Lepidosteus and Amia.

In the first place the basal radii of the pectoral fins of Polypterus are observed to be excluded from articulation with the scapular arch by the intervention of three elements, which form a pedicel or veritable arm for the fin. In Lepidosteus and Amia the radii are sessile on the scapular arch as in ordinary fishes. The ventral fins present a like difference; the basal radii are long and four in number in Polypterus. In the other two genera they are absent, excepting one rudimental ossicle on the inner basis of the fin (two in *Lepidosteus*) precisely as in the Physostomous families *Mormyridæ*, *Catostomidæ*, etc. If we examine the branchial ap-

paratus, we find an undivided ceratohyal, three branchihyal arches, and no inner and but two outer bones of the superior branchihyals, present in Polypterus. In Lepidosteus and Amia we have the double ceratohyal, four branchihyal arches, with four outer and four inner superior elements, characters of the typical *Teleostei*. The maxillary bone of Polypterus, instead of being free distally, as in fishes generally, is united with an ectopterygoid, and with bones representing, in position at least, postorbital and malar. In the other genera the relations of the maxillary are as in osseous fishes.

The sturgeons (*Accipenseridæ*) agree with Amia, etc., in all of these points but one, differing only in having the superior ceratohyal and several of the superior branchihyals cartilaginous. The one point of distinction is the extension of the basal radial supports of the ventral fin all across its basis as in Polypterus. The pectoral fin is, on the other hand, much as in Lepidosteus. Thus the sturgeons combine in this one respect, the features of both divisions. Both the basal ceratohyals are cartilaginous in this family; the superior only is cartilaginous in Polypterus, Lepidosteus and Amia, while both are ossified in the old *Teleostei*, except in the eels. In these the inferior is cartilaginous, while the superior is coössified to the ceratohyal. Thus in one unimportant character Polypterus agrees with its former associates, but differs more from others of them—the sturgeons, than from the bony fishes.

Another character of both Lepidosteus and Amia betokens a certain relationship to Polypterus, viz., the complexity of the mandible, especially in the possession of a coronoid bone. But here again Accipenser only possess an osseous dentary, while Gymnarchus and Gymnotus have the angular and articular bones distinct from the dentary, wanting the coronoid and opercular. In most bony fishes the angular is not distinct.

It is thus evident that the sub-class Ganoidea cannot be maintained. It cannot be even regarded as an order, since I will show that Lepidosteus, Accipenser, and Amia, are all representatives of distinct orders. I hope also to make it evident that Polypterus should be elevated to the rank of a sub-class or division of equal rank with the rest of the fishes, and with the *Dipnoi* already adopted.

The question may be discussed as to whether naturalists are

correct who regard the fishes as representing variously, from two to four classes. One of these (the Ganoidea), having been already disposed of, it remains to consider the claims of the remainder, viz: The Elasmobranchii (sharks), Dipnoi and typical fishes.

If we examine the points in which the whole taken together differ from the *Batrachia* and other classes above it, we find that it is confined chiefly to the structure of the limbs and the hyoid apparatus. The typical fishes present, however, other important peculiarities, viz.: 1st. The existence of two or three distinct bones in the suspensor of the mandible, instead of one. 2d. The attachment to these of the opercular bones. 3d. The absence of pelvic bones. 4th. The suspension of the scapular arch to the cranium. 5th. The large development of the pterotic (Parker, *mastoid* of Cuvier and Owen) is characteristic of bony fishes.

The types of variation, in the first point, only distinguish groups of subordinate rank. Thus: the suspensor of the mandible in the typical fishes consists of the hyomandibular stapes, quadrate (metapterygoid or incus), symplectic and mesopterygoid (quadratojugal Muller, quadrate Huxley, Elm. Comp. Anat.). In the *Mormyridæ*, *Siluridæ*, *Polypteridæ*, and others, the symplectic is absent; in the eels of several families both it and the metapterygoid are wanting, reducing the suspensorium to a rod of two pieces. This condition exists in many of the rays: in others, and in the sharks, the inferior element is wanting (Müller, Stannius). An important modification is exhibited by Chimæra, where the hyomandibular, which alone exists, is continuous with the cartilaginous cranium, **not being separated by the usual articulation.**

As to the opercular bones, all are wanting in the Elasmobranchs (sharks and rays) while the typical fishes posses four, viz: preoperculum, operculum, suboperculum and interoperculum. In many of these, however, the suboperculum is wanting, and in the sturgeons and many eels there is no preoperculum. In Polyodon the interoperculum is also wanting. In Lepidosiren the operculum and interoperculum are rudimental. In respect to this point also the divisions indicated are of subordinate value. As regards the development of the pterotic bone, its history is not yet sufficiently made out to enable us to understand its value. It does not exist in those with cartilaginous cranium (*Elasmobranchii*). The Elasmobranchs are well known to have the scapular arch suspended freely behind the cranium as in higher vertebrates. It is not

always attached to the cranium, on the other hand, among true fishes, for in the eels it is quite as in the sharks, and the spinous-finned Mastacembelus presents the same features.

The characters presented by the pelvic bones and limbs seem to be of higher import. Thus all the bony fishes and sturgeons lack all the pelvic elements. In the sharks and rays they are also wanting; but two elements on each side appear in the *Holocephali*, (Chimæra) according to Leydig and Gegenbaur. In Lepidosiren a large median pelvic cartilage exists, but which element it represents is unknown. This is evidently a character of high significance. As to the limbs, the peculiarities of Polypterus have been pointed out above. They mean nothing less than the development of the elements of the arm and leg of the higher vertebrata which intervene between the point of articulation and the distal segments, in Polypterus and the sharks and rays. In the former the distal segments are articulated exclusively to the extremities of the proximal pieces, which thus resemble, as well as represent, humerus and femur, and render the limb pedunculated. The proximal pieces are not continued distally, however, into the representatives of the main axis, which, as demonstrated by the admirable studies of Gegenbaur, consist after humerus, of radius, tarsals and metatarsals, and thumb; in the hind limb, of the line of the tibia and inner toe. This continuation is observed in the Elasmobranchi, where, however, the divergent segments extend along the sides of the proximal pieces to near, in some *Rajidæ* quite, to the articulation with the scapular arch. In the true fishes, including some of the old ganoids already considered, the divergent rays always reach this articulation, while the number of proximal or basal pieces is diminished. These pieces have been called by Gegenbaur the metapterygium (humerus), mesopterygium, and propterygium; the first being axial, the second and third being divergent from it. In Polypterus the propterygium and mesopterygium are largely developed; in sharks and rays the propterygium is sometimes small, sometimes wanting, while in the true fishes the propterygium and mesopterygium are both wanting, excepting in Amia, Lepidosteus, and the sturgeons, where a cartilaginous mesopterygium exists, according to Gegenbaur. This author finds it rudimental in young *Salmonidæ* and *Siluridæ*. Lastly, in the true fishes the distal elements of the axis of the limb are wanting, just as in Polypterus.

In *Dipnoi*, on the other hand, we have this axis complete, or rather with greatly multiplied distal segments, and with or without lateral radii. In the Australian *Ceratodus* Günther finds numerous lateral series on both sides of those of the axial row. Hence the limb of this order is considered by Owen, the simplest or primary type, and this proposition is abundantly confirmed by the beautiful researches of Gegenbaur. The foundation laid by this author for the history of the genesis of limbs will ever be a landmark in the history of *modern theories of creation*. See his memoir, Ueber das Skelet der Gliedmaasen der Wirbelthiere im Allgemeinen, etc., *Jenaische Med. Zeitschr.*, vol. v., p. 397:

Important as are the characters that distinguish the several groups indicated by the different types of structure of the limbs and pelvis, they do not seem to me to warrant their recognition as classes, equivalent to those of the six already pointed out. Taking them together there is a greater coherence also in the structure of brain and circulatory systems than would be the case with any other two of the classes adopted above. The peculiarities of the limbs, important as they are, are nearly related in the want of specialization of their parts, seen in the *Batrachia* and other classes, the differences consisting rather of number and position of similar parts. The pelvis of the *Dipnoi* might be regarded as of primary importance but for its existence in the *Holocephali*, whose limbs again are so near those of the shark.

It remains, therefore, to adopt the Linnæan and Cuvierian class *Pisces*, and to grant as sub-classes, the groups of *Holocephali*, *Selachii* and *Dipnoi*. There remain as sub-classes the groups typified by Polypterus on the one hand, and the true fishes on the other. The first has been already distinguished in its external characters by Professor Huxley, who again brought light out of obscurity when he established his "third sub-order of ganoids, the *Crossopterygidæ*." This division is in my estimation a natural one, and to be elevated to a rank equivalent to that of each of the three above named, being the only part of the original division of Ganoids of Müller entitled to it. Professor Huxley defined it as follows:

"Dorsal fins, two, or if single, multiplied or very long; the pectoral and usually the vertical fins lobate; no branchiostegal rays but two principal, with sometimes lateral and medianjugular plates situated between the rami of the mandible; caudal fin diph-

ycereal or heterocereal; scales cycloid or rhomboid, smooth or sculptured."

Of the above characters that which relates to the lobate fins is the essential one, and is the expression of the external appearance produced by the structure of the bones of the limbs already pointed out by Gegenbaur. The dorsal fins of some families. it is true, possess a remarkable structure, but in Phaneropleuron (Huxley) and some others they appear to be nearly like that of the Dipnoi. The absence of branchiostegal rays is important, but is shared by the sturgeons. The jugular plates appear to exist in Polypterus only among recent fishes, though several, as Amia, Elops, Osteoglossum, etc., possess a median one. Nevertheless, its nature would not lead one to anticipate its being a constant feature in any group of high rank; at least, such is our usual experience with dermal bones. The structures of the skin and scales given by Huxley are very subordinate.

The remaining division answers then to the Teleostei and Ganoidei of Müller, minus Polypterus. The name *Teleostei* cannot be preserved for this division, owing to its entire want of coincidence with that division of Müller, as well as from the fact that the cartilaginous sturgeons must be included in it. I propose, therefore, to call it the *Actinopteri*. The character of the five sub-classes will then be as follows:

CLASS PISCES.

The hyomandibular bone continuous with the cartilaginous cranium, with a rudimental opercular bone. Two distinct pelvic bones on each side. Derivative radii sessile on the sides of the basal bones of the limbs, separated from the articulation. *Holocephali.*

Hyomandibular bone articulated with the cranium; no opercular or pelvic bones. Derivative radii sessile on the sides of the basal bones of the limbs, rarely entering articulation. *Selachii.*

Hyomandibular bone articulated, with rudimental opercular bones; a median pelvic element. Limbs consisting of the axial line only, commencing with the metapterygium and with multiplied segments. *Dipnoi.*

Hyomandibular articulated, opercular bones well developed, a single ceratohyal; no pelvic elements. Limbs having the derivative radii of the primary series on the extremity of the basal pieces, which are in the pectoral fin metapterygium, mesopterygium and propterygium. *Crossopterygia.*

Opercular bones, well developed on separate and complex suspensorium; a double ceratohyal, no pelvic elements. Primary radii of fore limb parallel with basilar elements, both entering the articulation with scapular arch. Basilar elements reduced to metapterygium and very rarely mesopterygium. Primary radii of posterior limbs generally reduced to one rudiment. *Actinopteri.*

III. ON THE ACTINOPTERI.

In determining the primary types of this sub-class, we return to some characters already mentioned, in which they approximate the *Crossopterygia*, and adding others, follow the various divergences to their specialized terminations.

Thus in Accipenser and allies, the ventral fins possess a complete series of basal radial bones, and the pectorals each a large mesopterygium. In Amia and Lepidosteus the mesopterygium is small, and the basal radii of the ventrals are reduced to their lowest number. In none of them are the basihyals fully developed. Most of the eels retain a character which we have only observed heretofore in the *Selachii*.

We pass by a number of the lower fishes before we find the mandibular arch furnished with a symplectic. One of the most important modifications, which is more or less coincident with a number of others, is that which formed the basis of Bonaparte and Müller's order of *Physostomi*. The presence of the ductus pneumaticus which characterizes it, is always associated with the abdominal position of ventral fins and cycloid scales, and mostly with the presence of the præcoracoid arch, the entrance of the maxillary bone into the border of the mouth and the nonseparation of the parietal bones by the supraoccipital. Yet none of these characters are precisely associated at the point of change in each, for there are physostomous fishes with separated parietals and ctenoid scales (some *Cyprinodontidæ*), and there are *Physoclysti* with abdominal ventrals. Nevertheless, three prominent types stand out in the *Actinopteri*, the sturgeons or *Chondrostei*, the *Physostomi*, and the *Physoclysti*, which may be considered as tribes.

An entire series of basilar segments of the abdominal ventral fins; no branchiostegal rays. *Chondrostei.*

Basilar segments of ventrals rudimental, position of fins abdominal, parietal bones usually united; branchiostegal rays; swim

bladder connected with the stomach or œsophagus by a ductus pneumaticus. *Physostomi.*

No ductus pneumaticus; parietal bones separated by the supra-occipital; ventral fins usually thoracic or jugular; no basilar segments. *Physoclysti.*

CHONDROSTEI.

There are two orders in this division, as follows:

A præcoracoid arch; no symplectic bone; premaxillary forming mouth border; no suboperculum nor preoperculum; mesopterygium distinct; basihyals and superior ceratohyal not ossified; interclavicles present; no interopercuium nor maxillary; branchihyals cartilaginous. *Selachostomi*—The Paddle-fish.

Similar to the last, but with interopercle, maxillary bones, and osseous branchihyal. *Glaniostomi*—The Sturgeons.

The first order embraces the single family of *Spatularidæ*, the second that of *Acipenseridæ*. In both the chorda dorsalis persists, the tail is heterocercal and the osseous cranium is little developed. The basal and radial elements of the limbs, with the coracoids, are not ossified.

PHYSOSTOMI.

The following key will express the leading features of the orders of this division:

I. A præcoracoid arch.

A. A coronoid bone.

Maxillary in many pieces; vertebræ opisthocoelian. 3. *Ginglymodi*—The Bony Gar.

Maxillary not transversely divided; vertebræ amphicoelian. 4. *Halecomorphi*—The Dog Fish.

A A. No coronoid bone.

* No symplectic bone.

Pterotic simple, anterior vertebræ with ossicula auditus: supra-occipital and parietals coössified. 5. *Nematognathi*—The Cat Fishes.

Pterotic annular, including a cavity closed by a special bone: parietals distinct, vertebræ simple. 6. *Scyphophori*—The Mormyri.

* * Symplectic present.

Anterior vertebræ coössified and with ossicula auditus. 7. *Plectospondyli*—The Suckers, etc.

Anterior vertebræ, similar, distinct, without ossicula auditus. 8. *Isospondyli*—Herring, etc.

II. No præcoracoid arch.

A. Scapular arch suspended to cranium.

B. A symplectic.

Pterotic and anterior vertebræ simple; parietal separated by supra-occipital. 9. *Haplomi*—Pike, etc.

Anterior vertebræ modified; parietals united; pectoral fins. 10. *Glanencheli*—Electric eel.

B B. No symplectic.

Anterior vertebræ simple; a præoperculum and maxillary; no pectoral fins. 11. *Ichthyocephali*—Java eels.

A. A. Scapular arch free behind the cranium.

**A.* Preoperculum.

A symplectic; maxillary well developed; no pectoral fins. 12. *Holostomi*—Symbranchi.

No symplectic; maxillary lost on connate; pectoral fins. 13. *Enchelycephali*—Eels proper.

** Preoperculum wanting or rudimental.

No symplectic, maxillary, nor pectoral fins, no pterygoid. 14. *Colocephali*—Muræna.

Of the above orders the *Haplomi* (pike, etc.) approach nearest the *Physoclysti* of the families *Opheocephalidæ* and *Atherinidæ*; and the *Holostomi* of the family *Symbranchidæ*, to the Physoclyst family of *Mastacembelidæ*. The affinities between these families is in both cases so close as to render the distinction of the primary divisions in question hardly worth preserving.

The complete development of the support of the caudal fin is seen in many members of this tribe, while in others it remains in its primitive condition. Among *Physoclysti* it is nearly always complete, though in a few (*Trichiuridæ*), etc., it remains larval. In the first development of the vertebral column in fishes, it forms a straight axis. The fin is represented by a fold of the integument which extends equally round its extremity. In this membrane the rays are developed, and in many fishes they remain thus equally distributed. In this case the caudal vertebræ remain in a straight line to the extremity, and we have a termination such as is seen in *Lepidosiren* and the eels. This form of tail may be called the *isocercal*.

If now the radii basal or distal, acquire a greater development

on the lower side of the column, those on the upper side remaining rudimental, it will be necessary that such enlarged portion should strike the water in the plane transverse to the longitudinal axis of the body in order that the weight of the body be propelled with the least expenditure of force. This will necessarily cause the distal vertebræ, or end of the chorda dorsalis, to be turned upward, so that the inferior rays of the fin shall be brought as near to the vertical line of the superior as possible. This is the type of tail known as the *heterocercal*, as called by Agassiz.

We find among the *Physoclysti* that the lower rays of the fin are more and more strengthened, and the hæmal spines which support them, are more and more enlarged. Consequently the end of the column is more curved upwards, as seen in Amia. The superior rays and neural spines are also strengthened, and the inferior so extended upwards as to pass round the extremity of the column and come into contact with them. And now the vertebral centra are successively atrophied from the extremity. Counting from the extremity to the bases of the first supports of the outer rays of the caudal fin above and below, we find that ten vertebræ remain in the tail of Notopterus. In the *Hyodontidæ*, *Albulidæ*, *Elopidæ*, *Alepocephalidæ* and *Salmonidæ*, there are but two left, while one only appears in the *Osteoglossidæ*, *Aulopidæ*, *Lutodiridæ*, *Butyrinidæ*, *Coregonidæ*, *Clupeidæ* and *Chirocentridæ*. In most other families, especially of *Physoclysti*, the last one has disappeared, and the numerous hæmal arches are arranged like radii diverging upwards and downwards from the last caudal vertebra. In the highest groups, as *Pharyngognathi*, etc., they become coössified, and the tail has completed specialization. This is the type called ***homocercal*** **or** ***diphycercal*** **by later writers.**

These types are thus plainly stages in the development of this member, the first and second being simply arrests of development of the last. Thus the young salmon commences with an eel-like vertebral column, or is *isocercal;* it presently, by the upward curvature of the column, and unequal development of the caudal fin, becomes *diphycercal*, but ceases to grow before it has quite accomplished this stage. The Polypterus, the eels, Gymnarchus and other fishes ossify the vertebræ in the isocercal stage. The heterocercal type is seen in the *Chondrostei*, where the vertebræ never ossify. In Lepidosteus and Amia, they ossify in this stage.

I further specify the characters of the orders of *Physostomi* and the families they contain, in the paper itself.

PHYSOCLYSTI.

The following is an analytic synopsis of the orders. They all have the parietals entirely separated by the supra-occipital, and lack the præcoracoid; the symplectic is present, except in *Ostracium*, where it is not ossified.

A. Scapular arch not suspended from the cranium.

Superior branchihyals and pharyngeals developed: inferiors and maxillary distinct. 15. *Opisthomi*.

A A. Scapular arch suspended from the cranium.

I. Ventral Fins Abdominal.

Branchial arches well developed, the bones present, except fourth superior pharyngeal; third much enlarged; inferior pharyngeals distinct. 16. *Percesoces*—Mullet, etc.

Third and fourth superior pharyngeals much enlarged, inferior pharyngeals, coössified. 17. *Synentognathi*—Soft gar.

Superior branchials and pharyngeals reduced in number; inferiors separate; interclavicles present. 18. *Hemibranchi*—Pipe fishes.

Superior branchihyals and pharyngeals, and basal branchihyals wanting; gills tufted. 19. *Lophobranchi*—Sea horse.

II. Ventral Fins Thoracic or Jugular.

First vertebra united to cranium by suture: epiotics united behind superoccipital; basal pectoral radial bones elongate. 20. *Pediculati*—Goose Fish, etc.

Posterior cephalic region normal, anterior twisted so as to bring both orbits on one side; inferior pharyngeals distinct. 21. *Heterosomata*—Flounders.

Cranium normal; the premaxillaries usually coössified with the maxillaries behind, and the dentary with the articular; pharyngeal bones distinct. 22. *Plectognathi*—File Fishes.

Cranium normal; bones of the jaws distinct; inferior pharyngeal bones distinct. 23. *Percomorphi*—Perch.

Cranium normal; bones of the jaws distinct: third superior pharyngeal much enlarged, articulating with cranium: inferior pharyngeals coössified. 24. *Pharyngognathi*—Burgall. Parrot Fish.

These orders will be more fully defined, and the families which are referable to them pointed out.

GENERAL OBSERVATIONS.

In tracing the affinities of the *Physostomi*, I have pointed out the relation between the *Chrondrostei* and the *Nematognathi*, and between the *Halecomorphi* and the *Isospondyli*. The first named of each of these pairs are the structural, and probably genetic, predecessors of the second. The series commenced with the cat fishes may be continued into the *Mormyri* and then to the families of the *Plectospondyli*, where the series with altered vertebræ and with ossicula auditus terminates. The *Characins* have, however, considerable affinity to the *Isospondyli*, especially in the type of their branchial bones. From the latter group we pass to the *Haplomi*, and thence to the *Physoclyst* groups. The eel-like groups form a special line. The *Glanencheli* have cranial characters of the groups with modified vertebræ, with fins of the more typical eels. The latter show a steady approach in some points to the conditions characterizing the *Chondrostei*. The loss of the maxillary, of opercular bones, and of pharyngeal elements, reminds one of these, but in the loss of the premaxillary, and great development of the ethmoid, in the *Colocephali*, we have features quite unique. The vertebral position of the scapular arch is the only shark character they possess; while on the other hand, the *Holostomi* are undoubtedly related to the *Mastacembelus*, a real *Physoclyst* with spinous dorsal fin. These relations are as yet entirely inexplicable.

The affinities among the *Physoclysti* are more clear. Omitting the genus just mentioned, we find the four orders with ventral fins to form a true series, with a *Synentognath* variation, terminating in the greatly degraded order of *Lophobranchii*. The *Percesoces* give us our nearest connection with the groups with abdominal ventral fins, and lead at once to the *Pereomorphi*. From this centre radiate many lines of affinity. One leads from the *Chætodontidæ*, through the *Acronuridæ* and to the *Plectognathi*, by the similarity in the arrangement of the posttemporal and forms of the pharyngeal apparatus. An important division of the *Pereomorphi* has the basis cranii simple and the branchials reduced above; viz., the *Scyphobranchi*. The *Cottidæ* are the most generalized family of this group, and lead on the one hand to the *Tri-*

glidæ of the *Distegi*, with which they are generally arranged, and, on the other, to the *Blennioidea*. Some of the latter elongate the basal pectoral bones considerably, and lead to the *Batrachioidea* on the one side, where the number of these bones is increased, and on the other to the *Pediculati*, where the number is diminished. To these groups the *Anacanthini* and *Heterosomata* are less allied.

The third upper pharyngeal bone has already presented an increase of mass and use in the first orders of Physoclysti with ventral fins. Among the *Pereomorphi* the same increase makes its appearance by little beginnings in some *Sciænoidæ*. It is quite noteworthy in most of the *Carangidæ*, a group whose separation from the *Scombridæ* by Günther is supported by this part of their organism. Through forms not now specified, approach to the *Pharyngognathi* is made. Here the pharyngeals are modified into a mill-like structure, which is least specialized in the *Embiotocidæ*, and most so in the *Scaridæ*.

Mr. F. W. PUTNAM was not prepared to accept all the changes that were proposed by Prof. Cope, some of which were somewhat radical. At the same time, however, he regarded it as the nearest approach to a correct classification of the fishes that had ever been made. The points of distinction between the fishes and batrachians had never been better made, nor in a more unexpected manner. He thought Professor Cope had found the only means by which one can with certainty distinguish a fish from a batrachian. The way in which a number of the families had been grouped together he fully approved of, though some of the groups he thought still open to question.

THE LAWS OF ORGANIC DEVELOPMENT.—BY PROF. E. D. COPE.

THE discussion of this subject divides itself into two parts, viz.: a consideration of the proof that evolution of organic types, or descent with modification has taken place; and, secondly, the investigation of the laws in accordance with which this development has progressed.

I. ON THE PROOF FOR EVOLUTION.

There are two modes of demonstration, both depending on direct observation. One of these has been successfully presented by Darwin. He has observed the origin of varieties in animals and plants, either in the domesticated or wild states, and has shown, what had been known to many, the lack of distinction in the grade of difference which separate varieties and species. But

he has also pointed out that species (such, so far, as distinctness goes) have been derived from other species among domesticated animals, and he infers by induction that other species, whose origin has not been observed, have also descended from common parents. So far I believe his induction to be justified; but when from this basis evolution of divisions defined by important structural characters, as genera, orders, classes, etc., is inferred, I believe that we do not know enough of the uniformity of nature's processes in the premises to enable us to regard this kind of proof as conclusive.

I therefore appeal to another mode of proving it, and one which covers the case of all the more really structural features of animals and plants.

It is well known that in both kingdoms, in a general way, the young stages of the more perfect types are represented or imitated with more or less exactitude by the adults of inferior ones. But a true identity of these adults with the various stages of the higher has, comparatively, rarely been observed. Let such a case be supposed.

In *A* we have four species whose growth attains a given point, a certain number of stages having been passed prior to its termination or maturity. In *B* we have another series of four (the numbering a matter of no importance), which, during the period of growth, cannot be distinguished by any common, *i. e.*, generic character, from the individuals of group *A*, but whose growth has only attained to a point short of that reached by those of group *A* at maturity. Here we have a parallelism, but no true evidence of descent. But if we now find a set of individuals belonging to one species, and therefore held to have had a common origin or parentage (or still better the individuals of a single brood), which present differences among themselves of the character in question, we have gained a point. We know in this case that the individuals, *a*, have attained to the completeness of character presented by group *A*, while others, *b*, of the same parentage have only attained to the structure of those of group *B*. It is perfectly obvious that the individuals of the first part of the family have grown further, and, therefore, in one sense faster, than those of group *b*. If the parents were like the individuals of the more completely grown, then the offspring which did not attain that completeness may be said to have been *retarded* in their develop-

ment. If, on the other hand, the parents were like those less fully grown, then the offspring which have added something have been *accelerated* in their development.

I claim that a consideration of the uniformity of nature's processes, or inductive reasoning, requires me (however it may affect the minds of others) to believe that the groups of species whose individuals I have never found to vary, but which differ in the same point as those in which I have observed the above variations, are also derived from common parents, and the more advanced have been *accelerated* or the less advanced *retarded*, as the case may have been with regard to the parents.

This is not an imaginary case, but a true representation of many which have come under my observation. The developmental resemblances mentioned are universal in the animal and probably in the vegetable kingdoms, approaching the exactitude above depicted in proportion to the near structural similarity of the species considered.

Example 1.—It is well known that the *Cervidæ* of the Old World develop a basal snag of the antler (see Cuvier, Ossemens Fossiles, and Gray, Cat. British Museum,) at the third year; a majority of those of the New World (genera Subulo, Cariacus) never develop it except in abnormal cases in the most vigorous maturity of the most northern Cariacus (*C. Virginianus*), while the South American Subulo retains to adult age the simple horn or spike of the second year of all *Cervidæ*.

Among the higher *Cervidæ*, Rusa and Axis never assume characters beyond an equivalent of the fourth year of Cervus. In Dama the characters are, on the other hand, assumed more rapidly than in Cervus, its third year corresponding to the fourth of the latter, and the development in after years of a broad plate of bone, with points being substituted for the addition of the corresponding snags, thus commencing another series which terminates in the great fossil elk, Megaceros.

Returning to the American deer we have Blastoceros, whose antlers are identical with the fourth year of Cariacus. Corresponding with the Dama-Megaceros type of the Old World we have the moose (Alces) developing the same palmate horn on the basis of Cariacus (*i. e.*, without eye-snag.)

Example 2.—I select the following series, embracing the majority of the genera of the North American Helicidæ.

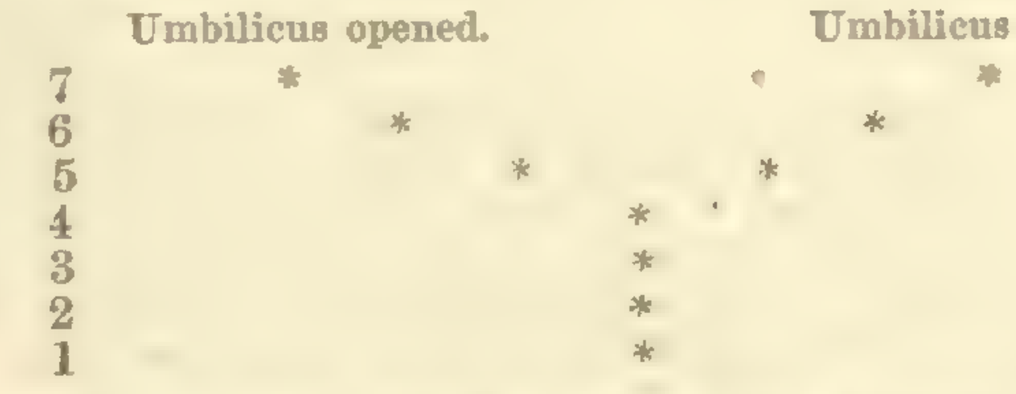
HELICIDÆ.

1. Turns of spire very few; wide umbilicus: shell thin, with thin lips. . . *Binneya.*
2. Turns few, but more; rest as above, ... *Vitrina.*
3. Turns still more numerous; rest as above, ... *Hyalina.*
4. As No. 3, but lip thickened inside, ... *Hygromia.*
5. Coiled; *umbilicus closed:* lip thickened inside and out, . . *Tachea* and *Pomatia.*
6. Same, with a parietal tooth, ... *Mesodon.*
7. Same, with parietal and two interior lip teeth. . . . . *Isognomostoma.*

* * Recommencing at No. 4. All with open umbilicus.

5. As No. 4, but lip thickened in and out. . . . . *Arionta.*
6. Same as No. 5, but with parietal tooth, ... *Polymita.*
7. Same, with both parietal and lip teeth, ... *Triodopsis.*

The successional relation of these genera may be represented in such a diagram as this:—



In the history of the growth of the genera Isognomostoma and Triodopsis, the extreme forms of the two series, it is well known that at first the coils of the shell are extremely few, as in Binneya; and that like it, it is very thin and with a delicately thin edge; that the turns increase successively in number, as in Vitrina and Hyalina, and that finally the lip thickens as in Hygromia. Then the umbilicus may close as in Tachea, or (in Triodopsis) remain open as in Arionta. In either case a tooth is soon added on the body whorl (Polymita, Mesodon), and finally, the full maturity of the shell is seen in the added width of the inside of the lip-margin. How many of the stages of the genera *Triodopsis* and *Mesodon* are identical with the genera of the series which represent them I leave to more thorough conchologists, but that some now exhibit and all have presented illustrations of the relation of exact parallelism I cannot doubt.

Example 1.—An abundant race of the American deer, *Cariacus Virginianus*, exists in the Adirondack region of New York, in which the development of the antlers never progresses beyond the spike stage of the second year. Therefore, some individuals of this species belong to Cariacus and some to Subulo.

Example 2.—A large part of the individuals of the common snail, *Mesodon albolabris*, never develop the tooth of the body-whorl, characteristic of the genus whose definition has to be modified to retain them.

Example 3. — Many individuals of *Triodopsis tridentata* from eastern North Carolina occur without the lip-teeth characteristic of the genus *Triodopsis*. Hence these specimens, though of common origin with others of the species, must be referred to another genus.

Example 4. — Structural characters are known in many, if not all, species which are said to be "inconstant," being present or absent indifferently, thus being useless for definition. They may be rudimental when present or considerably developed. The presence or absence of wings in some species of insects may be cited: also the presence of generic characters in the male sex of many Coleoptera and their absence in the females. The characters of males, females, workers and soldiers in bees and ants may be added. All these facts belong to the same category as those cited among deer and mollusks and have a similar explanation.

Example 5. — It does not seem to be the law in "retardation" that parallelisms exhibited by the series in its rise to its highest point of development should retrace the steps by which it attained it, and that "exact parallelisms" should be exhibited in a reversed order. Parallelisms, it is true, are exhibited; but so far as I have observed always "inexact," often in a high degree. A marked case of retardation occurs in the dental development of a number of persons who have come under my observation in the neighborhood of Philadelphia. It is not very uncommon to find persons in whom the third molars in both jaws are incomplete as to number, one, two, three, or all, being deficient. It is still more common for them to be incompletely covered by the enamel layer, and to become in consequence so worthless as to require early removal. I am acquainted with two families in which the absence of the exterior upper incisor on each side is common. In one of these the second and third generation have inherited it from the mother's side, and it now characterizes many of the children. The significance of this modification will be best understood by examining the dental structures of the *Quadrumana* in general, commencing with the highest family and the modification, we have: —

		Incisors.	Canines.	Premolars.	Molars.
Hominidæ,	Abnormal.	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{2}{3}$
	Normal.	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{3}{3}$
Simiadæ,		$\frac{2}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{3}{3}$
Cebidæ,		$\frac{2}{2}$	$\frac{1}{1}$	$\frac{3}{3}$	$\frac{3}{3}$
Lemuridæ,		$\frac{2}{3}$ — $\frac{3}{3}$	$\frac{1}{1}$	$\frac{3}{3}$ — $\frac{2}{3}$	$\frac{3}{3}$
Mammalia, Normal,		$\frac{3}{3}$	$\frac{1}{1}$	$\frac{4}{4}$	$\frac{3}{3}$

In this table we see a decline in the number of teeth of the higher groups. Thus the premolars are one less than the nominal number in the whole order, and they lose one in each jaw in the Old World apes, and man. The molars maintain the normal number throughout, but the third in both jaws is in the *Simiadæ* reduced by the loss of a fifth or odd tubercle, thus becoming four-lobed. In the upper jaw this is first lost in the Semnopitheeus; in the lower, in the next highest genus Cercopitheeus. In Homo its appearance is "retarded," the interval between that event and the protrusion of the second molar—six to ten years—being relatively greater than in any genus of *Quadrumana*. Its absence is then the result of continued retardation, not of a new and adaptive suppression, and is of direct systematic zoological value.

In the incisors a reduction is also plainly visible, as we pass from the most completely furnished *Lemuridæ* to the genus Homo. One from the upper jaw is first lost, then in the *Cebidæ*, one from the lower also. The number remains the same through the *Simiadæ* and normal *Hominidæ*, but in the abnormal cases cited the process of reduction is continued and another incisor from each side disappears. That this also is truly "retardation" is also evident from the fact that the exterior incisor is the last developed, being delayed in ordinary growth a year later than those of the inner pair. The same retardation is seen in the quadrumane *Cheiromys* (the *Aye-aye*), and the whole order *Rodentia*. In the latter, the rare presence of the reduced second incisors shows that here also the external incisors are lost. This retardation is also of systematic importance, and, should either of the characters described be constant in any of the species of the genus *Homo*, would at once entitle it to new generic rank. The very frequent absence of the posterior molars (wisdom teeth) has been recently found to characterize a race in India. Should this peculiarity prove constant, this race would with propriety be referred to as a new genus of *Hominidæ*, as we have many cases of very similar species being referable to different genera. It is altogether probable that such will, at some future time, be the condition of some race or races of men.

II. ON THE LAWS OF EVOLUTION.

Wallace and Darwin have propounded as the cause of modification in descent their law of natural selection. This law has been

epitomized by Spencer as the "preservation of the fittest." This neat expression no doubt covers the case, but it leaves the origin of the fittest entirely untouched. Darwin assumes a "tendency to variation" in nature, and it is plainly necessary to do this in order that materials for the exercise of a selection should exist. Darwin and Wallace's law is, then, only restrictive, directive, conservative, or destructive of something already created. Let us, then, seek for the originative laws by which these subjects are furnished —in other words, for the causes of the origin of the fittest.

The origin of new structures which distinguish one generation from those which have preceded it, I have stated to take place under the law of *acceleration*. As growth (creation) of parts usually ceases with maturity, it is entirely plain that the process of acceleration is limited to the period of infancy and youth in all animals. It is also plain that the question of growth is one of nutrition, or of the construction of organs and tissues out of protoplasm.

The construction of the animal types is restricted to two kinds of increase—the addition of identical segments and the addition of identical cells. The first is probably to be referred to the last, but the laws which give rise to it cannot be here explained. Certain it is that segmentation is not only produced by addition of identical parts, but also by subdivision of a homogeneous part. In reducing the vertebrate or most complex animal to its simplest expression, we find that all its specialized parts are but modifications of the segment, either simply or as sub-segments of compound but identical segments. Gegenbaur has pointed out that the most complex limb with hand or foot is constructed, first, of a single longitudinal series of identical segments, from each of which a similar segment diverges, the whole forming parallel series, not only in the oblique transverse, but generally in the longitudinal sense. Thus the limb of the Lepidosiren represents the simple type, that of the Ichthyosaurus a first modification. In the latter the first segment only (femur or humerus) is specialized, the other pieces being undistinguishable. In the Plesiosaurian paddle the separate parts are distinguished: the ulna and radius well marked, the carpal pieces hexagonal, the phalanges well marked, etc.

As regards the whole skeleton the same position may be safely assumed. Though Huxley may reject Owen's theory of the vertebrate character of the segments of the cranium, because they are

so very different from the segments in other parts of the column, the question rests entirely on the definition of a vertebra. If a vertebra be a segment of the skeleton, of course the skull is composed of vertebræ; if not, then the cranium may be said to be formed of "sclerotomes," or some other name may be used. Certain it is, however, that the parts of the segments of the cranium may be now more or less completely parallelised or homologised with each other, and that as we descend the scale of vertebrated animals, the resemblance of these segments to vertebræ increases, and the constituent segments of each become more similar. In the types where the greatest resemblance is seen, segmentation of either is incomplete, for they retain the original cartilaginous basis. Other animals which present cavities or parts of a solid support are still more easily reduced to a simple basis of segments, arranged either longitudinally (worm) or centrifugally (star-fish, etc.)

Each segment — and this term includes not only the parts of a complex whole but parts always subdivided, as the jaw of a whale or the sac-body of a mollusk, — is constructed, as is well known by cell division. In the growing fœtus the first cell divides its nucleus and then its whole outline, and this process repeated millions of times produces, according to the cell theory, all the tissues of the animal organism or their bases from first to last. That the ultimate or histological elements of all organs are produced originally by repetitive growth of simple, nucleated cells with various modifications of exactitude of repetition in the more complex, is taught by the cell theory. The formation of some of the tissues is as follows:

First Change — Formation of simple nucleated cells from homogeneous protoplasm or the cytoblastema.

Second — Formation of new cells by division of body and nucleus of the old.

Third — Formation of tissues by accumulation of cells with or without addition of intercellular cytoblastema.

A. In connective tissue by slight alteration of cells and addition of cytoblastema.

B. In blood, by addition of fluid cytoblastema (fibrin) to free cells (lymph corpuscles), which in higher animals (vertebrates) develop into blood-corpuscles by loss of membrane, and by cell development of nucleus.

C. In muscles by simple confluence of cells, end to end and mingling of contents (Kölliker).

D. Of cartilage by formation of cells in cytoblast which break up, their contents being added to cytoblast; this occurring several times, the result being an extensive cytoblast with few and small cells (Vogt). The process is here an attempt at development with only partial success, the result being a tissue of small vitality.

Even in repair-nutrition recourse is had to the nucleated cell. For Cohnheim first shows that if the corner of a frog's eye be scarified, repair is immediately set on foot by the transportation thither of white or lymph or nucleated corpuscles from the neighboring lymph heart. This he ascertained by introducing aniline dye into the latter. Repeated experiments have shown that this is the history in great part of the construction of new tissue in the adult man.

Now, it is well known that the circulating fluid of the fœtus contains for a period only these nucleated cells as corpuscles, and that the lower vertebrates have a greater proportion of these corpuscles than the higher, whence probably the greater facility for repair or reconstruction of lost limbs or parts enjoined by them. The invertebrates possess only nucleated blood corpuscles.

What is the relation of cell division to the forces of nature, and to which of them as a cause is it to be referred, if to any? The animal organism transfers the chemism of the food (protoplasm) to correlated amounts of heat, motion, electricity, light (phosphorescence), and nerve force. But cell division is an affection of protoplasm distinct from any of these. Addition to homogeneous lumps or parts of protoplasm (as in that lowest animal, *Protomoba* of Hæckel.) may be an exhibition of mere molecular force, or addition as is seen in the crystal, but cell division is certainly something distinct. It looks to me like an exhibition of another force, and though this is still an open question, it may be called for the present *growth force*. It is correlated to the other forces, for its exhibitions cease unless the protoplasm exhibiting it be fed. It is potential in the protoplasm of both protoplasmic animal mass and protoplasmic food, and becomes energetic on the union of the two. So long as cell division continues it is energetic: when cells burst and discharge the contained cytoblastema, as in the formation of cartilage, it becomes again potential.

The size of a part is then dependent on the amount of cell division or growth force, which has given it origin, and the number of segments is due to the same cause. The whole question, then, of the creation of animal and vegetable types is reduced to one of the amount and location of growth force.

Before discussing the influences which have increased and located growth force, it will be necessary to point out the mode in which these influences must necessarily have affected growth. Acceleration is only possible during the period of growth in animals, and during that time most of them are removed from the influence of physical or biological causes either through their hidden lives or incapacity for the energetic performance of life functions. These influences must, then, have operated on the parents, been rendered potential in their reproductive cells, and become energetic in the growing fœtus of the next generation. However little we may understand this mysterious process, it is nevertheless a fact. Says Murphy, "There is no act which may not become habitual, and there is no habit that may not be inherited." Materialized, this may be rendered—there is no act which does not direct growth force, and therefore there is no determination of growth force which may not become habitual; there is, then, no habitual determination of growth force which may not be inherited; and of course in a growing fœtus becomes at once energetic in the production of new structure in the direction inherited, which is acceleration.

III. THE INFLUENCES DIRECTING GROWTH FORCE.

Up to this point we have followed paths more or less distinctly traced in the field of nature. The positions taken appear to me either to have been demonstrated or to have a great balance of probability in their favor. In the closing part of these remarks I shall indulge in more of hypothesis than heretofore.

What are the influences locating growth force? First, physical and chemical causes; second, use; third, effort. I leave the first, as not especially prominent in the economy of type growth among animals, and confine myself to the two following. The effects of use are well known. We cannot use a muscle without increasing its bulk; we cannot use the teeth in mastication without inducing a renewed deposit of dentine within the pulp-cavity to meet the encroachments of attrition. The hands of

the laborer are always larger than those of men of other pursuits. Pathology furnishes us with a host of hypertrophies, exostoses, etc., produced by excessive use, or necessity for increased means of performing excessive work. The tendency, then, induced by use in the parent is to add segments or cells to the organ used. Use thus determines the locality of new repetitions of parts already existing, and determines an increase of growth force at the same time, by the increase of food always accompanying **increase of work done, in every animal.**

But supposing there be no part or organ to use. Such must have been the condition of every animal prior to the appearance of an additional digit or limb or other useful element. It appears to me that the cause of the determination of growth force is not merely the irritation of the part or organ used by contact with the objects of its use. This would seem to be the remote cause of the deposit of dentine in the used tooth, in the thickening epidermis of the hand of the laborer, in the wandering of the lymph-cells to the scarified cornea of the frog in Cohnheim's experiment. You cannot rub the sclerotica of the eye without producing an expansion of the capillary arteries and corresponding increase in the amount of nutritive fluid. But the case may be different in the muscles and other organs (as the pigment cells of reptiles and fishes) which are under the control of the volition of the animal. Here, and in many other instances which might be cited, it cannot be asserted that the nutrition of use is not under the direct control of the will through the mediation of nerve force. Therefore I am disposed to believe that growth force may be, by the volition of the animal, as readily determined to a locality where an executive organ does not exist, as to the first segment or cell of such an organ already commenced, and that therefore effort is **in the order of time, the first factor in acceleration.**

Effort and use have, however, very various stimuli to their exertion.

Use of a part by an animal is either compulsory or optional. In either case the use may be followed by an increase of nutrition under the influence of reflex force or of direct volition.

A compulsory use would naturally occur in new situations which take place apart from the control of the animal, where no alternatives are presented. Such a case would arise in a submergence of land where land animals might be imprisoned on an island or

in swamps surrounded by water, and compelled to assume a more or less aquatic life. Another case which has also probably often occurred, would be when the enemies of a species might so increase as to compel a large number of the latter to combat who would previously have escaped it.

In these cases the structure produced would be necessarily adaptive. But the effect would be most frequently to destroy or injure the animals (retard them) thus brought into new situations and compelled to an additional struggle for existence, as has, no doubt, been the case in geologic history. Preservation, with modifications would only ensue where the changes should be introduced very gradually. This mode is always a consequence of the optional use. The cases here included are those where choice selects from several alternatives, thus exercising its influence on structure. Choice will be influenced by the emotions, the imagination, and by intelligence.

As examples of intelligent selection the modified organisms of the varieties of bees and ants must be regarded as striking examples of its exercise. Had all in the hive or hill been modified alike, as soldiers, queens, etc., the origin of the structures might have been thought to be compulsory; but varied and adapted as the different forms are to the wants of a commmunity, the influence of intelligence is too obvious to be denied. The structural results are obtained in this case by a shorter road than by inheritance.

The selection of food offers an opportunity for the exercise of intelligence, and the adoption of means for obtaining it still greater ones. It is here that intelligent selection proves its supremacy as a guide of use, and consequently of structure, to all the other agencies here proposed. The preference for vegetable or for animal food determined by the choice of individual animals among the omnivores, which were, no doubt, according to the palæontological record the predecessors of our herbivores, and perhaps of carnivores also, must have determined their course of life and thus of all their parts into those totally distinct directions. The choice of food under ground, on the ground, or in the trees would necessarily direct the uses of organs in those directions respectively.

Intelligence is a conservative principle and always will direct effort and use into lines which will be beneficial to its possessor. Thus we have the source of the fittest—*i.e.*, addition of parts by increase and location of growth force directed by the will—

the will being under the influence of various kinds of compulsory choice in the lower, and intelligent option among higher animals. Thus intelligent choice may be regarded as the originator of the fittest, while natural selection is the tribunal to which all the results of accelerated growth are submitted. This preserves or destroys them, and determines the new points of departure on **which accelerated growth shall build.**

Acceleration under the influence of effort accounts for the existence of rudimental characters. Many other characters will follow at a distance, the modifications proceeding in accordance with the laws here proposed, and retardation is accounted for by complementary or absolute loss of growth force.

Prof. GRAY, Prof. SWALLOW, Dr. HILGARD, Mr. PUTNAM, and others participated in the discussion of this paper.

THE following papers were also read in SECTION B, but the authors **have failed to send us abstracts: —**

A Theory on the Nature of the Difference in the Mental Capacity of High and Low Races of Men.— By Mr. RENAS DAVIS.
Observations on the Geology, Physical Features and Retrocession of Niagara Falls.— By Mr. GEORGE W. HOLLEY.
Contributions to Physiographic and Dynamical Geology.— By Prof. RICHARD OWEN.
On the Phyllotaxis of the Cucurbitaceæ.— By Mr. H. W. RAVENEL.
Remarks on the Geology of the Mississippi Bottom.— By Dr. E. A. SMITH.
Remarks on the Catskill Red Sandstone Group as it occurs upon the borders of New York and Pennsylvania.— By Prof. JAMES HALL.
Remarks on the Snow Line in the Mountains of Montana.— By Prof. G. C. SWALLOW.
Some Observations on the Geology of Ohio.— By Prof. E. B. ANDREWS.
Notice of Tertiary Insects found by F. C. A. Richardson on the Green River in Wyoming.— By Prof. J. H. MCCHESNEY.
On Fossils and Minerals from North Carolina.— By Prof. W. C. KERR.

THE following were read by title only: —

The Classification of Echinoderms from their Microscopic structure.— By Mr. A. AGASSIZ.
Observations on the Common Ground Worm.— By Mr. JAMES J. H. GREGORY.
Some Questions on Surface Geology.— By Prof. FRANK H. BRADLEY.
On the Entozoa Peculiar to Swine.— By Dr. W. B. FLETCHER.
On the Apparently One-ranked Phyllotaxis of Baptisia pertoliata.— By Mr. H. W. RAVENEL.
On the Geology of Northwestern Massachusetts.— By Prof. SANBORN TENNEY.
Remarks on the Cinnabar and other Minerals from California.— By Prof. J. LAWRENCE SMITH.
Remarks on the Abies Douglassii and a new Species, or a peculiar variety of Abies balsamifera of the Rocky Mountains.— By Prof. G. C. SWALLOW.
On some of the results in Geology and Palæontology of the Geological Survey of Ohio.— By Prof. J. S. NEWBERRY.
The Lignites of the West: their Geology and Economic value.— By Prof. J. S. NEWBERRY.
On the Homologies of the Rays of the Dorsal Fins of Polypterus.— By Prof. E. D. COPE.

THE following were given as lectures at the General Sessions held at Terre Haute: — "On the Fertilization of Flowers by Insect Agency," by Prof. ASA GRAY. "On the Pterosauria," by Dr. B. WATERHOUSE HAWKINS.

Dr. T. **STERRY HUNT also delivered a lecture at Indianapolis, "On the** Coal and Iron Resources of Indiana," and Prof. E. S. MORSE gave a lecture at a general session in Indianapolis. "On some of the Common Animals."

THE following papers, presented before SECTION A, were also of spe**cial interest to members of SECTION B: —**

On the Rainfall in the United States.— By Prof. JOSEPH HENRY.
On the Dust Storm which occurred in Clinton Co., Ind., Dec. 24, 1870.— By Prof. J. TINGLEY.
On a new form of Boomerang in use among the Magni Pueblo Indians of North America.— By Dr. C. C. PARRY.
The Character and Chemical Composition of the Meteorite that fell in May, near Searsmont, Me.— By Prof. J. LAWRENCE SMITH.

Description of the exact Locality of the immense masses of Meteoric Iron in Cahuila, Mexico, with the analysis of one recently discovered.—By Prof. J. LAWRENCE SMITH.
On Dentistry as practiced by the Romans 600 years B. C.—By Dr. EZRA READ.

THE following abstracts of remarks, made in connection with several papers, are of sufficient interest to print, though the papers to which they should have been appended do not appear owing to our failing to receive abstracts from their authors:—

Prof. E. W. HILGARD remarked, in the discussion of the paper by Dr. Smith on the "Mississippi Bottom," that his own observations in the Tensas bottom, in Louisiana, confirmed those of Dr. Smith. Much of the best land there, is a genuine prairie soil, full of calcareous concretions—a feature entirely foreign to the true river allavium as well as the modern paludal deposits. These calcareous concretions appear to result from the maceration and dissolution of the fossil shells, as distinctly observed in several localities; and are very characteristic of the lower portion of the Port Hudson beds. There can be no doubt that a very large portion of the celebrated "alluvial" lands of the lower Mississippi are no alluvium at all, but substantially result from the disintegration of these older beds.

During the discussion on Prof. Andrews' paper on the "Geology of Ohio," the following remarks were made:—

Prof. A. WINCHELL remarked that he had examined the boulder-like stone taken by Professor Andrews from a coal bed in Ohio and felt very confident that it was a genuine boulder of Carboniferous times. The fragment showed that the rock had been a smoothed and rounded fragment of quartzite, composed of glassy and smoky grains of quartz, and that in every respect it was undistinguishable from surface boulders of Huronian quartzites, so abundant throughout the north. It was a very interesting phenomenon, since, so far as he remembered, it was the first instance of the discovery of a boulder in a bed of bituminous coal. It need not surprise us, however, because geologists well know that from the beginning to the end of the Coal-measure epoch, there were frequent intervals during which agencies existed which overspread portions of the sea-bottom with rounded quartzose fragments, evidently transported from the far north. Whatever these agencies were, it would not be unlikely that an occasional boulder should become mingled with the vegetable and alluvial materials quietly accumulating for the formation of a future bed of coal.

Dr. C. A. WHITE said he could not detect the presence of any hornblende in this piece of rock under his lens. It seems to be only a quartzite, similar masses of which he had often found in the coal-measures of Iowa. He had seen masses of quartzite imbedded in the very soft impure sandstones of the lower Coal-measures there, which had evidently been formed as quartzite just where they are, as the lines of stratification pass continuously through the soft sandstone and the quartzite lumps. The manner in which these quartzite masses, great and small, have originated need not now be discussed, but it is certain that they did originate where we now find them. He could not help regarding this mass as having a similar origin.

During one of the general discussions, Prof. A. H. WORTHEN said that the vertical range of the remains of the mammoth and mastodon is an interesting question; and bearing upon that I will relate the circumstances attending the discovery of the bones found between Illiopolis and Niantic, in Macon Co., in Illinois, in September, 1870. A farmer while digging a shallow well, to obtain water for the supply of stock, in a low peaty bog, at the depth of four feet below the surface, came upon what proved to be an entire tusk of a mastodon. This tusk was

nine feet in length, and eight inches in diameter at the largest extremity, and entirely perfect. In addition to this, he obtained about two-thirds of the other tusk, the lower jaw, with the teeth all remaining in their places, the teeth of the upper jaw, and also some fragments of other bones of the same animal. With these were found a pair of the antlers of a large elk, with some other bones of the same animal, and also bones of the buffalo and deer. These were all embedded in a quicksand containing Physa, Planorbis, and Cyclas, of existing species, and beneath four feet of black peaty soil.

There are, in the Illinois State Collection, some other remains of this kind, which have been found in older deposits, among which are fragments of two mammoths found in true Drift, and bones of another specimen of mastodon found in the vicinity of Morris, in Grundy County, in undisturbed Drift, at a depth of eight feet below the surface, so that these extinct animals seemed to have lived in Illinois down to a comparatively recent period. At Alton, Illinois, a jaw of a mastodon, with both teeth remaining in place, was found at the base of the Loess, thirty feet below the surface.

The meetings of Section B were well attended, and the members while feeling the necessity for fuller discussions of many papers, forebore to do so on account of the limited time for critical work in the section.

The officers of the section were Prof. C. G. Swallow of St. Louis, *Permanent Chairman*; Mr. J. E. Emerton of Salem, *Secretary*; Professors Cope, Morse and Marcy, *Sectional Committee*.

Subsection (of Section A.) MICROSCOPY.

The Subsection of Microscopy renewed its organization by the election of the following officers: *Chairman*, Prof J. E. Hilgard of Washington; *Secretary*, Dr. W. W. Butterfield of Indianapolis; *Sectional Committee*, Messrs. Ward, Bicknell and Tuttle.

The attendance was smaller than at the two previous meetings, but the papers and discussions presented some points of unusual interest. The abstract of Prof. Ward's paper is the only one we have received in time for publication in this number.

Among the novelties of apparatus may be noticed the observation of the electric induction spark by the micro-spectroscope, by Prof. Vander Weyde; the oblique illumination of transparent objects under high powers by means of light reflected from a plane mirror lying upon the stage and directly beneath the mounted object—a little expedient of great practical convenience, also by Prof. Vander Weyde; the adoption of the Wenham Binocular arrangement by Zentmayer; and the somewhat general introduction into use of the eye-piece condensers with a wide horizontal illumination (for binoculars) upon the plan proposed by Prof. Ward at the Troy meeting last summer, and published in the Naturalist of Dec., 1870. Mr. Bicknell places the stop-plate between the lenses of the condenser, instead of below them; and Prof. Ward, while retaining the eye-piece arrangement for use with low powers, for high powers combines the centring adjustment, Iris diaphragm, and stop-plate, with an achromatic combination of larger angle and more perfect corrections.

The committee on uniform standards in the powers of objectives and eye-pieces being unprepared to report, Messrs. Ward and Bicknell reported verbally, and the committee was continued until the next meeting. While an exact uniformity in the amplifying power of lenses in the same denomination is not to be looked for, it is believed that much of the existing confusion may be remedied. Many microscopists, the speakers among the number, have long been accustomed to alter the denomination of their lenses so as to represent, as nearly as practicable, their amplifying power when in actual use; and probably the principal makers in this

country will freely coöperate with microscopists attaining this very desirable result. The introduction already partially accomplished, of a grading of the eye-pieces by comparison with equivalent single lenses, 2in., 1 in., ½ in., etc., may render this part of the subject, which seemed almost unattainable, the easiest and first to be accomplished. The remarks on the subject of powers will be given in a future number of the NATURALIST.

ON A NEW MICRO-TELESCOPE.—BY PROF. R. H. WARD.

THIS is designed especially for travelling and field use, but applicable to some of the daily work of the microscopist. It consists of a stand and accessories as follows: (A) An ordinary Tank Microscope having the body focussed by a rack and clamped at any desired height upon a stand like that of the bull's eye condensers. Probably few naturalists have any suspicion of the real usefulness of this little piece of apparatus, not only in the study of objects living in an aquarium or preserved in alcohol, glycerine, etc., but for the hasty inspection of herbarium specimens permanently fastened upon sheets of paper too large for the stage of an ordinary microscope, and for the preliminary examination of objects in jars, boxes, dissecting troughs, etc. The writer always keeps upon his working table such an instrument carrying a double nose-piece (the crooked form) and usually one-inch and three-inch objectives, and uses it continually and with great satisfaction as a substitute for a simple microscope. The brass foot-plate at the bottom of the upright pillar should be made somewhat larger and heavier than usual. (B) A Stage of convenient size and simple construction, sliding upon the upright pillar and capable of being clamped securely in any position. This stage carries a diaphragm and mirror below and stage forceps above, and enables the instrument to be used as a vertical compound microscope for ordinary work when, as in travelling or on a field-day, no more commodious stand may be available. This combination may also be used as a dissecting microscope, though for that purpose it is greatly preferable to use the Tank Microscope as a magnifier only, and to place the object, if opake, on the table, or if transparent, on the stage of any good dissecting microscope that may be within reach. (C) A Draw Tube sliding over the compound body from below, and capable of being fastened by a bayonet catch to the brass-work through which the compound body is moved by the rack. The objective in the compound body now acts as an erector, and another is to be screwed, by means of a large adapter, into the lower end of the Draw Tube, to act as the objective.

The rack-movement now only varies the power, and may be thus used as a fine adjustment, while the coarse adjustment must be gained by moving the whole instrument. This combination is extremely useful for dissecting, its great-

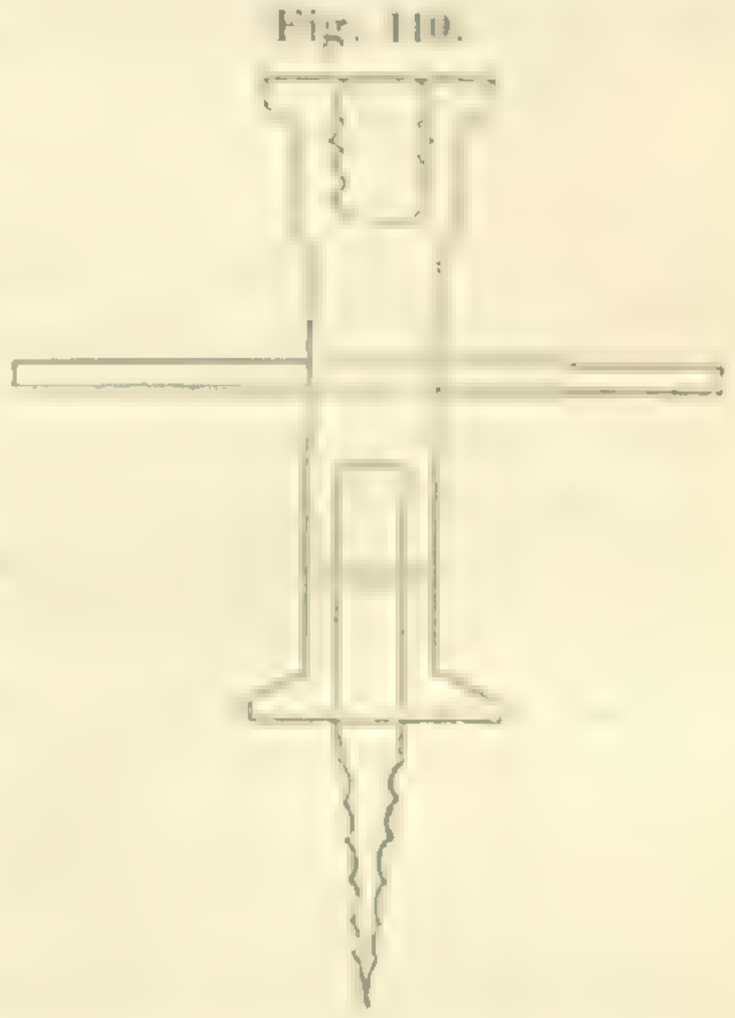


Fig. 110.

est misfortune being that it is a monocular arrangement. (D) A Telescopic Object Glass of one inch linear aperture and four inch solar focus, to be screwed, instead of the objective, into the bottom of the Draw Tube. To this Object Glass the compound body with its eye-piece and objective acts as an erecting eye-piece, and is focussed by means of its rack-movement. This combination gives a telescope of good working qualities, and of power entirely disproportioned to its size. (E) A brass Pillar (Fig. 110) about two inches long, having a steel transverse bar for a handle, and at its lower end a gimlet-screw to be fastened into a tree, post, or board. Into its upper end may be screwed the upright pillar of the Tank Microscope. The gimlet screw may be made of steel, which is somewhat durable, or a common iron screw may be used, which easily wears out but can be replaced at a nominal expense. This fixture adapts the instrument to field use, as a microscope or telescope.

This instrument should be furnished with a compressor and two objectives,—a one-inch and a two-inch, two-thirds inch, one-half inch, or four-tenths inch, according to the wants of the owner. Either of these objectives may be used as an erector, though the higher ones will seldom be preferred for this purpose. The four or five inch objective usually furnished with tank microscopes may well be dispensed with, as its effect is easily gained by means of the erecting arrangement. Microscopists who have laid aside the ordinary "erector" of the shops as an entirely unsatisfactory affair, need not, on that account, expect a similar failure in the use of a good one-inch or two-inch objective as an erector.

The cost of this instrument ought not to be large. It should not exceed sixty or seventy dollars to those already supplied with objectives and compressors, or one hundred dollars, complete.

THE following papers were also read in the Subsection of Microscopy:

Report on Photographing Histological Preparations by Sunlight.—By Dr. J. J. WOODWARD.
Remarks on a new form of Achromatic Condenser.— By Mr. E. BICKNELL.

Remarks on recent improvements in Achromatic Condensers.—By Prof. R. H. WARD.
On the use of the Microscope in Chemical Analysis.—By Prof. P. H. VANDER WEYDE.
On the observation of the Electric Induction Spark by the Micro-spectroscope.—By Prof. P. H. VANDER WEYDE.
On Oblique Microscopic Illumination, and a new simple Apparatus for the same.—By Prof. P. H. VANDER WEYDE.
On some observed changes in Vorticella.—By Mr. A. H. TUTTLE.
On a Standard of Powers for Microscopical Objectives and Eye Pieces.—By Prof. WARD.
On the Microscopic Structure of Eozoon Canadense.—By Mr. E. BICKNELL.

GENERAL OFFICERS OF THE INDIANAPOLIS MEETING.

President, Prof. ASA GRAY of Cambridge; *Vice President*, Prof. G. F. BARKER of New Haven; *Permanent Secretary*, Prof. JOSEPH LOVERING of Cambridge; *General Secretary*, F. W. PUTNAM, A.M., of Salem; *Treasurer*, WM. S. VAUX, Esq., of Philadelphia; *Standing Committee* present:—Messrs. GRAY, BARKER, LOVERING, PUTNAM, HUNT, J. L. SMITH, SWALLOW, HALL, J. E. HILGARD, WINCHELL, COX, LAPHAM.

One hundred and seven papers were entered, of which thirty-two were read in full in Section B, and eleven by title; ten were read in Subsection of Microscopy; thirty in full in Section A, and seven by title: two in the General Session; and fifteen were not entered on the daily programmes.

The first morning (Wednesday, Aug. 16) was given to organization, the work of the sections commencing in the afternoon. In the evening the retiring president, Dr. Hunt, gave his address, and resigned the chair to the president elect. Friday and Saturday were given to the excursion to the coal field of Clay county, and to Terre Haute, where the Association was most cordially welcomed. The town of Brazil also welcomed the Association on the trip to the coal field, which with several other cordial greetings, extended either to the Association as a body, or to small numbers of its members, evinced the hearty appreciation in which the objects of the Association were held by the inhabitants of Indiana. The local secretary, Prof Cox, the officers at the State House, and citizens who took a part in the reception, have left the Association in debt to them for their untiring efforts and generous welcome.

Of the Mammoth Cave and the Ancient Mounds on the Wabash, visited after the adjournment, we shall have papers in future numbers.

The invitation to hold the next meeting in San Francisco was renewed by letter from the Board of Trade and the Academy of Sciences, and was accepted provided the necessary arrangements could be made.

The invitation from Dubuque was accepted conditionally to that of San Francisco. Invitations to hold future meetings of the Association in the following cities were received: Pittsburg, St. Louis, Ann Arbor, and Leavenworth.

A Committee on the Geological Survey of Missouri, and one relating to Observations to be made at Niagara Falls, were appointed.

OFFICERS ELECTED FOR THE MEETING OF 1872.

President, Prof. J. LAWRENCE SMITH of Louisville; *Vice President*, Prof. ALEX. WINCHELL of Ann Arbor; *Permanent Secretary*, Prof. JOSEPH LOVERING of Cambridge; *General Secretary*, Prof. E. S. MORSE of Salem; *Treasurer*, WM. S. VAUX, Esq., of Philadelphia; *Auditing Committee*, Dr. H. WHEATLAND of Salem and Professor H. L. EUSTIS of Cambridge; *Standing Committee Ex Officio*, Messrs. SMITH, WINCHELL, LOVERING, MORSE, VAUX, GRAY, BARKER, PUTNAM.

Committee from the Standing Committee to arrange for next meeting: Profs. J. L. SMITH, ASA GRAY, JOSEPH LOVERING, in connection with a committee from the Association at large, consisting of Profs. J. L. SMITH, J. D. WHITNEY and O. C. MARSH.

The Association adjourned on Tuesday night, August 22d.

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EXPERIMENTS WITH VIBRATING CILIA.

BY JEFFRIES WYMAN, M.D.

The motions of vibrating cilia, and their action on the water around them, are among the most beautiful sights shown by the microscope. They are best seen on the respiratory surfaces of both land and aquatic animals, and of the last, the gills of the Mytili are especially favorable for examination. In such cases, the effects are confined to the movement of the secreted mucus, or of the surrounding water, and the particles floating in it, while in others the cilia cover the outer surface and become the chief organs of locomotion, as in the Infusoria. In the eggs of Radiates and Molluses, as in the remarkable phenomenon of the rotation of the yolk, much larger masses are moved, and among Batrachians, the yolk, soon after impregnation and segmentation, being large enough to be easily watched with the naked eye, is seen to revolve steadily under ciliary influence. Even the recently hatched larvæ of frogs and toads are carried along bodily by the same agents distributed over the whole outward surface, without the slightest aid from the muscular system. In all of these instances, however, although in some the mass moved is considerable, the motion takes place in a fluid, of nearly the same specific gravity as the objects, and so the force required to give the motion is exceedingly small. Indeed everything serves to give the impression that cilia are capable of exerting only the

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most delicate efforts. There are several ways in which their effects may be shown without the aid of the microscope, but the most common is that of sprinkling some light powder over the ciliated membrane, from which the powder is soon swept away. The object of this paper is to explain some other methods adapted to class experiments having the same end in view, but by which motion is imparted to much larger masses, and also to show that in some instances a much greater resistance can be overcome than has generally been supposed possible.

I. *Experiments in water.* — For these the gills of Unios and Anodontas are well suited. Their cilia are quite active, and vibrate in such directions, that on the inner gill the motion is *from* the free edge, and on the outer *to* it, facts which the experimenter should keep in mind. If an *inner* gill is cut away from its attachment and laid on the bottom of a flat dish, its cilia acting as legs, it will soon begin to move with its *free* edge forwards, and will in the course of time, travel the entire length of the dish. We have seen a whole gill move ten inches in four hours. Under similar circumstances the *outer* gill will move with its base or *cut* edge forwards. This difference depends, as will be readily seen, upon the fact that the cilia of the two gills vibrate in opposite directions.

The result of ten experiments gave the rate of motion of a piece of gill measuring 12mm. by 14mm., 6mm. a minute. If two outer gills are laid with their free edges towards each other they will at once begin to approach, and it frequently happens after meeting that one crawls directly over the other.

Another and more striking experiment which shows the reaction of cilia on each other may be made as follows. Fasten a gill to a piece of cork under water, and place upon it a portion of a second gill about a half inch square. If this piece is so placed that the cilia vibrate in the same direction with those of the gill below, it will remain stationary, or nearly so, since the cilia offer no resistance to each other. If now the upper piece is reversed so that the cilia vibrate in opposite directions, the upper piece will move with double the speed and through twice the distance in a given time that it would with its own cilia alone, for while the lower cilia move the upper piece through a certain space, the cilia of the upper piece also move this in addition through an equal space. A third form of this experiment consists in placing the upper piece so that its cilia vibrate at right angles to those of the

lower. In this case, while the lower cilia tend to move the upper piece from side to side, those of the upper tend to move this lengthwise of the lower. The direction which the upper piece takes, is a resultant one, viz., intermediate between the two.

II. *Experiments in air.* Though the tissues of the gills of Unios and Anodontas are quite soft and incapable of resisting other than very light weights, they will nevertheless carry small discs of paper supporting a bristle, on the top of which is a small pellet of cotton or a flag of tissue paper. In order to show the flag more distinctly, a board painted black should be nailed to the edge of the one on which the gill rests, to make a back ground. With this precaution the experiment may be seen over a large room. To mark the distance traversed, a pointer of white paper should be set up on the board supporting the gill and at the beginning of the experiment, the end of the pointer brought in contact with the end of the flag on the gill. When left to itself, the disc on the gill with its flag at once begins to move to the opposite side and the flag is seen to recede from the pointer. The distance traversed may be increased to several inches, by placing two or more gills side by side, the free edge of the first slightly overlapping the cut edge of the second, etc.

The mucous membrane from the roof of the mouth of frogs, is much more solid than the gills of Unios, and the cilia vibrate with much greater force. Different ciliated membranes exert very different degrees of force, but we have found none better suited for experiments than that just mentioned; especially, when taken from the mouth of the bull frog which gives a large surface. It has the advantage, too, of keeping up its activity for twenty-four hours or more, after being detached from its natural connections, if only kept cool and moist. For moistening it water answers sufficiently well, but the serum of the blood of the frog is still better.

The attention of the writer was first called to the possibility of moving weights much larger than was supposed possible by noticing the ease with which a piece of skin which was accidentally placed upon the ciliated membrane was swept off. By loading the piece of skin with weights the mass moved was found to be unexpectedly large.

In making experiments for the purpose just mentioned we have adopted the following method. The mucous membrane, being

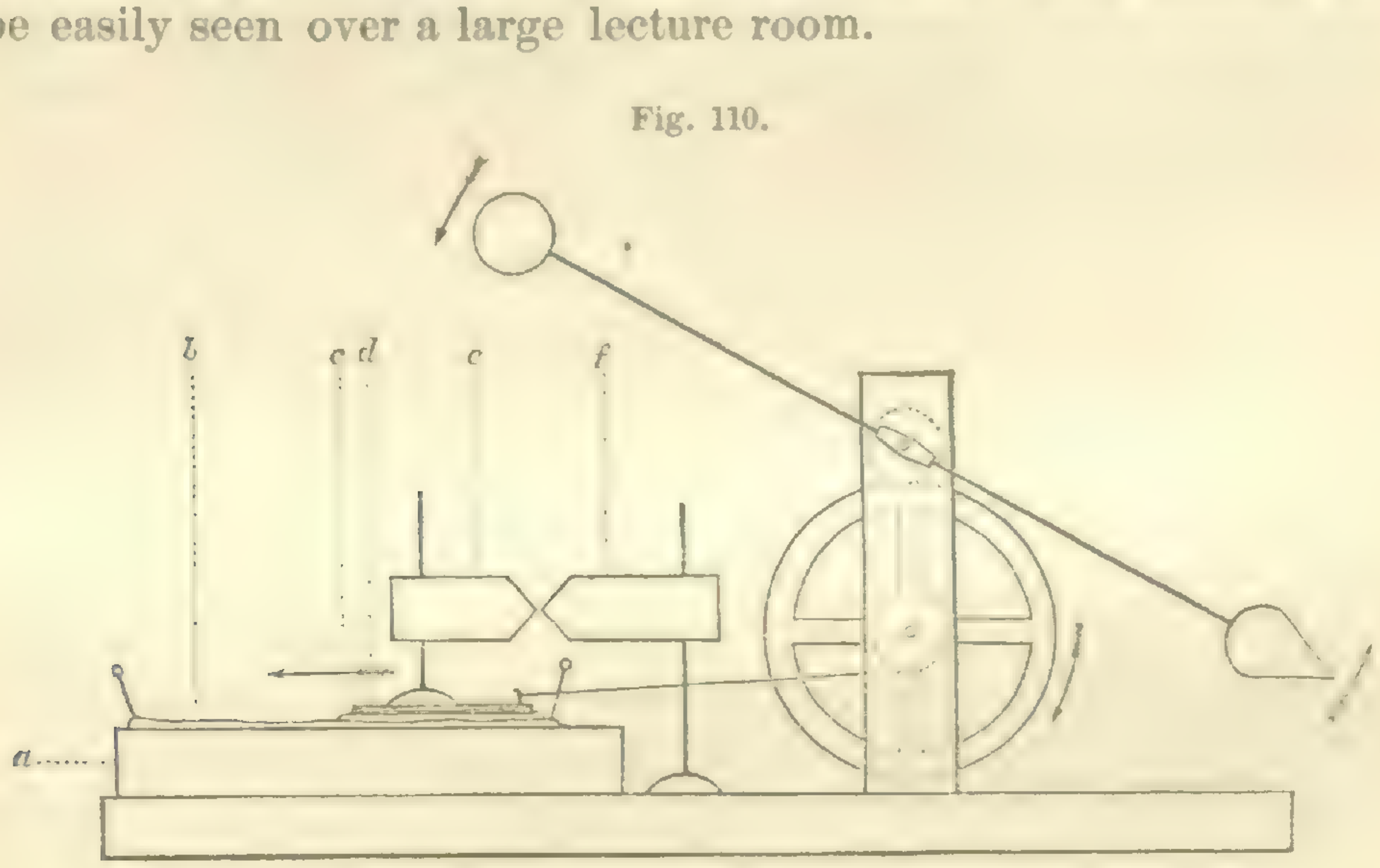
carefully dissected from the roof of the mouth, is pinned to a board. A piece of skin from near the throat of the frog, and from one-third to half an inch square, is placed upon this membrane with the inner surface in contact with the cilia, it being kept in mind that these vibrate from before backwards towards the throat. On the skin may be placed a plate of lead of somewhat smaller size. This serves as a vehicle to which weights may be added at will to increase the load, and also as a drag, to set in motion the instrument described farther on. To show the distance through which the load is carried, the flag and pointer may be used as in the case of the gills before described. Pains should be taken to have the board on which the experiment is made perfectly horizontal, otherwise a sliding motion, especially when heavy weights are used, may come in to vitiate the experiment.

Although the results are not uniform, the following will give some idea of the force exerted, as shown by the time in which and the distance through which the weight was carried. The mean of four experiments shows that a weight of 1.300 grams was carried 15mm. in 61.2 seconds, or about 4mm. per second, the weight resting on a surface 12mm. square. A weight of thirty-three grams resting on the same amount of surface, a mean of four experiments gave a distance of 6.6mm. per minute. We have seen forty-eight grams resting on a surface 14mm. square, moved, though very slowly, across the whole length of the membrane, but the exact time was not noted. Dr. H. P. Bowditch has repeated these experiments in the laboratory of Ludwig at Leipsic with even heavier loads.

Finding that so much force was exerted, the idea of utilizing it was naturally suggested, and after various trials the following instrument was devised for this purpose, in which the direct motion produced by the cilia was made to give rise to a rotary one. The instrument consists of two light toothed wheels (see figure), the larger 30mm. and the smaller 5mm. in diameter. To the axis of the first is attached a small drum 5mm. in diameter, around which is coiled a thread of the finest and most flexible cotton. The axis of the smaller wheel is prolonged through the frame in which both wheels move, and carries on its end an index made of two bristles inserted into a central piece of cork, which is attached to the axis. On the end of each bristle is a very light paper pointer. The whole length of the index is 110mm. but may be made longer

or shorter than this, as may be convenient to the experimenter. Behind the instrument there should be a small black board attached to the base on which the frame rests, to serve as a background against which the pointers are seen. The instrument is of sufficient delicacy to be moved by a weight of from one hundred to one hundred and twenty milligrams or of from seven to eight grains. All that is necessary to make an experiment is to attach the end of the thread coiled around the drum to the hook on the lead which rests on the piece of skin, which in turn rests on the membrane. The proportions of the wheels are such, that when the load resting on the membrane is carried through a space of 7mm. the index makes two whole revolutions, and the point of the index moves through a space of about two feet. One complete revolution is effected in about thirty seconds. This motion may be easily seen over a large lecture room.

Fig. 110.



Description of the diagram. *a.* A movable block of wood to which the ciliated membrane is pinned. *b.* Ciliated membrane. *c.* Piece of skin resting upon it. *d.* Plate of lead with a small hook to which the thread coiled around the drum is attached. *e.* and *f.* Pointers, one resting on the lead and the other on the board to which the instrument is fastened; these are made of wire inserted into a base of wood or cork, and carry each a piece of paper or thin card; both are movable. The wheels are toothed. Attached to the axis of the large wheel is the drum, and to the projecting portion of the axis of the small wheel is the index.

This figure is one-half the size of the instrument. The base on

which the instrument rests, should be made longer than in the figure so that the block to which the membrane is attached may be farther off from the wheels.

THE GRASSES.

BY W. W. BAILEY.

The earliest, as well as the latest sign of vegetable life is, perhaps, afforded by the grasses, whose green blades form the sward which we all so much admire. Did it ever occur to all our readers that these humble plants which form our out-door carpet or which are cultivated for forage, have flowers, often as beautiful in their way as any of their proud associates? All are aware that the tasselled heads and silky plumes of the Indian-corn are beautiful, and gaze with delight upon a sea of grain when rippled by the gentler breezes or thrown into billows by the more wrathful. When another season shall present the opportunity, let those who are beginning timidly to woo Dame Nature, examine more closely the beauty which the grasses offer, and we think that they will thank us for the advice. To study them understandingly, it will be necessary to be provided with an ordinary field microscope of one or two lenses, and if in addition, the observer happens to possess a compound instrument for the examination of the minuter parts, he will find it very serviceable.

A few words as to the structure of grasses, and the points in which they differ from other plants may be of interest, and while speaking of them, we will add a word about the sedge family,—their very next of kin. Both of these natural orders are so large, and the species so varied, that the study of them has become a specialty, and many men devote their whole lives to arranging and simplifying our knowledge of the classes, learning their habits, and ascertaining how the useful species may be made more serviceable and the valueless eradicated. Although we are not one of these specialists, we will try to give a familiar, and at the same time an accurate account of the structure of both grasses and sedges, referring, when in doubt, to those whose word is law.

The sedge family comes first in order, and includes the sedges proper, the bulrushes, cotton-grasses, and many other more or less familiar plants, all resembling the grasses, yet differing from them in essential particulars. The greater part of them have solid stems, called culms, around which the leaves form a closed sheath. The flowers are in spikes, have no calyx or corolla, and possess three stamens. The stem leaves, when present, are three-ranked, and the stems sharply angled. The fruit is one-seeded and forms what is technically known as an achene. The small beaked nutlets heaped up in the centre of a buttercup, will give an idea of an achene as it occurs in a totally different order of plants. Sedges may be regarded as weeds in every sense of the term, and their prevalence is an indication of swampy and poor ground. Unlike grasses, they are quite devoid of nutritious properties as a rule, and are shunned by animals when any thing else is obtainable. Independent of their occasional use in the manufacture of baskets, they have scarcely any economic value. The papyrus of the Nile, from which paper and boats were made, is a somewhat famous exception to their general uselessness. Unfit though they may be to minister in any way to the benefit of man, they are yet, in their infinite variety and exceeding grace, most charming to any one whose attention has been once directed to them.

Let us now pass to the grasses. Bearing in mind the several points of the above description, let us see how these differ from their near relations. Put them side by side and compare them. It will be seen that the grasses, unlike the sedges, have hollow stems swollen and closed at the joints, with two-ranked leaves, having many fine veins running parallel to the central vein or mid-rib, and split sheaths, the tops of which are prolonged into an appendage known as a "ligule," from a Latin word signifying a shoe-strap. The flowers are arranged in spikes as in the timothy (Phleum), or in panicles as in the bent grass (Agrostis). These spikes and panicles differ greatly as to their concentration or diffusion, and the flowers themselves as to their appendages. Some are armed with long awns or bristles as in the barley and oats—and we wish here to testify that these are about as awkward things to swallow as in our juvenile days we ever tried. The stamens are usually three, with anthers or pollen cases attached only by one point, and therefore swinging freely. The styles are mostly two, with feathery stigmas which form charming micros-

copic objects. In common with sedges, the grasses have fibrous roots. To describe the flowers, without the use of actual specimens or drawings, is a difficult matter. Let the following quotation supplement the above remarks:

"A few rudimentary leaves collected at the ends of the branches of inflorescence and constituting flowers, a very small number of stamens inclosed in a thin pericarp [skin or walls of the fruit], are all that nature provides to enable these plants to preserve their race and to distinguish their numerous kinds from one another. Yet with such a simple apparatus, many thousand species are so precisely characterized, that the natural order of grasses is perhaps one of the easiest to study and arrange, provided the task be commenced upon right principles."

There is, despite the above statement, scarcely an order more dreaded by the young student. It is a good test of his love for science and severe application, if he persistently investigates it. It contains three thousand or more species generally diffused over the earth.

With us, the plants are usually small and grow close together, forming a mat, though even here there is much diversity in the habit of growth, the Aira or hair-grass, for instance, forming isolated clumps. In the tropics the plants are often much larger —the bamboo sometimes attaining a length of ninety feet—and there is little or no tendency to form a sward.

It is useless to speak of the value of the grass family to man. It is enough to say that it produces all the cereal grains, most of the forage plants, the valued sugar-cane, and the bamboo, applied by the natives of the East to such a multiplicity of purposes, that we are led to wonder if they could survive without it. Man by observing processes of nature, has in some cases usefully applied certain species of grass to prevent the encroachments of the sea, the fibrous and interlacing roots serving admirably to bind the shifting sands. No injurious properties are known positively to appertain to the order, except in the case of the darnel (*Lolium temulentum*), the fruit of which is acknowledged to be pernicious.

Of our common grasses there are many that are beautiful, none more so to our thinking than the wild rice (Zizania), which we have often admired on our northern rivers as it nodded over the passing row-boat. The flowers are larger than usual in this genus, and are elegantly marked with light bands of red. It is curious how

many fanciful resemblances one sees in plants. We were lately quite provoked to find that Winthrop, with whom we certainly never had conversed, had hit upon an idea which we esteemed peculiarly our own. It was the comparison of the heads of timothy to cannon sponges. Many other curious similitudes have been observed, nor has man in his architectural and ornamental workmanship, begun to avail himself of one quarter of the lovely models at all times displayed before him.

If one makes a bouquet consisting alone of grasses, he will soon perceive how beautiful they really are. The panics and herd's grasses are especially lovely, both in the fields, which some of them tinge with their ruddy smoke, and in the vase at home, where their ethereal delicacy can be more closely noted.

The grasses are so numerous that it is impossible to refer even briefly to one quarter of them. We can only give our advice to "go and look them up."

CONTRIBUTIONS TO THE NATURAL HISTORY OF THE VALLEY OF QUITO.—No. I.

BY PROFESSOR JAMES ORTON.

The Geographical Distribution of organized beings is one of the unfinished chapters of natural history. Much has been done within the last twenty years in defining zoological and phytological provinces: but we are still very far from knowing the precise range of species. This has arisen partly from the failure of collectors to give exact localities, and partly from the ignorance of home naturalists, who often confound places hundreds of miles distant. The vast collections of Fraser, *e. g.*, are of little use in determining distribution, as in many cases the indefinite habitat, "Andes of Ecuador," is given, which may mean the Pacific slope, the headwaters of the Amazon, or the Quito Valley—three regions quite distinct in physical aspect.* On the other hand, those who determined his specimens have in some cases located them indiscrimi-

*The term *Andes* strictly belongs to the Eastern range, and *Cordillera* to the western; but this distinction is not always observed.

nately on either side of the Andes, from an ignorance of the geography of the country. Our generalizations lose half their value from this want of care and precision. "Could we only know the range of a single animal as accurately as Alphonse De Candolle has lately determined that of many species of plants, we might begin a new era in Zoology. It is greatly to be regretted that in most works, containing the scientific results of explorations of distant countries, only new species are described, when the enumeration of those already known might have added invaluable information respecting their Geographical Distribution."*

The importance of every fact relating to the natural limits of animals and plants is felt in its bearing on the great question of the day — the origin of species. Whether "all the grand leading facts of geographical distribution are explicable on the theory of migration, together with subsequent modification and the multiplication of new forms,"† cannot be safely answered until we have more precise as well as more extensive knowledge of habitats. We should know more thoroughly the conditions which favor migration, as also the effect of barriers in preventing the spread of species, and "the narrowest limits within which animals of different types may be circumscribed."

The following contributions are based mainly on the writer's personal observations. So far as we know, no attempt has been made to form a synopsis of the life in the region described; and it is hoped that this list may serve as the foundation of a more perfect work. The Valley of Quito is selected because it is a remarkably well-defined district, having a uniform temperate climate. It is nearly three hundred and fifty miles in length, stretching from 1° N. to 4° S., and has an average width of forty miles, being walled in by the grandest group of volcanic mountains in the world. These barriers have an average elevation of 12,000 feet above the sea, and are broken at few points, chiefly by the narrow gorges of the Santiago and Pastassa, and the sources of the Mira and Esmeraldos. The valley is subdivided by ridges into three basins —Quito, Ambato and Cuenca, having the respective altitudes of 9500, 8000 and 7500 feet, and mean temperature of 59°, 61° and 62°. At Quito the thermometric range in twenty-four hours is

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* Agassiz, *Essay on Classification*, p. 35.
† Darwin, *Origin of Species*, p. 355.

about 10°; and the extremes in a year are 45° and 70°. The mean annual fall of rain is 70 inches.

The region belongs to Selater's "Neotropical"; more particularly, it is the northern part of Schmarda's subdivision—"the country of llamas and condors." When we have full returns, it will be interesting to compare life in the Quito Valley with the nature and relative proportion of inhabitants in oceanic islands. Darwin has pointed out the important lessons which may be learned from the natural history of the latter; and the study of isolated mountain districts is of nearly equal value. It is certainly of interest to ascertain whether the organic productions of the Andean Valley, like the endemic forms of the Galapagos Is., have a special adaptability for migration. The proportion of species to genera in islands is smaller than in continents; how in this respect does Quito compare with Amazonia? The vertebrates of South America are remarkably restricted in their range: does this show that the continent has been lately split up into isolated districts?

MAMMALS.

Nearly all the quadrupeds seen in the Valley have been introduced from Europe, as the horse, ass (mule), ox,* goat, sheep (two, four and six-horned), hog, dog and cat. The horse, ox and dog flourish at the highest inhabited altitude, or 13,300 feet. Quito cats are no mousers; dogs are far superior. Six orders are represented by the indigenous forms: but the following list of species is very incomplete. Years of observation in every part of the valley, from Ibarra to Loja, and up to the snow-line are necessary to finish the work. The largest mammal is the llama, always domesticated. The equine and ovine races are fast superseding it. It is usually of a dark brown color; but one of pure white is occasionally seen. The llama is not taken, we believe, as high up as the Hacienda of Antisana. A deer (*Coassus rufus* F. Cuv.?) occurs particularly about Lake Sn. Pablo at the foot of Imbabura. The *Tapirus Roulini* Fisch., possibly visits the vicinity of Loja; but its proper place is on the eastern slope. Of carnivores, the only certified examples are the puma which fol-

*The prevailing colors of the cattle are white and liver-color. "I have often observed (writes an old English resident), that the cattle in general are much lighter-colored than in England: even black has a blue cast. I have never seen one that would be called jet black." The majority of dogs are white or light brown curs.

lows the deer into the valley, a large brown weasel with a light colored belly, and the skunk, *Thiosmus mesoleuca* Licht. (var. *Quitensis* Humb.?) called by the natives "zoro" or Indian fox. The last is of a grayish color with black longitudinal bars. "All the South American *Canidæ* belong to the dogs" says Murray; but on the slope of Chimborazo we caught sight of an animal which had a very close resemblance to a true fox. The small black bear of the Cordilleras is not known to enter the valley. It does not exceed one hundred and sixty pounds in weight. Bats are not numerous, but there are doubtless several species. The only one we have examined appears to be a *Nyctiecjus*. The *Cavia cobaya* Schr. (domesticated) is wonderfully prolific. The "cuye del monte" of the natives is confined, we believe, to the warm western slope. It is four times as large as the common guinea-pig, and covered with a thin coat of long hair, mingled brown and black. We observed a hare, perhaps the *Lepus Brasiliensis* Linn., the only one determined from South America. The squirrels, which are not uncommon, are probably distinct from the *Sciurus æstuans* of Brazil. Compared with their number in other regions, mice (*Hesperomyinæ*) may be considered rare: their scarcity may be due to the multiplication of the guinea-pigs. Of opossums we obtained two species; *Didelphys Azaræ* Tem., and *D. philander* Linn.?

The palæontology of the valley of Quito has not been fully developed; but enough is known to excite deep interest in the ancient life on the top of the Andes. At Alangasi, near Quito, a large mastodon tooth was found many years ago; but the most extensive mammiferous deposit is at Punin, seven miles southwest of Riobamba. The bones are imbedded in an unstratified cliff, four hundred feet high, of very compact silt or trachytic clay. They were evidently drifted to the spot and deposited (many of them in a broken state, and none in their proper relative positions) in horizontal layers along with recent shells. In 1867, the writer took out a large collection * which included vertebræ, patellæ and femur (solid!) of mastodons, adult and young; vertebræ, leg bones and upper and lower jaws of two horses, one of ordinary size, the other about as large as the ass; vertebræ, leg bones and ischium of a llama or some auchenia; metatarsal like and large

* Now in the Museum of Yale College. A collection, strikingly similar excepting the mastodon, has been recently found at Table Mountain, Tuolumne Co., California.

as those of the camel: leg bones, jaw and teeth of a deer; remains of an unknown ruminant; and a small, hollow bone resembling the tibia of a bird. We are surprised at the absence of hollow-horned Ruminants, Rodents and Edentates which abounded in the Pleistocene of the Atlantic side. "Undoubtedly [says Darwin], the climate of the Cordilleras must have been different when the mastodon inhabited it." We think, however, the great pachyderm would have had little difficulty in thriving at the present day at Quito, on the score of temperature or altitude. But the vegetation is hardly sufficient.

BIRDS.

The avi-fauna is better known; and the following catalogue is believed to be nearly complete. It does not include all the stragglers; and other residents may be added from Loja which has not been thoroughly explored. Introduced species, as geese and poultry, are of course omitted. Those marked (*) were not obtained by the writer but are added on good authority; such as are considered restricted to the valley are indicated by a dagger (†). The further known range of the migratory ones is also added.

Turdidæ:
- Turdus gigas Fras.—New Granada.
- * " chiguanco Lafr.—Peru.
- " Swainsoni Cab.—From Greenland to Peru.

Hydrobatidæ:
- Cinclus leuconotus Scl.—New Grenada.

Troglodytidæ:
- †* Thryothorus euophrys Scl.
- †* " mysticalis Scl.
- Troglodytes solstitialis Sch.—Pacific slope?
- † Cistothorus æquatorialis Lawr.
- † Cinnicerthia unibrunnea Lafr.
- " canifrons Lafr.—New Granada.

Pteroptochidæ:
- Triptorhinus orthonyx Lafr.—New Granada.

Mniotiltidæ:
- Mniotilta varia Linn.—United States to Peru.
- Basileuterus nigricapillus Lafr.—Bolivia.
- " coronatus Tsch.—Peru.
- Setophaga ruficoronata Kaup.—New Granada.
- Dendroica Blackburniæ Gm.—United States to Peru.

Hirundinidæ:
- †* Petrochelidon murina Cass.
- " cyanoleuca Vieill.—Bolivia, Chili, Brazil, Paraguay.

Coerebidæ:
- Diglossa aterrima Lafr.—New Granada.
- " humeralis Fras.—New Granada.
- " Lafresnayi Boiss.—New Granada.
- " personata Fras.—New Granada. Peru.
- " similis Lafr.—New Granada.
- Dacnis pulcherrima Scl.—New Granada.
- †* Oreomanes Fraseri Scl.
- † Conirostrum Fraseri Scl.

Tanagridæ:
- Tanagra Darwini Bp.—Peru.
- Pyranga æstiva Gm.—Canada to equator.
- Calliste atricapilla Lafr.—New Granada. Venezuela.
- Dubusia tæniata Boiss.—New Granada.
- Iridornis dubusia Bp.—New Granada.
- Psittospiza Riefferi Boiss.—New Granada. Peru.
- Buarremon assimilis Boiss.—New Granada.
- " latinuchus Du Bus.—Peru.
- * " pallidinuchus Boiss.—New Granada.
- * " schistaceus Boiss.—New Granada.
- " leucopterus Jard.—Nanegal.
- Buthraupis Edwardsii Ell.—New Granada.
- " cucullata Jard.—New Granada.
- † " chloronota Scl.
- Chlosospingus atripileus Lafr.—New Granada.
- " superciliaris Lafr.—New Granada.
- " canigularis Lafr.—New Granada.
- Chlorochrysa calliparaea Tsch.—New Granada, Peru.
- † Compsocoma cyanoptera Cab.
- " notabilis Jard.
- †* " sumptuosa Less.—Peru, Venezuela.
- " victorini Lafr.—New Granada.
- Diva vassori Boiss.—New Granada.
- Euphonia nigricollis Vieill.—New Granada. Venezuela, Brazil.
- † Pœcilothraupis atricrissa Cab.
- * " lunulata Du Bus.—New Granada, Peru.

Fringillidæ:
- Catamblyrhynchus diadema Lafr.—New Granada.
- †* Catamenia avaloides Lafr.
- " homochroa Scl.
- * Chrysomitris icterica Licht.
- " Magellanicus Vieill.—United States? South America.

* Pheuticus aureiventris Lafr.
† " chrysogaster Less.
* Phrygilus alaudinus Kitt.
* " ocularis Scl.
* " unicolor Lafr. et D'Orb.—Bolivia, Chili.

Sycalis arvensis Kitt.—Chili.
Zonotrichia pileata Bodd.

Icteridæ:
* Cassiculus leucorhamphus Bp.—New Granada.

* Sturnella bellicosa De Fil.

Corvidæ:
Cyanocitta turcosa Bp.—New Granada.

Dendrocolaptidæ:
* Synallaxis Antisiensis Scl.
" elegantior Scl.—New Granada.
† " flammulata Jard.
†* Cinclodes albidiventris Scl.
†* " excelsior Scl.
Margarornis squamiger Lafr.—Bolivia.
† Ochetorhynchus excelsior Scl.
Picolaptes lacrymiger Lafr.—New Granada.
Pseudocolaptes Boissoneautii Lafr.—New Granada, Peru.

Formicariidæ:
Grallaria hypoleuca Scl.—New Granada.
" monticola Lafr.—New Granada.
* " Quitensis Less.
" ruficapilla Lafr.—New Granada.
" squamigera Prev.—New Granada.

Tyrannidæ:
†* Agriornis audicola Scl.
† " solitaria Scl.
* Elainia griseogularis Scl.—New Granada, Chili.

†Mecocerculus amoenus Scl.
* " stictoptera Scl.—New Granada.

* Muscisaxicola albifrons Tsch.—Peru.
" cinerea Phil.—Chili.
* " maculirostris Lafr.—Bolivia and Chili.

†Myiarchus nigriceps Scl.
* Myiobius cinnamoneus Lafr.—New Granada, Bolivia.

†Myiothesetes erythropygius Scl.
Myiozeta Guiavensis Cab.—New Granada.
Octhoeca fumicolor Scl.—New Granada.
" fumigata Boiss.—New Granada.
" Lessoni Scl.—New Granada.
† " rufimarginata Lawr.
Pyrocephalus manus Gould.—Puna Is., Galapagos Is.
* Sayornis cineracea Lafr.—Venezuela.
Serpophaga cinerea Str.—New Granada, Brazil.
* " parula Kitt.—Bolivia, Chile, Patagonia.

Cotingidæ:
Ampelion arcuatus Lafr.—New Granada.
" rubrocristata L. et D'O.—New Granada, Bolivia.
Cotinga cincta Bodd.—Guiana, Brazil.
Pipreola melanolunia Scl.—Venezuela.
" Riefferi Boiss.—New Granada.
* Tityra dorsalis Scl.—New Granada.

Alcedinidæ:
Ceryle torquata Linn.—Peru, Bolivia, Brazil, Arg. Republic.

Galbulidæ:
* Galbula chalcothorax Scl.—Napo?
* " castanopectus?—Brazil.

Trogonidæ:
Trogon Antisianus D'Orb,—Napo? New Granada.
* " personatus Gould—New Granada, Brazil.

Caprimulgidæ:
Antrostomus nigrescens Cab.—New Granada, Guiana.

Cypselidæ:
Chætura rutila Vieill.—New Granada, Guatemala, Trinidad.

Trochilidæ:
† Oreotrochilus Chimborazo Bourc.
† " Pichincha Bourc.
* Campylopterus æquatorialis Gould.—Maranon.
Colibri iolatus Gould.—Peru, Bolivia.
Myrtis Fanny Less.—Peru.
Lafresnaya Gayi Bourc.—Peru.
Docimaster ensiferus Boiss.—New Granada.
" Schliephackei Cab.—Nanegal.
Helianthea Lutetiæ Delatt.—New Granada.
Pterophanes Temmincki Boiss.—New Granada.
Aglaeactis cupripennis Bourc.—New Granada.
Panoplites flavescens Lodd.—New Granada, Napo.
† Rhamphomicron Herrani Delatt.
" Stanleyi Bourc.
† " microrhynchus Boiss.—New Granada, Upper Amazon.
† Adelomyia maculata Gould.
Metallura tyrianthina Lodd.—New Granada, Puna Is.
Lesbia amaryllis Bourc.—New Granada, Peru, Puna Is.
† " gracilis Gould.
† " Ortoni Lawr.
Acestrura Heliodori Bourc.—New Granada.
" Mulsanti Bourc.—New Granada.
Chlorostilbon chrysogaster Bourc.—New Granada, Pacific slope.
Patagona gigas Vieill.—Peru, Bolivia, Chile.

† Eriocnemis Luciani Bourc.
† " nigrivestis Bourc.
† " squamata Gould.

Cuculidæ:
Coccygus melanocoryphus Vieill.—Upper Amazon, Guiana, Paraguay.

Capitonidæ:
* Capito Bourcieri Lafr.—New Granada.
" Hartlaubi Lafr.—New Granada.
† Tetragonops ramphastinus Jard.

Picidæ:
Colaptes elegans Fras.—New Granada.

Strigidæ:
Strix punctatissima Gray.—Galapagos Is.
* Bubo crassirostris P. et L.—Chile.
Glaucidium infuscata Tem.—Brazil, Guatemala?
* Speotyto cunicularia Mol.—Brazil, Peru, Chile.
Syrnium albogulare Cass.—New Granada, Mexico.

Falconidæ:
† Milvago carunculatus Des Murs.
Polyborus Audubonii Cass.—Texas to Magellan Sts.
Craxirex unicinctus Tem.—Southern U. S. to Arg. Repub.
Geranoaetus melanoleucus Vieill.—The Andes.
Hypotriorchis columbarius Linn.—New Granada, North America.
Tinnunculus sparverius Linn.—Brazil, Guiana, North America.
Accipiter erythrocemius Gray.—Bolivia, Brazil.
† " nigroplumbeus Lawr.
Circus cinereus Vieill.

Vulturidæ:
Sarcoramphus gryphus Linn. † —Andes.
* Catharista atrata Bartr.—Tropical America, Chili.

† Unless we are much mistaken, there is another species of *Sarcoramphus* on the Andes a yet undescribed. See *Proc. Am. Assoc. Sci.* 1870, p. 194.

Columbidæ:
* Chamæpelia gravativa Bp. — New Granada.
*** Chloroenas albilinea Bp.— New Granada, Costa Rica.**
*** Columbula cruziana Lafr.**
† Zenaida hypoleuca Bp.
Penelopidæ:
* Ortalida Montagnii Bp.
* Crax globulosa Spix? — Upper Amazon.
Chamæpetes Goudotii Less. — New Granada.

Tinamidæ:
* Rhynchotus perdix Mol.
Charadriidæ:
Vanellus resplendens Tsch. — Peru.
Chionididæ:
†* Attagis Chimborazensis Scl.

Scolopacidæ:
Tringa maculata Vieill. — North America.
*** Tringoides macularius Linn. — N. A., Europe.**
*** Gambetta melanoleuca Gm. — U. S., Central America.**
" flavipes Bp.— North America.
Totanus solitarius Aud. — North America.
Gallinago nobilis Scl.
Ardeidæ:
Nycticorax Gardeni Baird. — U. S. to Peru.
Rallidæ:
Rallus Virginianus Linn.— North America.
* Fulica Chilensis Des Mur. — Peru, Bolivia.
Anatidæ:
* Querquedula discors Linn. — United States.
*** Anas moschata Linn. — Brazil.**
Colymbidæ:
Podiceps occipitalis Less.— Chili, Magellan Sts.

This list gives one hundred and eighty-four species, of which thirty-eight are believed to be confined to the Valley.* The Insessores number one hundred and sixty-nine, humming, tanagers and fly-catchers predominating. The one hundred and eighty-four species represent one hundred and twenty-five genera: Southern New England (Mass., Conn. and R. I.) with the same area contains two hundred and forty-two species in one hundred and sixty-three genera: Ceylon, nearly twice as large as the Valley, has over three hundred and twenty species in two hundred genera. The relative proportion is not very different. The majority of the Quito birds have a northern stamp. About eighty species range north of Quito, chiefly in New Granada: of these, twenty-one are found in North America. About twenty-five species range south into Peru, Bolivia and Chile: while very few indeed are found on the Pacific or Brazilian slope. This accords with that "rule of high generality" that the inhabitants of an area are much more nearly related to those of the nearest source whence immigrants might have come. The birds of the Quito Valley have a more **extensive latitudinal than horizontal range.**

As a general rule the highland species are larger than the same residing in the lower altitudes. Thus, *Buthraupis cucullata*, *Ancistrura Mulsanti* and *Metallura tyrianthina* of Quito are much larger than those of Bogota. So the *Patagona gigas* is larger in Ecuador than in Chile; and the *Chætura rutila* of Quito eclipses the same species in Guatemala. The *Euphonia nigricollis* of Brazil, however, seems to be larger than that of the Andes. The

*Many specimens are reported from Quito which in fact come from Nanegal or the Napo region. Thus, *Andigena laminirostris*, *Bourcieria fulgidiguia* and *Peristera mejanoptera* are from the west side, and *Tanagra cœlestis* from the east. It is doubtful if either species of *Docimaster* enters far into the Valley. The Trogons and Jacamars are also accidental.

birds of the high Valley are essentially aerial; they show a greater development of wings over legs; climbers, scratchers, runners, waders and swimmers are few. There is less brilliant plumage than in lower, warmer altitudes. Green and brown are the prevailing colors. Even the hummers are surpassed by those on the Pacific slope, in the Valley of the Magdalena and along the coast to Rio. All of the Trochilidæ belong to the group Polytminæ; the "Hermit" hummers keep to the dense forests. Leaving out the *Docimaster* (which properly belong to Nanegal on the west slope), the average length of the bills of Quitonian hummers is three-fourths of an inch. Their nests are covered with moss; never with lichens. The finches nidify in October; the condors in February; the hummers in April.

THE GENUS HYSTERIUM AND SOME OF ITS ALLIES.

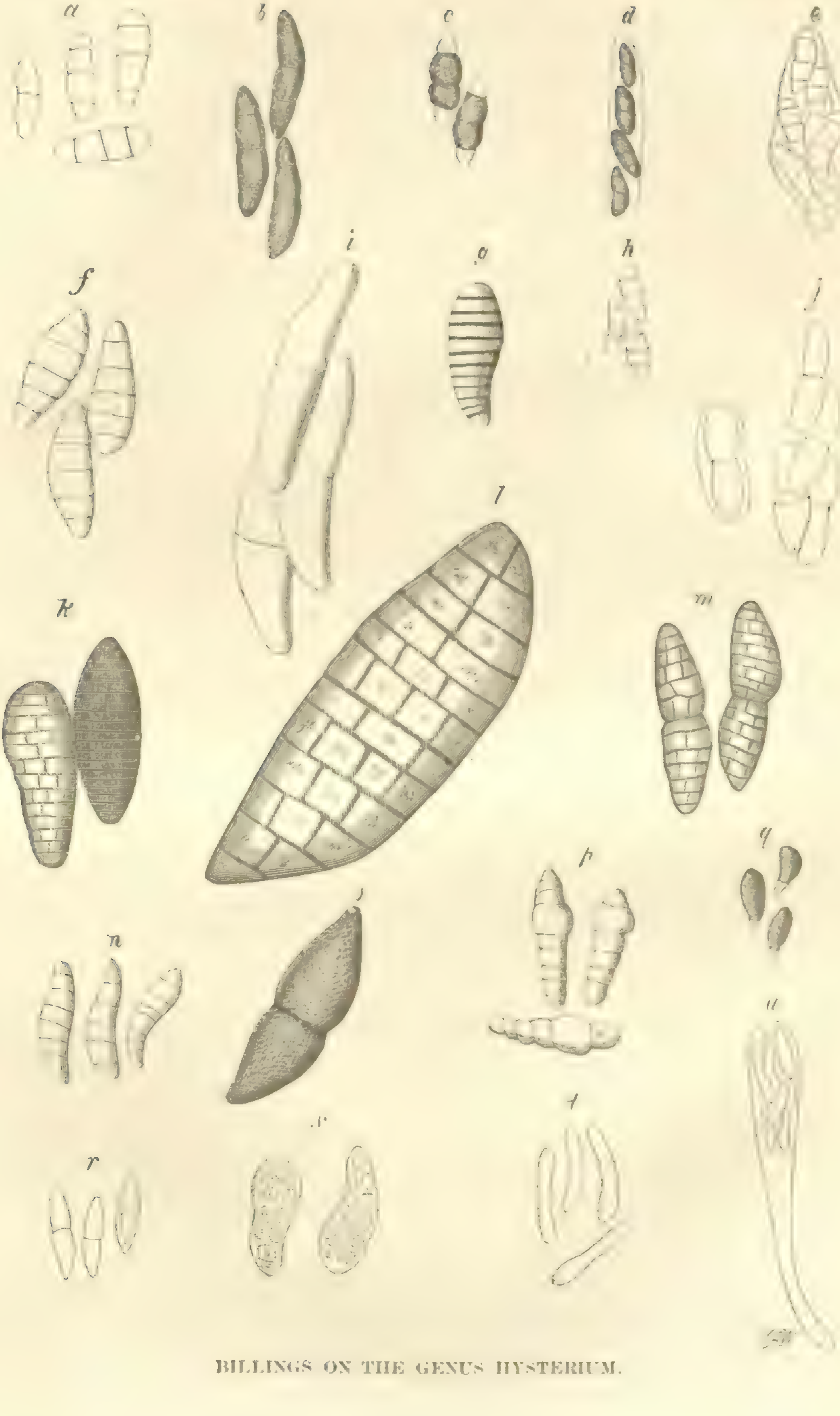
BY DR. J. S. BILLINGS, U.S.A.

My purpose in the following paper is to enable those who are commencing the study of mycology, but who have not access to authentic specimens and to the greatly scattered and often contradictory literature of the subject, to identify the common species of the genus Hysterium and its closely allied forms. My data for this purpose are derived from the examination of authentic specimens in the Schweinitz Herbarium, and in the herbarium of Mr. H. W. Ravenel of South Carolina; from specimens named by Rev. M. A. Curtis, and from the description and figures given by M. Duby in his "Mèmoire sur la Tribu des Hystèrinèes," Geneva, 1861.

The genus Hysterium is one of the Ascomycetous forms of fungi characterized by the peculiar shape and mode of opening of its conceptacle or perithecium,* which is either elliptical or longitudinal, opening by a slit or fissure running in the direction of its greatest length.

The species are found upon dead wood, bark, leaves and stems

*For explanation, with figures, of the parts of fungi, see NATURALIST, vol. iv. p. 667-674.


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in the shape of black specks or crusts which, under a lens, will be seen to be small, boat-shaped bodies with a vulvæform fissure looking like minute grains of black wheat. When developed in or on wood, their structure is usually carbonaceous and brittle. When developed beneath the epidermis of leaves or herbaceous stems, the perithecium is usually thin and membranaceous, and more or less connate with the surrounding structures.

The difference in fruit is also well-marked and hence these latter forms will be referred to the genus Hypoderma.

For the identification of the species of this genus in the present state of our knowledge, we must rely mainly upon the size, shape, structure and color of the spores, and hence a few words are necessary with regard to the morphology of the spore. Spores vary according to age and some other circumstances in all the points upon which we rely. Thus the same spore at different periods may be colorless or very dark colored, uniseptate or multiseptate, fusiform or obovate, and from .0005 to .002 of an inch in length.

The limits of this variability are not precisely known, but the student may be guided somewhat by the fact that the development of spores and asci is not everywhere simultaneous in the same perithecium. When in any ascomycete we find the perithecium fully developed, and all the spores apparently equally mature—for instance, all yellow brown, triseptate and varying not greatly in form and size,—we are justified, I think, in concluding that these spores are mature.

If, on the other hand, we find that some of the asci do not contain spores, but merely the mass of greenish colored protoplasm which by segmentation will ultimately form them, while other asci contain greenish spores the contents of which are divided into two or four parts—and in none do we find colored or clearly septate spores—we may consider the specimen as immature.

The peculiar greenish hue of the spore, to which I have alluded, seems to indicate that it is an immature state of a yellow or brown spore, while a white, perfectly colorless or hyaline spore may be in itself a perfect form. In the examination of specimens which have been for some time in an herbarium, we should expect to find the spores mostly mature, as in the first place it is to be presumed that only the more perfect specimens would be thus preserved, and secondly, the perfecting and ripening of immature spores will go on, even in the herbarium, to some extent.

Again it must be remembered that the classification of the genus Hysterium must be as yet provisionary, not being based at all upon the only real test of a true species, *viz.*, the propagation of its kind. But before we can attempt the true physiological classification of such forms, we must have some sort of division of them that we may know what we are talking about. In this point of view it is evident that we want to name as many forms as possible to avoid confusion, and that two different forms should not receive the same name unless the observer is very certain as to their identity. To explain my meaning more fully I will take the case of one of the commonest forms among the Ascomycetes, *viz.*, *Hysterium pulicare* Pers. The description of this species, as given by Persoon, Fries and the older mycologists, is entirely insufficient to enable us to identify it, and we must have recourse to authentic specimens to know positively which form the older authors placed under this head. The spores shown in fig. *a* of plate 11 were drawn from a specimen in the Schweinitz herbarium received from Fries as a type specimen. Another specimen from Fries, marked *B. lenticulare* has the same kind of spores. A specimen from the *Scleromycetes Suecia* in Mr. Ravenel's herbarium has somewhat larger spores which are obovate, triseptate and very dark brown. Duby states as the result of the examination of authentic specimens that the spores of *H. pulicare* are oblong, two or three times longer than wide, triseptate, clear brown, or with the terminal loculi colorless. When young the spores are 1-septate and hyaline.

Corda figures the spores in like manner. On the other hand, I find in one specimen named by Kunze, and in specimens named by Berkeley, Curtis and Ravenel, that the spores are much larger, darker, more opake, with longitudinal septa and obovate or pyriform, in short, like the fruit of *H. elongatum*. (Pl. 11, fig. *k*). The authors last named consider the above as belonging to *H. pulicare* for the reason that in one perithecium, resembling those of that species, they find spores varying from the short, colorless, uniseptate form, to those described above. It is of course possible, and perhaps not improbable, that the large cellular spores are the fully developed fruit, but on the principles stated above (as I find in the majority of authentic specimens that all the spores present an equal development and yet have a simpler form), I prefer to consider that form as the perfect type and refer the others to *H. elongatum*.

It will be observed that I have taken no note of the minor differences which the perithecia present.

An examination of many varieties and specimens has shown that in *H. pulicare*, for instance, the perithecia may be long or short, wide or narrow, striate or smooth, with lips thin or thick and more or less gaping, the variations appearing to depend on the kind of wood, the age of the specimen, and the amount of heat, light and moisture to which it has been subject, and hence such characteristics are of little relative value.

It is supposed that besides the ascous form, Hysterium has other modes of manifestation; for instance, Tulasne affirms that *Leptostroma vulgare* is a form of *Hysterium herbarum*; the argument being the usual one of *post hoc ergo propter hoc*, that is, *Hysterium herbarum* has been found either coincident with, or immediately succeeding to the Leptostroma on the same matrix. As I have elsewhere insisted, the only way to settle this question is by culture of the various forms upon different matrices.

The germination of Hysterium spores goes on very well in an ordinary growing slide, and the results are very interesting, especially in regard to those species with cellular spores, in which each loculus gives rise to a mycelial filament. I have several times observed a connection formed between neighboring filaments, resembling very much the sexual process as it occurs in some algæ, but as yet am not prepared to say that it is of a sexual nature. I recommend the subject for observation and experiment to those who have microscopes and no definite work on hand for their instruments.

The best classification of the Hysteriacei is that of M. Duby, but I think he has been premature in his effort to construct half a dozen new genera. The old division of Lophium, Glonium, Actidium and Hysterium serves well enough for identifying purposes, although as stated in the commencement of this paper, those forms of Hysterium, with thin membranous perithecia found in leaves and herbaceous stems, may be conveniently referred to the subgenus Hypoderma.

The data are yet wanting for a revision of this family with a view to indicating their relations to other fungi and to each other.

The accompanying plate gives the figures of the spores of the common forms of Hysteriacei magnified five hundred diameters. Fig. *l* represents a very large spore from a specimen in Mr. Rav-

enel's herbarium, marked *H. depressum* B. and C. Other spores in the same specimen were one-fourth less in size. With these figures and the following brief synopsis, there will be little difficulty, I think, in identifying the usual forms.

HYSTERIUM.

A. Spores simple, colorless, minute (Aporia of Duby).
1. *Hysterium herbarum* Fr. Spores minute, colorless, globose. (Sp. ex. Fr. in Schw. Herb.)

B. Spores filiform, colorless or greenish, lying side by side in bundles, often apparently without an investing sheath or ascus. (Lophodermium, Sporomega, Coccomyces and Colpoma of Duby.)
2. *H. pinastri* Schrad.
3. *H. arundinacearum* Schr.
4. *H. melaleucum* Fr.
5. *H. maculare* Fr.
6. *H. tumidum* Fr.
7. *H. foliicolum* Fr.
8. *H. griseum* Schw.
9. *H. variegatum* B. & C.
10. *H. rhois* Schw.
11. *H. rhododendri* Schw.

A number of additional species are enumerated in this connection by M. Duby, but I give only those which I have examined. The structure and relations of this group are very obscure. Some of them are almost certainly immature or aborted forms, and science would lose nothing if the whole were retured to *H. arundinacearum* and *H. foliicolum*.

C. Spores simple, colorless, elongate, often curved and sausage-shaped.
12. *H. rubi* Pers. Spores colorless, .0015 inch long. (Fig. 20.) (Spec. ex Kunze in Schw. Herb.)
13. *H. scirpinum* Fr. Spores colorless, .0018 inch long. (Sp. ex Fr. in Schw. Herb.)
14. *H. corni* Schw. Spores rod-like, straight, .002 inch long. (Spec. ex Kunze in Schw. Herb
15. *H. rufescens* Schw. Spores subfusiform, colorless, .0005 inch long, in long c vate asci.

D. Spores uniseptate.
16. *H. smilacis* Schw. Spores colorless, subpyriform, .001–.0013 inch long, with a gelatinous envelope when young. (Fig. 16.) (*H. Curtisii* Duby, is probably the same.)
17. *H. varium* Fr. Spores brown, opake, fusiform, subacuminate, .003 inch long.
18. *H. linearе* Fr. Spores colorless, ovoid or obovate, sometimes constricted in the middle, .0005 inch long.
19. *H. repandum* Blox. Spores at one end elongate and hyaline, the rest dark brown, .0006–.0007 inch long. (Fig. 17.)

E. Spores triseptate.
20. *H. pulicare* Fr. Spores dirty brown, terminal loculi often clearer or colorless. .0009 inch long.
21. *H. betulignum* Schw. Spores brown, .0008 inch long.
22. *H. tortile* Schw. Spores brownish, obovate, .0005 inch long.
23. *H. flexuosum* Schw. In the specimen in the Schweintz Herbarium, the spores in the distinctive flexuose perithecia are identical with those of *H. pulicare*. In some straight short perithecia the spores are cellular, .0015 inch long.
24. *H. biforme* Fr. Spores yellow brown, .001–.0012 inch long, sometimes constricted at the septa or torulose.
25. *H. Prostii* Duby. Spores brownish, subpyriform, .0005 inch long.
26. *H. rufulum* Fr. (Tribidium of Sprengel.) Spores at first reddish brown, afterwards dark, .001–.0014 inch long.

F. Spores multiseptate, or cellular.
27. *H. acuminatum* Fr. Spores curved, yellow, multiseptate, obtuse or subacuminate, .001–.0013 inch long.
28. *H. insidens* Schw. Spores dark yellow brown, 5–7 septate, .0011 inch long; third or fourth joint swollen.
29. *H. Mori* schw. Spores dark yellow brown, curved, subpyriform, multiseptate. .001–.0013 inch long.
30. *H. teres* Schw. Spores yellow, 3–5 septate, .0008–.0012 inch long.
31. *H. fraxini* Pers. Spores dark brown, elliptic or subpyriform, cellular, .0015 inch long. (Spec. ex Kunze.)
32. *H. prolongum* Schw. Spores yellowish, broadly obovate, cellular, .0012 inch long.
33. *H. subtratum* Schw. Spores dark, nearly opake, constricted in the middle with distinct septum, .0015–.002 inch long, each half cellular.
34. *H. elongatum* Wallr. Spores dark brown, obovate or subpyriform, cellular. .001–.002 inch long. (Spec. ex Fries.)
35. *H. depressum* B. & C. Spores dark, opake, brown, cymbiform, cellular, with central distinct septum, like *H. subtratum*, .003–.0015 inch long. (Spec. in Rav. herb. ex Curt.)

36. H. *decipiens* Duby. Spores straw color, obovate or elliptical, .001 inch long, 4-5 septate, with one or two longitudinal septa.
37. *H. Lesquereuxii* Duby. Spores brownish, ovate oblong, constricted in the middle, obtuse, 6-7 septate, with longitudinal septa.
38. *H. fraxineum* DeNot. Spores ovoid or oblong, 4-7 locular, with one or two longitudinal septa, four times as long as broad, clear, brownish. Duby.
39. *H. complanatum* Duby. Spores linear lanceolate, acute, 3-5 septate, not constricted, reddish brown.
40. *Hysterium verbasci* Schw. Spores colorless, subpyriform, often curved; endochrome multipartite, .001 - .0015 inch long.
41. *H. elatinum* Pers. Spores like *H. verbasci*.
42. *H. rimincola* Schw. Spores colorless or greenish, multipartite, obovate, .001 inch long or more.
43. *H. virgultorum* Desm'g. Spores colorless, curved rods indistinctly 4-5 septate, .0005 inch long.

Species which should be rejected as not belonging to the genus, or as having no fruit, and therefore not to be identified:—

H. abbreviatum Schw. Spec. in Schw. Herb. is an immature Sphæria.
H. polygonati Schw. Sp. in Schw. Herb. has no fruit.
H. oxycoccus Fr. Sp. ex Fr. has no fruit. Duby found no fruit in authentic specimens.
H. osmundæ Schw. Sp. in Schw. Herb. is a Septoria.
H. nucicola Schw. " " " " has no fruit.
H. librincola Schw. " " " " is a Hendersonia.
H. kalmiæ Schw. " " " " has no fruit.
H. syringæ Schw. " " " " " " "
H. sphæroides A. S. " " " " ex Fr. no fruit. Duby found no fruit in authentic specimens.
H. castaneæ Schw. Spec. in Schw. Herb. has no fruit.
H. Andromedæ Schw. " " " " " " "

The following species are rejected by Duby.

H. abietinum Pers.
H. parallelum Wahl.
H. rubrum Fr.
H. coccíferum Cast.
H. oleæ Cast.
H. strineforme Walls.
H. samœorum Larch.
H. pithyum Kunze.
H. minutum D. C.

DESCRIPTION OF PLATE II.

Fig. *a*. Spores of *Hysterium pulicare* Pers.
" *b*. " " " *hiforme* Fr.
" *c*. " " " *teres* Schw.
" *d*. " " " *tortile* Schw.
" *e*. Asceus and spores of *Hysterium flexuosum* Schw.
" *f*. Spores of *Hysterium fraxini* Fr.
" *g*. " " " *mori* Schw.
" *h*. " " " *Prostii* Duby.
" *i*. " " " *chlorinum* B. & C.
" *j*. " " " *smilacis* Schw.
" *k*. " " " *elongatum* Fr.
" *l*. " " " *depressum* B. & C.
" *m*. " " " *vulvatum* Schw.
" *n*. " " " *acuminatum* Fr.
" *o*. " " " *varium* Fr.
" *p*. " " " *insidens* Schw.
" *q*. " " " *repandum* Blox.
" *r*. " " " *Glonium graphicum* Fr.
" *s*. " " " *verbasci* Schw.
" *t*. " " " *rubi* Fr.
" *u*. " " " *rufescens* Schw.

SOME DIFFERENCES BETWEEN WESTERN AND EASTERN BIRDS.

BY T. MARTIN TRIPPE.

When the primitive prairie becomes reclaimed from a state of nature by the pioneer and farmer, the fauna and flora undergo a very marked change. Many plants and animals disappear, and new ones take their places. The buffalo, elk and antelope retire before the advancing line of civilization, and are seldom found within the settlement; the deer, wolf and turkey gradually disappear as the country becomes populated, and are finally exterminated. Many species of Compositæ and other plants, found in great profusion on the unbroken prairie, become scarcer and scarcer, as the sod is broken up and cultivated, and at last disappear altogether. With the birds, the changes are rapid and numerous; some species are quickly exterminated, and others previously unknown, become abundant. So rapid is the progress of settlement in some portions of the west, that these changes become very marked from their suddenness. Local lists of the avi-fauna of eastern Iowa and Minnesota, taken twelve or fifteen years ago, would differ very materially from those of the same localities to-day; and these lists would differ both in the species, and in their comparative and actual abundance. Even the habits of the birds undergo considerable modification, as it will appear in the following pages.

Every one in the Eastern States is familiar with the song sparrow, that little brown minstrel that comes even before the blue-bird to tell us that spring is at hand. He is our earliest bird; a sort of ambassador from the feathered court, sent on by those princes royal of song, the thrushes and grosbeaks, to herald their approach. On some bright sunny day in February, when the chill of the air is somewhat softened by the returning sun, and the woods are vocal with the cry of the downy woodpecker, you hear him first,—a brisk, ringing strain, full of joy and hope, that speaks of warm days to come, and whispers promises of violets and anemones. If you wish for a nearer acquaintance, he is not a bit afraid, but sings as unconcernedly, although you may be watching him a few yards off, as though you were a mile away. In fact, he is semi-

domestic in the early days of his coming, and hovers about the house and garden, tame and familiar, a willing dependent upon your bounty, picking up the crumbs about the door-steps, and repaying you a thousand fold, every morning and evening; and, having taken up his abode with you, he likes it well enough to stay all spring, summer, and fall, always the same, cheerful, familiar and musical.

Very different, indeed, is the song sparrow of the transmississippi states. In March, the ornithologist who rambles over the prairies and along the wooded water-courses of southern Iowa, notices a small, brown bird, flitting among the hazel copses, shy, restless and timid, eluding his observation so carefully, that, if he is unaware of its nature, he will frequently be obliged to shoot it before he can identify it. Then to his surprise, he finds it to be the song sparrow. For a few weeks, he meets in his daily walks, the same shy apparition, though never very frequently, until in April it disappears. Perhaps, once or twice, on an unusually lovely morning, he may catch the familiar song that used to delight him in early March amid the hills of New England: but to hear it even once he must be very fortunate. During summer he may rarely meet the bird in the thickets on the edge of the timber, or even catch him, towards the approach of autumn, reconnoitring in some garden: but only rarely,—until in September and October, they come back again in greatly increased numbers, more tame and familiar than in the spring, and now he begins to recognize some resemblance to the song sparrow of the Eastern States.

Where have they been all summer? In Minnesota — the greater part of them at least. The brush prairies, the thicket in the river valleys, and the shrubbery that surrounds the lakes of western and central Minnesota, are the summer resort of the song sparrow. Here, hundreds build their nests and raise their young, — shy and timid as ever, but no longer silent. The ornithologist just from the east, is astonished to find in the song sparrow, the wildness that marks the meadow-lark and flicker, in New York or Massachusetts, although the notes and habits are otherwise precisely similar.

Yet it takes only a short time for the song sparrow to find out that he has nothing to fear from men, but that on the contrary, it is safer and pleasanter to live in their company than without it. When a region has been settled for a few years, small birds of all

kinds begin to increase in a very marked degree. In the older settlements in Minnesota the song sparrow has already taken up his abode, and though something of his original shyness remains, yet it is rapidly wearing off, and he is becoming the same familiar, confiding bird as in the east. As we progress toward the frontiers, we find him becoming shyer and wilder, till in the wilderness he exhibits almost the wildness and timidity of a wild-duck.

What has been said of the song sparrow, is equally true of the bluebird and robin. In Iowa, some of these birds breed in the timber near the streams, but the greater number pass quickly over the prairies, and find more congenial haunts amid the woods of central and northern Minnesota. The pine barrens seem exactly suited to the robin; here he raises his brood undisturbed; and, amid the dead and decaying poplars and tamaracks that cover miles upon miles of the surface of northern Minnesota, the bluebird nests in great numbers. But very different are they from the robin and bluebird of the east. They fly from your approach afar off; they shun you as the hawk and crow do in New England; and though they have the appearance and voice of old friends, you cannot help feeling that they are old friends become estranged. But as the country becomes settled, like the song sparrow, they soon perceive the advantage of dwelling in civilized society, and are not slow in acting upon it. In some portions of Iowa and Minnesota, these three birds are as domestic as in New York or Pennsylvania.

Thus, the robin, bluebird, song sparrow, and some others of our birds, before the prairies were settled, passed the breeding season in the northern woods of Michigan, Wisconsin and Minnesota; but as the wilderness becomes civilized, and groves of trees are planted upon the prairie, they take up their abode among the habitations of men, and become residents of regions, where before they were merely transient visitors.

But if some birds are more timid in the newly settled parts of the prairies, with others it is precisely the reverse. In the town in which I write — a city of five or six thousand inhabitants of southern Iowa, — blue jays are as common in the trees lining the streets as vireos among the elms of New Haven; crow blackbirds breed as familiarly in the gardens as chipping sparrows; while at almost any hour of the day, wild pigeons and doves may be seen gleaning in the busiest streets. On the upper Mississippi, near

St. Cloud. I have seen crows so tame that I walked within thirty feet of them with a gun on my shoulder, without alarming them in the least. The meadow-lark is as tame as the bluebird in the east, and sings familiarly from the roofs of houses in the villages, and the marbled godwit will let you walk up within twenty or thirty yards without seeming aware of your presence. In the woods of Minnesota, far beyond the settlements, I have found hawks, *Buteo borealis* and *Falco sparverius*, scarcely more concerned at my presence within fifty feet, than the robin or bluebird in the Eastern States. But birds are quick to learn; the mallard and the prairie hen soon discover that it is dangerous to let a man approach within fifty yards, while the wild goose is very discriminating as to the range of buck-shot and rifle-bullet. It is surprising to see how soon birds learn this lesson. I knew a certain cornfield situated at the edge of a large wood in a recently settled part of Minnesota. Here the blue jays from all the country round were wont to forage, coming in scores every morning and evening. Undisturbed at first, they grew so bold as to remain quietly at work within twenty or thirty feet of a passer-by; till finding that they were destroying a considerable portion of his crop, the farmer commenced shooting them, killing them by the dozen for the first few days. In two weeks, the blue jays were so wild when in that field, that it was difficult to get within gunshot of them; while in the woods, half a mile away, they were as tame as ever; and while before they were very noisy and garrulous when in the cornfield, now they never uttered a sound from the time they entered it till they left it again. It took the blue jays only a fortnight to comprehend the situation.

It is easy to see why some birds, as the hawk and crow, should be tamer in the frontier settlements than in the older parts of the country. Not being hunted as game and having few or no enemies, it is not strange that they should have the boldness and confidence which is the result of a sense of security and freedom from danger. On the other hand, it is equally apparent that such small birds as the sparrows, thrushes and finches, continually persecuted by their natural enemies, should learn to be distrustful, and shun the approach of everything from which danger might be apprehended. But in course of time, the larger birds being destroyed as pests or for amusement become, in time, shy and suspicious; while the smaller, protected in a degree and less subject to the attacks of their former enemies, grow tame and familiar.

Some birds, however, seem but little affected by the settlement of the country. The baywinged bunting, for instance, is scarcely more abundant in eastern Iowa than on the unbroken prairies in the western part of the state, nor are his habits different. The greater number breed among the pines of Minnesota, very few remaining in any part of Iowa during summer.

Some species increase rapidly on the first settlement of the country, and then decrease again. Of this class are the prairie hen and mallard. They find abundance of food in the corn and wheat fields; while the population is sparse and larger game so abundant, they are hunted very little; but as the population increases, they are gradually thinned out and become in some cases exterminated. Other birds, as the quail, are wholly unknown beyond the frontier; and only appear after the country has been settled a short time. Still others, woodland species, appear in regions where they were never known before, as groves of trees are planted, and thick woods spring up on the prairies, as soon as the ravages of the fires are checked. Thus, some species are introduced and some exterminated by the settlement of the country, while the numbers of almost all are more or less affected.

The same changes have taken place in the Eastern States, and are still going on there, but so slowly as to be imperceptible. Here in Iowa, on the contrary, they are so rapid as to attract the attention of the most careless observer.

The breeding habits of birds undergo considerable modification on the settlement of the country. In the wilds of Minnesota, I never saw the nest of the robin elsewhere than in the tops of the tallest Norway pines. The crow, in similar localities, often builds on low bushes. The chipping sparrow nests in the same places, and in company with the grass finch. The chimney swallow breeds in hollow trees; the wrens in the decaying trees in the windfalls. The larger birds, hawks and crows, take but little pains to conceal their nests. So far as my observations went, I think that the robin, bluebird and some other small birds, breed a little later in the season than in the settled regions, though I may be mistaken.

The real influence of man upon animals and especially on birds is scarcely yet appreciated. When the subject comes to be more thoroughly understood we shall find that not only are they governed in their range and numbers through his agency, but that even their natures and mental characteristics are changed as well.

REVIEWS.

THE GEOLOGY OF WYOMING.* — The first part contains a geological itinerary, while the second part is more general in its nature, containing chapters giving a general view of the geology of the Missouri Valley, of the region between Omaha and Cheyenne, the route over the first range, the Laramie Plains and westward to Bear River, and onward to the Great Salt Lake Valley, closing with a chapter giving a general review of the geology of the country from Omaha to Salt Lake Valley, and a final chapter on the mines, etc.

Prof. Hayden's explorations are extended over an immense extent of country, and while the work is our only authoritative guide to the geological and agricultural capabilities of this important area, even these preliminary reports throw a flood of light on the geological history not only of the American Continent, but we may venture to add that of the globe and the succession of life on its surface. In illustration we quote as follows:—

"That there is a connection between all the coal beds of the far West I firmly believe, and I am convinced that in due time that relation will be worked out and the links in the chain of evidence joined together. That some of the older beds may be of upper Cretaceous age I am prepared to believe, yet until much clearer light is thrown upon their origin than any we have yet secured, I shall regard them as belonging to my transition series or beds of passage between the true Cretaceous and the Tertiary.

When the large collections of fossil plants from the West now in the possession of Dr. Newberry are carefully studied, we shall have a much better basis upon which to rest a conclusion. It will be seen at once that one of the most important problems in the geology of the West awaits solution, in detecting, without a doubt, the age of the coal series of the West, and the exact line of demarcation between the Cretaceous and Tertiary periods.

The study of this question shows the importance of the continued accumulation of facts and the collection of organic remains. Neither can we place too rigid reliance on the teachings of the fossils, for it has already been shown many times that the fauna

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*Preliminary Report of the U. S. Geological Survey of Wyoming, and portions of contiguous territories (being a second annual report of progress). By F. V. Hayden. U. S. Geologist. Washington, 1871. 8vo, pp. 511.

and flora of the Tertiary deposits of this country, when compared with those of the Old World, reach back one epoch into the past. We have already obliterated the chasm between the Permian and the Carboniferous era, and shown that there is a well-marked inosculation of organic forms — those of supposed Permian affinities passing down into well-known Carboniferous strata, and admitted Carboniferous types passing up into the Permian. We believe that the careful study of these transition beds is destined to obliterate the chasm between the Cretaceous and Tertiary periods, and that there is a passing down into the Cretaceous period of Tertiary forms, and an extending upward into the Tertiary of those of Cretaceous affinities. It appears also, that every distinct fauna or flora of a period ought to contain within itself the evidence of its own age or time of existence, with certain prophetic features which reach forward to the epoch about to follow. If there is a strict uniformity in all the operations of nature when taken in the aggregate, as I believe there is, then this is simply in accordance with the law of progress which in the case of the physical changes wrought out in the geological history of the world has operated so slowly that infinite ages have been required to produce any perceptible change. The position that I have taken, in all my studies in the West, is that all evidences of sudden or paroxysmal movements have been local and are to be investigated as such, and have had no influence on the great extended movements which I have regarded as general, uniform and slow, and the results of which have given to the West its present configuration. The splendid group of fossils obtained on the Upper Missouri, from the Fox Hills Group or upper Cretaceous beds, illustrates the prophetic element I have mentioned above. Among them are many true Cretaceous forms, as *Ammonites*, *Baculites*, *Inoceramus*, etc., yet these all present such a modern facies that they seem plainly to look forward into the succeeding epoch, which in the case of our Atlantic coast was strictly marine. It was no fault of the fossils themselves that they were mistaken in this instance."

Prof. Hayden's remarks on the relation of the Quaternary period to the Tertiary are of much interest: —

"As we have previously remarked, we believe that the Quaternary period, although more difficult to study, will be found to be scarcely second in importance to any of the previous great epochs in geology. A careful study of these modern deposits will undoubtedly show consecutive links by which it was united to the Tertiary period, in the same manner as the Cretaceous and Tertiary are connected in the case of the great Tertiary lake now indicated by the deposits on White and Niobrara Rivers, in Nebraska, in which the waters continued to cover a greater or less area through most of the Quaternary period, at least, as is shown by the thick

deposits of fine sand, with bones of mammals and shells of existing species, on Loup Fork and its tributaries. The same may be said of the bluff deposit, or loess, which is so well displayed along the Missouri from Fort Pierre down below St. Louis, and probably, to the Gulf of Mexico. At a modern period it is probable, that the waters of the ocean swept high up inland, reaching nearly to the foot of the mountains. The great water-courses had already been marked out, consequently we find the yellow marl or loess fifty to one hundred and fifty feet thick in the immediate valley of the Missouri, but thinning out as we recede from it, or the valleys of any of its branches. The existence of so many fresh-water mollusca and the entire absence of any marine forms indicate that the waters of the Mississippi and Missouri were either cut off from the direct access to the sea, or that the influx of such a vast quantity of fresh water as must have flowed down from the mountain districts rendered completely fresh the inland portions.

We may suppose the temperature just prior to the present period to have been extremely low, and that the elevated portions of the West were covered with vast masses of snow and ice; that as the temperature became warmer this snow and ice melted, producing such an accession to the already existing waters that they covered all the country excepting, perhaps, the summits of the highest peaks; that masses of ice filled with fragments of rocks, worn and unworn, floated off into this great sea, and melting, scattered the contents over the hills and plains below; that as the waters diminished these masses of ice would accumulate on the summits of the foot-hills of the mountains, or at certain localities in the plains; and thus account for the great local accumulations of stray rocks at certain places. The materials also which must have been removed from all portions of the West drained by the Missouri and its tributaries by surface denudation, as is illustrated by the "bad lands", etc., were also swept into this vast inland lake, and then carried beyond the reach of currents, would settle quietly to the bottom, almost without lines of stratification, as we observe in the loess. The last act was the recession of these waters to their present position, and the formation of the terraces. We believe the terraces constitute the last change of any importance in the surface of the western continent. We suppose that the channels of all the streams on the eastern slope of the Rocky Mountains were at one time occupied with water from hill to hill, and that the drainage was toward the sea. But in the Great Basin, which so far as we know has no outlet, the drainage must have been by evaporation, for the evidence points to the conclusion that it was entirely filled with water high up on the sides of the mountains. There is greater uniformity in the terraces in the Great Basin than in the valley of the Missouri, which indicates a far more equable drainage. Still, those along the flanks of the Wasatch Mountains number two or three principal ones, but these

formations separate into five or six; and Stansbury mentions one locality where there are ten or twelve of them. In the Missouri Valley and along the eastern slope generally, the terraces vary much in height and importance.

The distant hills are composed of the yellow marl or loess, and the surface has been weathered into the rounded, conical hills. This portion is often covered with the drift or stray rocks, or what I have called in a former report the erratic block deposit. On the terraces these erratic masses are scarcely ever found, and in the broad bottoms of the Missouri River seldom if ever. This fact strengthens the opinion that the terraces are really one of the latest features, and that they were formed during the drainage of the waters toward the sea after the temperature had reached nearly its present state. Oscillations of level may have contributed somewhat to the formation of the terraces, but I am inclined to believe that the drainage or the contraction of the waters is the main cause. This is an important point, and I hope hereafter to treat it more fully when I have accumulated a greater number of facts. It has been my belief for years, that not only the Missouri River but all the branches, from the largest river like the Yellowstone or Platte that flowed into it to the smallest creek that has cut its cañon deep into the sides of the mountains, were once filled with water from side to side, but have gradually shrunk to their present diminutive proportions. All over the West are large dry beds which must have at one time given passage to vast bodies of water. The flanks of the mountains, from the north line to Mexico are gashed with gullies or cañons, many of which are now dry as the dusty road for the greater portion of the year. I mention some of these details here simply to show how closely the story of the physical growth of our western continent is linked together, and that it needs only the careful, conscientious grouping together of the facts to secure this history step by step from the earliest commencement to the present time, and mould it into one harmonious whole."

Any one with geological proclivities about to take a trip across the continent over the Pacific Railroad should by all means read this interesting sketch of the country between Omaha and Salt Lake.

The third part contains a report by Prof. C. Thomas on the agriculture of the Territory, with notes on the grasshoppers, especially the Western Locust (*Caloptenus spretus.*)

Part IV. contains a preliminary paleontological report by Prof. F. B. Meek, with reports on the Tertiary coals of the West, by James T. Hodge; on the ancient lakes of Western America, their deposits and drainage, by Prof. J. S. Newberry (which will be

found at p. 641 vol. IV of this journal) : on the vertebrate fossils of the Tertiary formations of the West, by Prof. J. Leidy : on the fossil plants of the Cretaceous and Tertiary formations of Kansas and Nebraska, by L. Lesquereux : on the fossil reptiles and fishes of the Cretaceous rocks of Kansas, the fossil fishes of the Green River group and the recent reptiles and fishes obtained by the naturalists of the Expedition, by Prof. E. D. Cope : and finally, a report on the Industrial Resources of Western Kansas and Eastern Colorado, by R. S. Elliott.

These reports contain matter of much general interest by the distinguished scientists whom Prof. Hayden has summoned to his aid, and give the volume a lasting value. From Mr. Lesquereux's report we select the following remarks on the discordance in the characters of the European and American flora of the Tertiary and Cretaceous epochs :—

"Since the first appearance of land vegetation upon the surface of our earth, what we know of it by fossil remains seems to indicate for our country a precedence in time in the development of botanical types. Large trunks of coniferous wood are already found in our Devonian measures, while analogous species are recorded as yet only in the Carboniferous measures of England. Though the analogy of vegetation between the flora of the coal measures of America and Europe is evidently established by a number of identical genera and species, we have nevertheless some types like the *Palœoxiris*, which are considered as characteristic of strata of the European Permian, and which are found in our coal measures as far down as the first coal above the millstone grit. Even peculiar ferns of our upper coal strata have a typical analogy with species of the Oölite of England. Our Trias, by the presence of numerous Cycadeæ, touches the Jurassic of Europe. But it is especially from our flora of the lower Cretaceous that we have a vegetable exposition peculiarly at variance with that of Europe at the same epoch and whose types so much resemble those of the European Tertiary that the evidence of the age of the formation, where the plants have been found, could not be admitted by paleontologists until after irrefutable proofs of it had been obtained."

Prof. Cope's report gives glimpses of the reptilian life which formerly flourished over this region : —

"The species of reptiles which have been found in the Cretaceous strata west of the Mississippi River up to the present time number fourteen. Five of these pertain to the *Sauropterygia*, one to the *Dinosauria*, and seven to the *Pythonomorpha*. In the present report attention is confined to the species discovered near the line

of exploration of Dr. Hayden, or that of the Kansas Pacific Railroad, and that of Professor B. F. Mudge of the State Agricultural College.

During the period when the Cretaceous ocean extended from Eastern Kansas over the present site of the Rocky Mountains, and from the Gulf of Mexico to the Arctic Sea, it abounded in life. Among vertebrata, fishes and marine reptiles chiefly abounded, and in varied forms. Many of the reptiles were characterized by a size and strength exceeding that seen in any other period of the world's history. The species of *Sauropterygia* and *Pythonomorpha* were all aquatic, but the two types present very different adaptations to their mode of life. While the former possessed two pairs of limbs the latter appear to have possessed an anterior pair only, or with the posterior pair so reduced as to have been insignificant. They substituted for them an immensely long and flattened tail, which they used, like the eels and sea-snakes, as an oar. The *Sauropterygia* were generally stout-bodied and with a very markedly distinct neck. In the *Pythonomorpha*, on the other hand, the body was snake-like, with narrow chest and neck scarcely differing in diameter. They were immensely elongate, and might be called sea-serpents with considerable propriety.

Of *Sauropterygia*, *Polycotylus* had a slender neck and very stout limbs; but in *Elasmosaurus* the neck attained dimensions exceeding that of any vertebrated animal. The species *E. platyurus* was probably the longest of the order, measuring perhaps fifty feet, but of this the neck amounted to twenty-two feet. The creature was carnivorous, and could no doubt like the snake-bird, swim at a considerable distance below the surface of the water and reach to the surface for air, or explore the depths or plunge for fishes to the depth of forty feet.

Among the *Pythonomorpha* the *Liodon dyspelor* is the largest species and the *Clidastes intermedius* the smallest. A specimen of *Mosasaurus Missuriensis* obtained by William Webb near Topeka is stated by him to measure seventy-five feet in length. Should this be substantiated the *L. dyspelor* was at least one-third larger. This is, however, as yet uncertain.

The upper arm bones of the Clidastes are remarkably short and wide and furnished with strong processes for the insertion of muscles. They are among reptiles much like those of moles among quadrupeds, and, as in the latter, indicate probably great power of propulsion in the fore limbs. The finger bones were long and slender and formed a long fin or flipper, while the upper arm was probably concealed in the skin. The whole limb came off but a short distance posterior to the head. These reptiles, so far as known were all carnivorous; their food was chiefly fishes."

His notes on the fossil fishes are of much interest:—

"The laminated rock from which the above species were ob-

tained is similar in general appearance to the clay beds of Mount Lebanon and Mount Bolca. The first indication of the existence of this deposit was brought by Dr. Jno. Evans, who obtained from it a clupeoid, which was described by Dr. Leidy as *Clupea humilis* (Proc. Acad. Nat. Sci. Phila., 1856, p. 256). One of the blocks contains the remains of two shoals of the fry, probably of *C. humilis*, which were caught suddenly by a slide or fall of calcareous mud, and entombed for the observation of future students. They must have been taken unawares, since they lie with their heads all in one direction as they swam in close bodies. One or two may have had a moment's warning of the catastrophe, as they have turned a little aside, but they are the exceptions. The fry are from one-half to three-quarters of an inch long and upward.

True herring, or those with teeth, are chiefly marine, but they run into fresh waters and deposit their spawn in the spring of the year, and then return to salt waters. The young run down to the sea in autumn and remain there till old enough to spawn. The size of the fry of the Rocky Mountain herring indicates that they had not long left the spawning ground, while the abundance of adults suggests they were not far from salt water, their native element. To believe, then, that the locality from which these specimens were taken was neither far from fresh, nor far from salt waters is reasonable; and this points to a tide, or brackish inlet or river. The species of *Cyprinodontidæ* inhabit also tide and brackish waters. Most of the species of the family as well as of the genus, are inhabitants of fresh water; but they generally, especially the cyprinodons proper, prefer still and muddy localities, and often occur in water really salt. This habitat distinguishes them especially from Cyprinidæ (minnows and suckers) and pike. Lastly, the known species of Osteoglossum inhabit fresh waters.

The material which composes the shales indicates quiet water, and not such as is usually selected by herring for spawning in: while the abundance of adult Clupeas indicate the proximity of salt water.

This is far from a satisfactory demonstration of the nature of the water which deposited this mass of shales, but is the best that can be obtained with such a meager representation of species.

As to geological age the indications are rather more satisfactory. The genus Clupea ranges from the Upper Eocene upward, being abundant in the slates of Lebanon and Monte Bolca, while Cyprinodon has been found in neither, but first appears in the middle or lower Miocene in Europe. The Asineops resemble very closely, and I believe essentially the Pygæus of Agassiz of Eocene age, from Monte Bolca. The peculiarities presented by the genus found by Dr. Hayden are of such small significance as to lead me to doubt the beds in question being of later than Eocene age, though the evidence rests chiefly on this single, new and peculiar genus.

The position of these fishes, seven thousand feet above the level of the sea, furnishes another illustration of the extent of elevations of regions once connected with the ocean, and the comparatively late period of geologic time at which, in this case, this elevation took place."

If we find so much of interest and novelty in the preliminary report, how much has our science in store when the final report and its illustrations appear!

Geographical Distribution of the Beetles.*—In this exceedingly interesting and suggestive essay, the author divides the Coleoptera of the world into three great "stirps," or assemblages:—the Indo-African, the Brazilian, and what for want of a better name he calls the "microtypal" stirps; the species composing it "being of a smaller size, or, more strictly speaking, not containing such large or conspicuous insects as the others." Thus all but the tropical, even including the Australian insects, are considered as belonging to this mass of small forms. "The coleopterous fauna of our own land [Great Britain] may be taken as its type and standard."

We very much question whether this division be not too artificial to be generally received by zoologists. The primary distribution of faunæ corresponding to the polar, temperate and tropical regions, would seem to be the more philosophical, being based on climatic causes.

Mr. Murray believes that the diffusion of animals and plants by accidental means "bears no important part in the establishment of any definite fauna or flora." He thinks that actual continuity of soil and subsequent isolation alone produce faunæ with a definite character. While he thinks these changes of surface took place before the Tertiary period, and does not believe that the new Atlantis, to take a case in point, existed during that period, yet he is one of the most ultra in the school of writers on geographical distribution who take up and put down continents like checkermen. Thus the Azores, Canary Islands and St. Helena, Ascension Island, St. Paul and Tristan d'Acunha, are to Mr. Murray the relics of a former continent, when the Atlantic was dry land, and Europe and America ocean beds. He puts down a

*On the Geographical Relations of the Chief Coleopterous Faunæ. By Andrew Murray. Extracted from the Linnæan Society's Journal.—Zoology. vol. XI, London. 1871. 8vo. pp. 89.

"stretch of dry land" between Old Calabar, Africa and Brazil, and again another "continental route of communication" between Patagonia and the Cape of Good Hope "and which, last of all and probably not without relation to the preceding, united Brazil and Madagascar." Now it seems to us this is in direct violation of one of the best founded and grandest laws in physical geography, as brought out by Professor Dana. He has shown that the present continents of the globe, were each built up around a Laurentian nucleus, and have gradually extended to their present dimensions, being originally islands or archipelagoes, and that the present ocean beds have never been dry land; the borders of the continents within the line of a hundred fathoms more or less, often involving thousands of square miles, oscillating above or below the ocean level, but with no intercontinental bridges. It seems to us that this law goes hand in hand with the climatic laws regulating the distribution of the faunæ of the earth, and that the writer of the essay before us has, in a measure, violated both at the outset.

Space does not permit us to notice the many new and extremely interesting points brought out by Mr. Murray in reference to the smaller faunæ, except to briefly give his remarks on our own fauna. We think that what we quote will show that while a great mass of facts are given, the author's broadest generalizations will not meet with general acceptance. Thus he labors to show that the fauna of Australia is much like that of Europe and North America, both being "microtypal," namely, having small species. By the same mode of reasoning an Esquimaux does not differ from an Australian, as both are not gigantic in stature, and hence both belong to the same primary fauna. He remarks, "North America has no special fauna or flora of its own. That which it has is a mixture of the microtypal and Brazilian stirps intermingled with fresh importations of different dates, and modified by the advance and retreat of the glacial epoch; but, on the whole, the preponderating element in its fauna is the microtypal." The similarity of the Californian fauna to that of Asia is accounted for by a "former communication having existed between Asia and California."

As to the European fauna and flora being the type of the "microtypal" fauna, we wonder what would have been considered the standard, if modern science had developed first in Japan or Australia, rather than Europe? Is the flora of North Temperate Amer-

ica any more European, than is that of northern Europe, North Temperate American? This is a species of anthropomorphism in science that we are disposed to distrust, as facts of distribution of life in palæozoic times, as Mr. Murray acknowledges, tend to show that the Silurian continental nucleus of Europe was not indebted to that of North America for its fauna, or *vice versa;* and in all probability there has been no interchange of forms between the Arctic and Antarctic lands. Do not the known facts in geographical distribution tend to show that the different continental nuclei have been from the first, distinct centres of distribution and evolution for the larger proportion of animals and plants, which may have evolved from ancestral forms, at the outset restricted to separate ocean beds, and separate continents?

The Brachiopoda of the Coast Survey Expedition.*—In this valuable contribution to our knowledge of the Brachiopods, Mr. Dall instead of being content with giving a synonymical list of the species, with descriptions, enters as thoroughly as his material would allow into the anatomy of these animals. He also enumerates the characters of the class, and the two orders in which it is divided. As a striking feature in the anatomy of *Terebratula Cubensis* he also notes "the absence of that great series of sinuses in the anterior part of the mantle, which was termed by Hancock 'the great pallial sinuses.'" The illustrations are excellent.

Sea Side Studies in Natural History.†—A second edition of this useful book has appeared. As a preparatory note states, it is a mere reprint of the first edition, with a few verbal changes. A brief notice of the recent deep sea explorations is added.

Catalogue of European Lepidoptera.‡—A catalogue of European butterflies and moths is of great use to the American student, and we are glad to see an enlarged and revised edition of the present work, the only available catalogue we have.

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*Report on the Brachiopoda obtained by the U. S. Coast Survey Expedition in charge of L. F. de Pourtalès, with a revision of the Craniidæ and Discinidæ, by W. H. Dall. Bulletin of the Museum of Comp. Zoology, Vol. 3. No. 1 with 2 plates. Cambridge, May 1871. 8vo. pp. 45.

†Sea side Studies in Natural History, by Elizabeth C. Agassiz and Alexander Agassiz. Marine Animals of Massachusetts Bay. Radiates. Boston. J. R. Osgood & Co. 1871. 8vo pp. 157, with 186 wood cuts.

‡Catalog der Lepidopteren des Europæischen Faunengebiets; I, Macrolepidoptera, bearbeitet von Dr. O. Staudinger; II, Microlepidoptera, bearbeitet von Dr. M. Wocke. Dresden, 1871. 8vo. pp. 426.

The Early Stages of Brachiopods. * — The final memoir on this subject, of which an abstract by the author is given on p. 385 vol. iii., of this journal, has at length appeared. After describing the different stages of *Terebratulina septentrionalis*, which are figured with many details on two excellent plates, Prof. Morse discusses the relations of Brachiopods with the Polyzoa, and in closing remarks as follows: —

"With propriety may also be suggested a certain parallelism between the leading groups of the Polyzoa and the Brachiopods. We have forms like Lepralia, attached by one region of their shell, this shell being calcareous and exhibiting minute punctures, which have been compared to similar markings in certain Brachiopods. So among the latter group do we find forms attached, as in Thecidium, and some species of Productus; and generally the articulate Brachiopods might be compared to such forms as Lepralia, while on the other hand, such genera as Pediculina, with its long, pliant and muscular stalk, or Loxosoma, with a stalk highly retractile, may be compared to Lingula. The limits or intentions of this paper will not allow any considerations regarding the relations of the Brachiopods with the other groups of the animal kingdom. I have elsewhere expressed my belief that they are true articulates, having nearer affinities with the Vermes; and in view of the above relations of the Brachiopods with the Polyzoa, it is interesting to remark that Leuckart has for a long time placed the Polyzoa with the Vermes, and in a new edition of the 'Outlines of Comparative Anatomy' Professor Carl Gegenbaur removes the Polyzoa from the Mollusca, and associates them with the Vermes."

NATURAL HISTORY MISCELLANY.

BOTANY.

Cross Fertilization of Plants. — Mr. Meehan exhibited some flowers of the common *Bouvardia leiantha* of the green-houses, and of the hardy *Deutzia gracilis*, and referred to his papers, published a few years ago in the "Proceedings of the Academy," on practical diœcism in the trailing arbutus (*Epigæa repens*) and

*On the early stages of Terebratulina septentrionalis. By Edward S. Morse, Ph. D (From the memoirs of the Boston Society of Natural History). Boston, 1871. 4to. pp. 10. With two plates.

Mitchella repens, in which he pointed out that these plants, though apparently hermaphrodite, had the stamens and pistils of different characters in separate plants, and were therefore subject to the laws of cross-fertilization as indicated by Darwin. He had had his attention called to the Bouvardia, by Mr. Tatnall of Wilmington, Del., as furnishing a similar instance to that of Epigæa and Mitchella, belonging to the same natural order in which the Cinchoneous division of the Rubiaceæ, Bouvardia, was placed. These had some plants with the pistils exserted, while in others only the stamens were visible at the mouth of the corolla tube. Mr. Tatnall had not had the matter suggested to him early enough to say that it was so in all cases; but he believed that these flowers, which practically might be termed pistillate and staminate, were found entirely on separate plants. This is a very important fact, as Bouvardia is not raised from seeds in green-houses, but from cuttings of the roots, and therefore, all these plants with separate sexes must have been produced from one original individual, without the *intervention of seed*, and thus confirm the position advanced in a previous paper on "bud variations," namely, that variations in form, and, by logical inference, new species, may arise without seminal intervention; and that in this way identical species may appear in separated localities without the necessity of supposing an emigration from one small point, as Darwinism now does.

In the specimens of *Deutzia gracilis* were two forms of flowers on the same plant. Besides the large ones with stamens and pistils apparently perfect as generally seen, there were numerous small flowers in which the petals were only partially developed. The filaments were entirely wanting, but the anthers were as perfect, if not larger than in what we should call the perfect flowers. Any one could see that these small flowers were the result of deficient nutriment, and would be apt to pass the matter over with this simple reflection; but he wished to emphasize the fact that this defective nutrition rendered the female organs inoperative, while the male organs were still able to exercise their functions; thus affording another instance, if any more be needed, of the truth of his theory of sex, namely, that with defective nutrition, the female sex is the first to disappear; and that only under the highest conditions of vitality is the female sex formed.

In the case of the *Bouvardia* a similar law was seen. The

most vigorous stems, or, as they would be technically called. woody axes, produced the female flowers.

Wolffia Braziliensis in Michigan.—On June 25, 1871, I found the *Wolffia Braziliensis* Wedd. var. *borealis*, in the River Rouge, a tributary of the Detroit emptying a few miles below our city. The little plants grew rather sparingly with *W. Columbiana* Karsten, and *Lemna polyrrhiza* L. Though the *W. Columbiana*, in general its associate, has been found in the east, the *W. Braziliensis* has not, I believe, been met with there. For those not acquainted with it, I will state that it is easily distinguished from the former, even with the unassisted eye, by its subacute, oblong fronds, bright green and shining above, and pale beneath. It is further distinguished by being contracted or somewhat concave above, denser and less cellulose, by its more numerous stomata, and by being marked more or less with brown dots. It is also not so much submerged as the *W. Columbiana*, but floats on the surface of the water, the intensely green upper part lifted quite above it, bearing some resemblance to a little boat. Some botanists take the *Braziliensis* to be a form of the *W. arrhiza* of Europe.—Henry Gillman, *Detroit, Michigan*.

Anthers of Parnassia.—In the "Journal of the Linnæan Society," vol. xi, Mr. A. W. Bennett published, two or three years ago, an interesting article upon *Parnassia*—its structure, affinities, and its mode of fertilization. I am now to remark only upon its anthers, which are generally described as extrorse. Mr. Bennett, observing that the present writer, in the "Genera of North American Plants Illustrated," describes the anthers as introrse, and gives a drawing of *P. Caroliniana* as an illustration, proceeds to say: "I do not, however, find any other observer to agree with Prof. Gray's observation in this respect, except two American botanists, Dr. Torrey and Mr. Chapman, who have probably borrowed their descriptions from him; nor do any specimens of this species which I have been able to examine confirm any departure in this respect from the ordinary type of the genus."

It is easy to show that Dr. Torrey's observation, at least, is independent and original. In his "Flora of Northern and Middle States," published in 1824, p. 326, he described the anthers of *P. Caroliniana* as "incumbent;" in his "New York State Flora," 1843,

as "fixed by the base, introrse." The first volume of the "Genera North American Illustrated" appeared in 1848. This season I have, for the first time, had the good fortune to see both *P. palustris* and *P. Caroliniana* in flower, in the Botanic Garden of Harvard University, the former blossoming at the beginning, the latter at the close of August. The difference between the two species "in this respect" is obvious.

In *P. palustris*, the anthers are certainly extrorse as to insertion; but the line of dehiscence lateral, with introrse rather than extrorse tendency.

In *P. Caroliniana*, the anthers are quite as much introrse as extrorse as to insertion, and truly introrse for dehiscence. A transverse section removes all doubt, showing the connective or solid part to be posterior, and the anther to be as truly introrse as possible.—A. Gray, *American Journal of Science.*

Geographical Distribution of Sea Grasses.—Under this title, Dr. P. Ascherson gives an account, in a recent number of Petermann's "Geographische Mittheilungen," of the distribution of the species of flowering plants native to sea water. Of these he enumerates twenty-two, belonging to eight genera, and two natural orders. The area of each species is generally very limited, its distribution being mainly dependent on the present condition of the sea in which it is found, as to temperature, etc. Those which grow in temperate regions are frequently represented by closely allied species in tropical seas. Although the Isthmus of Suez is of comparatively recent geological date, the nine species found in the Red Sea are entirely distinct from the four species of the Mediterranean, and, with one exception, belong to different genera. A good map accompanies the paper.—A. W. B.

The Structure of Bog Mosses.—Dr. R. Braithwaite, the highest authority in England on the mosses, has published in a recent number of the "Monthly Microscopical Journal," an account of the structure of the *Sphagninæ* or Bog-mosses. Dr. Braithwaite follows Schimper in considering them as a distinct order of the same rank as the true Mosses and Liverworts; the muscal alliance being thus formed of the three orders *Bryinæ*, *Sphagninæ* and *Hepaticinæ*. The spore of the bog mosses does not, on germination, produce the much-branched confervoid pro-

thallium of mosses; but, if growing on wet peat, a lobed foliaceous production similar to one of the frondose Hepaticæ; if in water, the prothallium is a fine filament, the lower end of which forms roots, and the upper enlarges into a nodule, from which the young plant is developed. The male organs of *Sphagnum* differ also from those of mosses, and, in the arrangement and form of the antheridia, resemble those of Hepaticæ. They are grouped in spikes at the tips of lateral branches, each of the imbricated perigonial leaves enclosing a single globose antheridium on a slender pedicel. Paraphyses surround them; but, instead of being simple, as in mosses, they are very long, much-branched, and of cobweb-like tenuity. The leaves of the bog mosses are very peculiar and form well-known and beautiful microscopic objects. They are remarkable from the cell-walls being perforated by holes, through which it is common to find that infusoria have passed, which may be seen sporting about in the cell-cavity.—A. W. B.

Peloria in Labiatæ.—In a recent number of the "Sitzungsberichte der Kais. Kön. Akademie der Wissenschaften" of Vienna, Dr. J. Peyritsch records the continuation of his investigations of Peloria, or abnormal irregularity in the flowers of the Labiatæ. He finds the pelorial flower to be very commonly the terminal one in the inflorescence, the lateral ones being of the usual bilabiate type. The numbers of the parts of the calycine, corolline, and staminal whorls vary from two to six, the number being sometimes uniform throughout, and sometimes varying in each whorl; by far the most common arrangement being four of each. The pistil is usually quite regular, but in one instance the ovary was found to be six-lobed, surmounted by a single style and three stigmas. Examples of Peloria are recorded in the following species: —*Galeobdolon luteum*, *Lamium maculatum*, *Ballota nigra*, *Clinopodium vulgare* (one only), *Calamintha Nepeta*, *Micromeria rupestris*, *Nepeta Mussini*, *Nepeta Cataria*, and *Brunella vulgaris*. The abnormal development was found more frequently in plants grown in the Botanic Gardens than in the wild state. The paper is illustrated by several excellent lithographs.—A. W. B.

Lemna trisulca in Flower.—The flowering of the Cruciform Lemna (*Lemna trisulca* L.) is of such extremely rare occurrence, that my discovering it on Belle Isle, in the Detroit river, will be

deemed worthy of record. Floating on the surface of a small pond on this island, which is opposite the east end of our city, I found, on July 16, 1871, an abundance of the flowering *trisulca*, associated with *L. minor* L. and *L. polyrrhiza* L.; though the latter were greatly in the minority. I enclose specimens, from which will be perceived the remarkable difference of the plant from the usual submerged form. The flowering plant, it appears, is always of this small, compact, depauperate-looking type, and is provided with air-cavities which float it to the surface. The fronds are mostly proliferous from but one side, and the stalks are either much reduced or wanting, only five or six generations being connected; from which it would seem that this is a young state. I was not able to observe whether the posterior stamen opens later in the day than the anterior one, as Dr. Engelmann has surmised; but I found that a large number of the flowers had both stamens expanded at five o'clock, P. M. The exsert stamens were in such cases quite distinguishable by even the naked eye. Many of the plants were in bud, or about going to flower, having the anthers still enveloped in the spathe. I have collected a quantity of specimens which I shall be glad to distribute among my botanical friends. I hope to be able, at a later date, to secure the fruiting plant.

Last season (June 7, 1870) I discovered in the greatest abundance *L. minor* L. in full flower, at Eaton Rapids, Michigan. the locality so celebrated for its mineral springs. This plant also is rarely found flowering.—Henry Gillman, *Detroit, Michigan.*

Lemna polyrrhiza in Flower.—I have to add to my former discoveries of flowering Lemnas, the finding of *Lemna polyrrhiza* L. in full blossom. I found it, July 30, 1871, at the west or opposite end of the same pond on the Belle Isle, in the Detroit River, Michigan, in which two weeks previously I collected the flowering *L. trisulca*. Here the *L. polyrrhiza* was largely in the majority, though growing with *L. minor* and *L. trisulca*; all three species being in flower together! At four o'clock, P. M., I observed many of the flowers of the three species with both stamens expanded. I was unable to reach the ground at an earlier hour. The analyzed flower exhibits two ovules. I enclose specimens. *L. polyrrhiza* was found in flower last year for the first time in America by Mr. Leggett of New York—and, I believe, the first time

anywhere for twenty or thirty years—at least the first time to give it a critical examination. The great rarity of the flowering of *L. polyrrhiza* is almost mysterious. Though I believe I have been enabled to throw some light on this matter, yet as I am not positive as to the correctness of my conclusions without further experiment, I refrain from printing them. — HENRY GILLMAN. *Detroit, Michigan.*

ZOOLOGY.

AQUARIA STUDIES.—At the outset of the present sketch we would premise that the glass side of our aquarium which is placed next to the wall, is never cleaned, and in consequence of this, it is soon covered over with a growth of what botanists call Confervæ. The Confervæ are among the lowest forms of Algæ, a group which contains a great number of very minute microscopic plants, which have been, of late years, specially studied by microscopists. Among the lower forms of these Protophytes are the Diatomaceæ, Desmidiæ and Volvocinæ, plants of very simple organization, only lately removed from the animal kingdom. Other orders are the Palmellaceæ, likewise plants of humble type; Ulvaceæ, plants of a rather more complex character; Oscillatoriaceæ, remarkable for a peculiar kind of motion; Nostochaceæ, Siphonaceæ, and Confervaceæ.

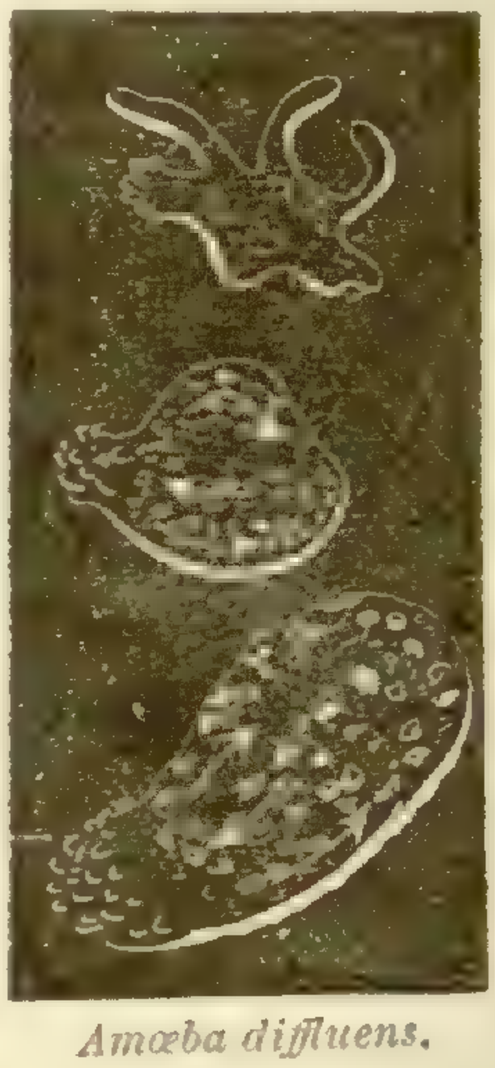
First let us scrape some of the growth off the glass at the back of the tank, then place it in the live box with a drop of water over it, and having adjusted our microscope, what do we see?

First of all notice the vegetation contained in this drop of water. That long pointed ribbon, having the green colouring matter twisting and curling through the centre, is one of the Confervæ, a species of Spirogyra, and close beside it there is another jointed species having the chlorophyll or colouring matter in patches: this is a variety of Stigeoclonium. These are purely vegetable, and are the resort of many little creatures which revel and hide themselves among their tiny clusters of bands.

The first intruder in the field of the microscope we would call attention to is that shapeless mass near the centre. It looks like a small piece of clear jelly with little black dots or granules within. But see, it has changed its shape: it is, as it were, running out; a finger-like process is flowing out here and there; the

granules also are moving. Again we look; it has now assumed a shape something like an outline of a map of Italy. While you are looking it has again changed. You ask what is that? That is one of the simplest forms of animal life; it is called the Amœba or Proteus. (Fig. 111, *Amœba diffluens* Ehr. This and the other figures illustrating this article are copied from Clark's "Mind in Nature.")

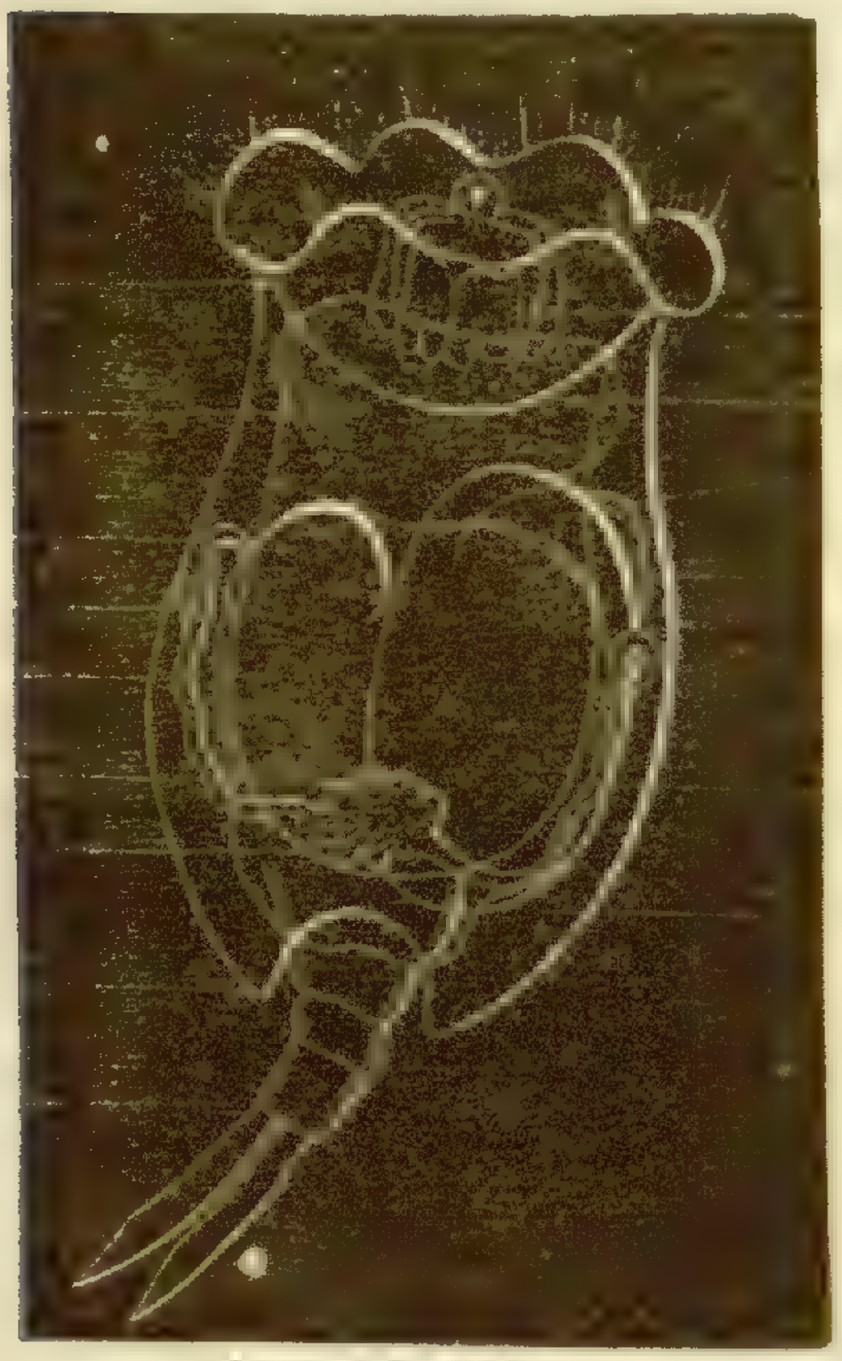
Fig. 111.



Amœba diffluens.

In the Amœba we see an animal that breathes without lungs or gills, digests without a stomach, moves without limbs, and contracts without muscles. Like other animals of simple type, which live for the most part in the deep sea, and which from the possession of root-like feet, are called Rhizopods, its body is composed of a jelly-like substance called sarcode. Some of these creatures have silicious and some calcareous shells, while others have none at all. You will ask how does the Amœba live, and how does it feed? We shall endeavor to show. Although without a nervous system, it is nevertheless very sensitive, as will be seen.

Fig. 112.



Squamella oblonga.

That other creature near it is a Rotifer or wheel-bearer. If you watch you will now see how and upon what the Amœba feeds. As its body flows and contracts, it is nearing the Rotifer which is attached by its foot to the glass, unconscious of his fate. Presently the little mass of jelly flows and touches him, but too late for the Rotifer to make his escape; as if stimulated by the contact, the Amœba has fairly covered him, and through its transparent body the Rotifer's struggles for life are perceptible. All is over with it now, the laws of absorption have so decreed it, and soon nothing will be left of it but its silicious covering. This is the way the Amœba feeds, by absorbing the juices of its victim. This creature is reproduced by fission,

that is, by splitting or dividing itself into pieces, each of which becomes a perfect animal. (Fig. 112 represents a Rotifer, the *Squamella oblonga* Ehr.)

The wheel animalcule (*Rotifer vulgaris*) will be our next subject for examination. He is many degrees higher in the scale than the Amœba; his body is constructed in some degree on the principles of the tube of a telescope; he can also draw himself into a ball at pleasure; he has a mouth and jaws, which are constantly at work; his eyes are distinctly visible. When fishing he attaches himself by a foot or tail-like process either to the glass or to the stems of aquatic plants and stretches himself out, when the entrance to his mouth opens and the cilia, or hair-like appendages with which his mouth is furnished, commence moving or rushing, thus causing a current or small whirlpool in the water, by means of which monads and other animalcules are drawn in, and amongst others our friend the Amœba falls in, so that the victor of yesterday is the victim of to-day.

Rotifers are produced from eggs, although in one species (*Actinurus neptunius*) we have distinctly seen the young one in the body of the parent, and not only so, but have noticed its jaws going as if the creature was feeding. The red eyes of the young Actinurus could also be distinctly seen.

When swimming, the Rotifer is a very graceful creature; with his crown of cilia extended, he glides across the field of view with amazing swiftness.

We well remember when young at microscopy, the anxiety experienced to possess a Rotifer; the quantities of infusion of leaves of all sorts we made, including hay, straw and sage, but to no purpose. We could get lots of monads and other varieties, but no Rotifer. For two years this state of things went on, when we were tempted to bottle some water from one of the street puddles, taking some of the sediment with it. The bottle was placed uncorked, in the window, so that the full benefit of the sun-light might be obtained. As soon as business was over that day the bottle was produced, the animalcule cage filled, the focus of the microscope adjusted, and to our delight, the water was swarming with Rotifers; and from that day to this, we have been close companions. This water was kept for nearly three years, and fresh water now and then added to compensate for evaporation, with a little piece of pond-weed (*Anacharis alsinastrum*), or duck-weed (Lemna)

to keep the water sweet. Many generations of Rotifers lived and died in that bottle, as their silicious skeletons testified, the sediment being full of them.

Temperature has very little effect on Rotifera. We have had a bottle of water containing these creatures frozen solid, and on thawing them, they were as lively as ever. We have also placed a large-sized drop of water on a slip of glass, and held it over the flame of a lamp, long enough for the glass to be uncomfortable to the fingers, with the like result. They only appeared to be a little more active after their warm bath.

Fig. 113.



Epistylis flavicans.

The old experiment of evaporating a drop of water on a slide containing Rotifers we have also tried, and on again wetting the spot, have resuscitated some of them. We have had them the twenty-fifth to the thirtieth part of an inch in length; about the fiftieth part of an inch is the usual size.

A little to the left of the Rotifer, attached to a piece of Conferva, is a beautiful cluster of bell-shaped animalcules, *Vorticella campanularia*. They are attached to the plant by means of a stalk, which has a contractile muscle running from the base to the upper end: they have a ciliated mouth. Just watch that little cluster of crystal bells. They have by means of the muscle drawn back until they look like an irregular mass of gelatine. Now they slowly move out again, as if all were guided by the same will. Now they are at full stretch, with cilia revolving, fishing and feeding. Again, they are all retracted with a jerk. Some of them look as if they were double. Reproduction is going on in these: it is effected by fission. Bye-and-bye these will separate and detach themselves, and swim about till matured, when they attach themselves, to go through the same existence as their progenitors. (Fig. 113 represents a vorticellidan. *Epis-*

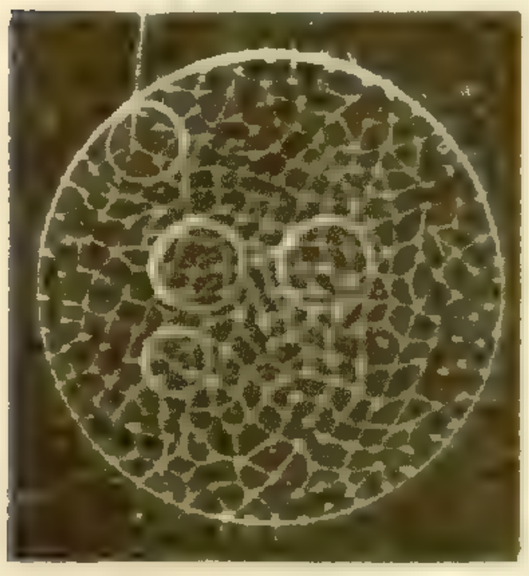
Fig. 114.



Epistylis flavicans, magnified.

tylis flavicans slightly magnified: Fig. 114. the same magnified 250 diameters).

A smaller species, *Vorticella nebulifera*, is to be found attached to the bodies of some Entomostraca, as *Cyclops quadricornis*, and on *Lynceus*. Another species (*Carchesium polypinum*) is also found attached to these creatures. We have a specimen of Cyclops, mounted as a microscopic object, having *Vorticella nebulifera* attached to the back of the crustacean. The presence of the Vorticella on the slide was accidental, as the object was intended to be *Volvox globator* (Fig. 115) only. It evidently



Volvox globator.

Fig. 116



got in, either attached in some way to some of the Confervæ, or from the water.

The stalks in Carchesium are not retractile; the body, however has the power of closing up by muscular action. These we have not found in numbers in our aquarium, but in the ponds near the city they are to be met with in abundance.

Another beautiful creature — the Blue Stentor (*Stentor cœruleus*)—has attached itself to a little bit of weed; its beautiful crown of cilia is expanded, and moves rapidly, creating quite a small whirlpool, into which the unfortunate monads are drawn and engulphed into its stomach. It is of a beautiful blue colour, and is found in great abundance at times on the tops of ponds, which look then as if covered with coal dust. (Fig. 116 represents *Stentor polymorphus* Ehr).

On taking another drop of water from the aquarium, with more of the vegetable matter, we observe other and different creatures, resembling snakes twisting and entwining each other in their folds; these are called Lurcos or Gluttons. They are well named, for they are very voracious, feeding

on animal and vegetable life; their bodies are annulose, or composed of rings having hair-like processes on each segment, which enables them to move about with considerable quickness; their mouth is capacious and ciliated; the intestinal canal is plainly seen, and their food can be well observed through their transparent bodies. We have seen them devour rotifers, monads, bell animalcules and other animals; in fact they refuse nothing. They are produced from eggs.

Fig. 117.



Paramecium caudatum.

That slipper-shaped species is very common, and found in great numbers; it can be seen by the unassisted eye as a tiny speck coursing across the animalcule cage. It is called the Chrysalis animalcule (*Paramecium aurelia.*) It is ciliated all round the sides of its body, and moves about very swiftly; it is like a porpoise in a shoal of herrings—dashing here and there, devouring the smaller species, such as monads, in all directions. It undergoes many changes, and assumes many shapes during its metamorphosis; it is produced by fission as well as from the egg. (Fig. 117 represents *Paramecium caudatum* Ehr.)

That restless little fellow with four horns is *Cyclops quadricornis* (Fig. 118). The only way to get a good look at him is to bring a little pressure to bear by giving the cover of the live-box a slight squeeze so as to keep him still. He is very active, and measures about the sixteenth part of an inch in length. His head is furnished with four antennæ or horns, and the creature is provided with five pairs of feet and a long tail, which is terminated by bristles. It has in the centre of its forehead, a single red eye—hence the name Cyclops, after Vulcan's workman. The legs of the Cyclops at each of the joints, are furnished with hairs, evidently to help the creature in swimming, as is also the case with aquatic beetles. The female carries two ovaries at the extremity of the abdomen.

where the eggs are hatched, and, on the young leaving these sacs, they fall off. The young, according to Carpenter, undergo five changes in their development.

Besides these little creatures we have mentioned there are many more about which much might be said.

We have monads, vibrios in great numbers, always present in the water of our aquarium: not only there we may state, but in the Montreal water this spring we detected in two instances, living vibrios in the water immediately taken from the pipe.

Fig 18



In concluding this sketch of the inhabitants of our aquarium the following remarks may not be out of place.

How little is known, by the great mass of mankind, of the various creations possessed with the wonderful and unknown principle, "life," respecting which much more might, perhaps, be known by means of patient microscopic research. By its aid we may learn how admirably each little organ plays its part, and how the various members contribute to each of these creatures' happiness in their struggle for life, for, for some wise purpose, every animated being, from the monad to the whale is battling for existence.

There is not, perhaps, a single species of animated being whose existence depends not, more or less, upon the death or destruction of others.

In the plan of nature death and dissolution seem to be indispensable for the support and continuance of animal life.

Man may be said, with a few exceptions, to have universal empire over the other animals. Carnivorous animals and birds are also engaged in this general work of destruction.

In fishes, also, as their habits demonstrate, from the least to the greatest, their appetite is almost insatiable, and their object in life seems to be either to devour other fishes or to avoid their own destruction.

Insects, also, are no exception to the rule. We find the same

struggle going on among them, each preying on, or being preyed on by other species.

Even in our aquarium this struggle can be witnessed, as illustrated in the first part of these sketches; also among microscopic creatures, the subject of the present paper. They also have their enemies, the fish swallow them in countless thousands, while the smaller ones supply the larger ones with food.

In the economy of nature no creature lives for its own happiness alone, but by its destruction, contributes to the happiness of others. The balance of power is not entrusted to any particular class or species, and He who in wisdom made them all governs and guides the whole.—A. S. Ritchie, *in Canadian Naturalist and Geologist.*

Hybrid Between Cat and Raccoon.—I saw yesterday (May 2d, 1871) the most interesting hybrid animal I ever examined; and hasty as the examination was, it may be worth mentioning. Passing through Taunton, Mass., I saw in the doorway of Mr. Dunbar's bookstore what struck me, at first, as being the handsomest cat I had ever beheld. The second glance revealed an unmistakable look of wildness; and, for a moment, it seemed to me that it must be some creature of the squirrel kind, at any rate something else than a cat. On inquiry, I found it to be the offspring of a domestic cat and a tame raccoon, kept in the same family in China, Maine. I was informed that there had been several litters of these hybrids, and Mr. Dunbar had before owned one of a previous litter. That had been stolen, and he had obtained this younger one, now seven months old, from Maine.

She is larger than an average cat of that age, and is at once distinguishable both in shape and color. The color is a dark tawny, brindled with streaks that are almost black, on body and legs, and more obscurely on the tail. The under side of the body is lighter, as you will see from the matted hair which I enclose, and which was cut from the under side of one of the hind legs. (She is just now shedding her hair.) All the darker tints are quite unlike any that I ever saw in a cat. In shape she is somewhat slender, I should say, though this is concealed by the great length of the hair. The legs seem longer than a cat's, and there is something peculiar in her gait as if they were set on differently. Her walk is neither plantigrade nor yet quite feline, while it is easy and not

ungraceful. I noticed no peculiarity in the paws, but the owner said she used them "unlike a cat, more like a squirrel." The head looks more triangular than a cat's, possibly, from the pointed and tufted ears, which are quite peculiar. The expression of the creature's face was so wild and formidable that I actually hesitated to touch her, but found her gentle and caressing, beyond even the habit of cats; she seemed more sympathetic and human, instead of less so, which surprised me. But the chief beauty was in the hair which I found to be very long and silken, with a softness such as I have rarely felt in any quadruped, except at a very early age. This characteristic attains its greatest perfection in the tail, which does not in the least remind one of a cat's, but is as bushy and ornamental as a squirrel's — broad, and waving and graceful. I am not well acquainted with the raccoon, though I have seen it alive; but it seems a remarkable and interesting circumstance that a hybrid should have a softness and silkiness of coat beyond that of either progenitor.

The owner has had this beautiful animal but a few weeks, and had the elder specimen of the same race but a day. He says that this one is ordinarily quite gentle and docile; but that, on one occasion, being taken up by the tail, she turned upon the aggressor with a fury far beyond that of a common cat. She also never retreats before a dog, and the dog usually retires. She feeds on milk and meat, like a cat; but has never yet caught a mouse, perhaps for want of opportunity. She is peculiarly nocturnal in her habits; is quite drowsy by day (which I also noticed) but becomes playful at night, and is always found rambling about the large shop in which she is confined.

Mr. Dunbar states that the other specimen of this breed, which he previously owned, resembled this one in color and shape, but not in the length of hair, having more resemblance in that respect to the common cat. It would be exceedingly interesting to compare the different offspring of this strange union. I was unable to ascertain which of the parents — cat or raccoon — was the female; nor could I obtain the name of the person in China, Maine, beneath whose roof these singular hybrids were produced. Possibly, you may have some correspondent in that locality who could give more accurate information. If it were possible to overcome, in this case, the ordinary infertility of hybrids, I am confident that there would be quite a demand for animals of this breed, for their beauty alone. — T. W. Higginson, *Newport, R. I.*

We give the following copy of a letter received by Mr. Higginson:—

"Dear Sir;—your favor was received on Wednesday night and Thursday morning I went over to Taunton to see the cat. It is certainly a hybrid and I am very confident Mr. Dunbar is right in believing it to be a cross of the raccoon and cat. 1st. Its tail in markings and bushiness is strongly coon, as well as the markings of its fore and hind legs and paws. 2d. Its walking gait particularly in the handling of its hind legs is purely coon. 3d. Its disposition is astonishingly wild intermingled with tame. 4th. I understood Mr. Dunbar that his brother-in-law brought the creature from China, Maine, and was assured by the man of whom he obtained it, that it was an *intentional* hybrid of the coon and cat, and not accidental, which to my mind makes it much more probable. Mr. Dunbar promised to get the name of the original owner, and also to let me have the cat to stuff, if it should happen to die. He has also sent for a male hybrid, and if he gets it will inform me. This cat will soon have kittens, and as I am frequently in Taunton, I shall follow up the enquiry with interest. Thanking you for drawing my attention to the queer specimen, and promising to give you farther information as fast as I obtain any

I am, Yours respectfully,

J. W. P. Jenks."

Ornithological Notes from Maine.—Mr. G. A. Boardman of Calais, Me., writes us that he has a Florida Gallinule, *Gallinula galeata*, that was shot near Calais this last spring. Also a *black* Golden-winged Woodpecker, *Colaptes auratus*, black as a grackle and breeding with a woodpecker of the usual color. An albino of the Little Black-headed Duck, *Fulix affinis*, has also been added to his collection, and he found a pair of Red-headed Ducks, *Aythya Americana*, breeding near Calais. This is the first time he has found the Red-head in summer.

A New Species of Alligator.—Dr. Schulte-Buckow, who has travelled extensively in South America, gives in the New York "Zeitung" an interesting account of the habits of the alligators. He discovered a new species, which has been described by Prof. E. D. Cope under the name of *Prosuchus fuscus*.

The Duck Hawk.—Mr. William Jarvis of Hanover, N. H., writes us that he found the nest of a Duck Hawk on Eagle Cliff, near the Profile House, Franconia Notch, last summer. The young were able to fly from the nest, which was made of a few dry sticks placed round a slight hollow on a shelf of the cliff.

ANTHROPOLOGY.

THE FLATTEST TIBIA ON RECORD.—In the Fourth Annual Report of the Peabody Museum of American Archæology and Ethnology (1871), reference is made (pp. 21, 22.) to a certain tibia obtained by me with other similar relics, in 1869, from an ancient mound on the River Rouge in Michigan. It is mentioned as the most extreme case of the flattening of this bone, the transverse being only 0.48 of the fore and aft diameter. Tibiæ from mounds in other parts of the country give the extent of this flattening as 0.60; and in the "most marked case mentioned by Broca, viz., in the old man from Cro-Magnon" (France), it was 0.60.—But I have lately met with several cases presenting this flatness in even a greater extreme: and I have now in my possession two tibiæ, evidently of great antiquity, taken from a mound on the Detroit River, in one of which the short is 0.42 of the long diameter, and in the other only 0.40. This last, therefore, may be considered as the flattest tibia on record. In both, the bone is curved, being remarkably convex forwards. A large amount of the most interesting relics of the ancient mound-builders was associated with these bones, which were selected from among the remains of eleven human bodies. Some of these relics give evidence of the identity of this race with those of the "ancient miners" of Lake Superior, or, at least, of their intercourse; others give evidence of traffic with the southern races—perhaps along the Gulf of Mexico. In all of the mounds along the Detroit River and its tributary the River Rouge, I find a large majority of the tibiæ presenting this flattening. This appears to be an exception to the facts as noted in other parts of the country where the flattening has been estimated as pertaining to "only about one-third of all the individuals observed." Here a tibia not flattened is the exception. And I would further state that where this bone is found approximating to the equilateral, it is manifestly of subsequent burial, and of much later date. This region, at the junction of the Detroit and Rouge rivers, was known formerly as "the Paradise of the Indians," and they evidently congregated here in large numbers.

Prof. Wyman's interesting comparison of the mound-builders with the ancient races of Europe, in which the flattening of the tibia was one of the peculiarities, as also his allusions to the same

characteristic in the corresponding bones of the ape, will not fail to receive attention. He says—"In some of the tibiæ the amount of flattening surpasses that of the gorilla and chimpanzee, in each of which we found the short 0.67 of the long diameter, while in the tibia from Michigan it was only 0.48." Similar comparisons of the other bones, particularly of a large number of crania and of the pelvis, are equally suggestive, and render this one of the most valuable of the reports issued by the trustees.—HENRY GILMAN, *Detroit, Michigan.*

THE TANIS STONE: A NEW TRILINGUAL.—A trilingual stone recently discovered in excavations made at Tanis, on the eastern or Pelusiac branch of the Nile, has been deposited in the Museum of Egyptian antiquities at Cairo. It is a perfect stela, about six feet high, two and a half feet broad, and a foot thick, the summit arched. The inscriptions cover one entire face and most of one side; hieroglyphics occupy about three-fifths (the upper portion) of the face, the Greek version the remainder, while the Demotic translation covers scarcely more than two-thirds (the upper part) of the left side. The letters are small, closely crowded, and all perfect and sharply cut, the stone not having been defaced in the slightest degree; in the extent and perfection of the inscriptions, it is, therefore, much superior to the "Rosetta stone." Plaster casts of the Tanis stone have recently been taken, and copies sent to the museums of London and Berlin; and through the intercession of the American consul, Col. Butler, at the instance of Rev. Dr. Lansing, one of the American missionaries stationed at Cairo, a copy is now preparing for Monmouth College, in Illinois. —S. H. SCUDDER.

GEOLOGY.

REMARKS ON FOSSIL VERTEBRATES FROM WYOMING.—Prof. Leidy remarked that the collection of fossils presented at the meeting of the Philadelphia Academy of Natural Science, August 8, by Drs. J. Van A. Carter and Joseph K. Corson were of unusual interest. They consist of remains mainly of turtles, with those of mammals and crocodiles, and were obtained from the Tertiary deposits in the vicinity of Fort Bridger, Wyoming Territory.

The great abundance of remains of turtles, of many species and genera, of fresh-water and terrestrial habit, obtained in Wy-

oming, indicates this region to have swarmed with these animals during the earlier portion of the Tertiary period. Crocodiles and lacertian reptiles were likewise numerous. The many mammalian remains found in association with the reptilian fossils mainly belong to tapiroid and carnivorous animals.

The Wyoming Tertiary fauna presents a remarkable contrast with the later faunæ of the Mauvaises Terres of White River, Dakota, and of the Niobrara River, Nebraska. Among the large number of fossils from these two localities, rich in evidence of mammalian life, there occur the remains of a single species of turtle in each, and none of crocodiles or other reptiles.

Dr. Carter's collection, besides containing remains of *Trionyx guttatus*, *Emys Jeanesianus*, *E. Haydeni* and *E. Sternsonianus*, and *Bœna arenosa*, also adds two new turtles to the list. One of these is a species of Emys of the largest size, and exceeds any now living. The carapace has measured about two feet and a half in length, and the sternum about two feet. In honor of its discoverer, it may be named *Emys Carteri*.

The first and second vertebral plates of this species present an unusual, perhaps an anomalous appearance. The first is four inches long, and clavate in shape with the narrow part foremost. The second is two and one-fourth inches long, and presents the usual hexagonal form reversed. The third plate, a little longer, is quadrate with convex sides. The first vertebral scute is vase-like in outline, five and one-half inches long, two and three-fourths inches wide in front, four and three-fourths inches near the middle, and three and one-half inches at the back border. The second scute, of the ordinary form, is five inches long, and four inches wide.

The second turtle belongs to the recently characterized genus *Bœna*, but is considerably larger than its associated species which have been described. The shell in its complete condition, has been upwards of a foot and a half in length, and is seven inches and a half high. The sternum is flat, and about fifteen inches long. Its pedicels ascend at an angle of about 45° and are seven inches and a half broad. As in the living Dermatemys, and the sea turtles, they are covered with large scutes, four in number, as in *Bœna arenosa*. The intermediate vertebral scutes are longer than broad — the third being four inches long, and three and one-half inches wide. A peculiarity of the species is the undulating

manner in which the costal scutes join the marginal scutes, and the sternal scutes one another. The species may be named *Bœna undata.*

Dr. Carter's collection also contains some fragments of bones of a large mammal, which are so mutilated as to be hardly characteristic. A jaw fragment among them, with the retained fragments of the true molars, would appear to indicate a species of *Palæosyops* much larger than *P. paludosus.* In absence of other evidence, it might be viewed as a species of this genus, under the name of *P. major.* The true molars occupied a space of four and a half inches. The last molar measured an inch and seven-eighths fore and aft, and an inch transversely in front.

Dr. Carter had also sent some fossils to Prof. Leidy, among which were portions of jaws, with nearly full series of teeth of *Hyrachyus agrarius.* This animal is related to the Tapir, Hyracodon and Lophiodon. The formula of its dentition, is the same as in Hyracodon: seven molars, one canine, and three incisors. The true molars are like those of Lophiodon, except that the last lower one has a bi-lobed instead of a triple-lobed crown. Apparently the same animal has been indicated by Prof. Marsh, under the name of *Lophiodon Bairdianus.* A fragment of a lower jaw containing the last premolar, and the first true molar, indicates a larger species of *Hyrachyus*, which may be named *H. eximius.* The crown of the last premolar is seven and one-fourth lines antero-posteriorly, and five and one-half transversely. The true molar has measured about eight and one-half lines, fore and aft, and six lines transversely. The depth of the jaw fragment below the true molar is over an inch and a half.

Another fossil is a mutilated incisor, indicating a species of *Trogosus* rather more than half the size of *T. castoridens*, which may be named *T. vetulus.*

A femur of *Palæosyops paludosus* in the collection, exhibits the third trochanter, characteristic of the unequal-toed pachyderms. The astragalus of this animal almost repeats that of the living tapirs.

Among the remains of Dr. Corson's collection, there is the greater part of the lower jaw of a large crocodile, but too much broken to attempt to give an opinion in regard to its specific character, until it is in some degree mended or restored.

NOTES.

William Blackmore, Esq., the munificent founder of the "Blackmore Museum," in his native town of Salisbury, England. (which we are authorized by Mr. Squier in saying is the finest illustration of that part of "prehistoric" archaeology denominated the "Stone-age" in the world) is anxious to obtain all possible information regarding the range of the buffalo at the time of the settlement of this country. Mr. Blackmore purchased from Dr. Davis his portion of the antiquities of the west which formed the basis of the first volume of the "Smithsonian Contributions." Any information on the points indicated above, if sent to the care of Mr. E. G. Squier, 135 East 35th St., New York, or communicated to this magazine, will be highly appreciated.

Prof. Albert N. Prentiss of Cornell University has taken the first Walker prize offered by the Boston Society of Natural History. The subject was "The Mode of Natural Distribution of Plants over the Surface of the Earth."

The veteran Herpetologist and Ichthyologist of America, Dr. John E. Holbrook of Charleston, S. C., died at Norfolk of apoplexy on Sept. 8th, aged seventy-six years, eight months. Dr. Holbrook's principal publications were the *Herpetology of North America*, in four quarto volumes containing descriptions and colored figures of all the North American Reptiles known at the time, and the *Ichthyology of South Carolina* in similar style. The former work went through two editions and is to this day the basis of our knowledge of the reptiles of this country. Of the latter work only one volume was published, as the war prevented its completion by the state of South Carolina, though we have certain knowledge that the drawings and descriptions of the concluding volume were in an advanced state, if not even ready for the press at the breaking out of the war.

Mr. S. I. Smith, Assistant in the Sheffield Scientific School, has been appointed State Entomologist of Connecticut.

Mr. J. A. McNiel proposes to make another expedition (the fourth) to the Pacific Coast of Central America. He will leave New York about the first of December and solicits orders for specimens in all departments. His address is Binghamton, N. Y.

It will be remembered that last year Dr. William Stimpson and others explored the bottom of Lake Michigan at great depths with the dredge, and with the most gratifying success. We learn that Mr. S. I. Smith, zoological assistant of the Sheffield Scientific School has been dredging during the past summer in the deepest parts of Lake Superior.

Professor Henry recently, in a few remarks before the California Academy of Sciences, presented the results of the meterological observations which have been made and collected by the Smithsonian Institution. The paper will soon be published. The rainfall of the United States comes from three different quarters, the Atlantic, Gulf of Mexico and the Pacific. Perhaps the largest comes from the Gulf of Mexico, the bottom, as we term it, of the trade wind. Although nothing appears more irregular than the rains in the Eastern States, a long series of observations establishes the fact that they are very regular.

The speaker explained briefly the law controlling the movement and precipitation of vapors, and exhibited several charts, showing on what months the maximum and minimum of rainfall were observed to occur in different localities and upon different areas.

He also displayed a number of the latest compiled charts, showing by graduated colors the comparative amount of the rainfall in various localities. He explained the fact of the rainfall being wholly absent in California in summer.

In Florida the rainfall was light in winter and heavy in summer, owing to the fact that in winter the trade wind which brought the rain took its course more to the southward. The temperature of Sitka was about seventeen degrees warmer than it would otherwise be from the influence of the summer trade winds.

In connection with the present condition of science, Professor Henry enlarged on the reasons why wealthy men should give liberally to the cause. Large donations had been made to the cause of education, while science was nearly neglected. This should not be. Education is merely the diffusion of knowledge already gained. The Chinese are highly educated, but they lack science,

and are therefore non-progressive. Science seeks constantly to add something to the general fund.

No civilization is possible without a concentration of power. The ancients had their power in slaves. The pyramids were built by slave labor. Athens had four hundred thousand slaves and twenty thousand masters. The civilization of those days was supported by the brute forces of man. The civilization of to-day is supported by the brute forces of nature. The latent force of the coal puts the life of a thousand horses into an engine. One ton of our best anthracite coal burned in one of our best engines, is estimated as being equal to two years of labor of an able bodied slave, working ten hours a day; and counting thirty years for his life, fifteen tons of coal would be equal to the life of an able-bodied slave.

It is in the further utilization of these brute forces of nature that the fortunes of our wealthy men lie. When men of intelligence understand that their fortunes depend on the advancement of science, they will be induced to give a small portion of their wealth to this end. Science seeks to enlarge knowledge. No name has gained higher honor than that of James Smithson, for the donation on which the Smithsonian Institution was founded. The only man who has followed his example is Professor Bache of the Coast Survey.

Scientific men should endeavor to impress on the wealthy that their interest lies in the advancement of science as well as the diffusion of knowledge already gained.

Professor Henry referred to his recent visit to Europe and to the rapid strides which science was making in England, and attributed it to the advantages which are given to those men who are pioneers in original discoveries.

A great degree of success has attended the researches carried on by Prof. Baird, the U. S. Commissioner of Fisheries, at Wood's Hole, Mass., during the past season from June till October. He has called to his aid several naturalists, and by their united exertions much light has been thrown upon the distribution of the fishes and the invertebrate animals which form their food. The fishes have been collected in large numbers, and will be worked up by Prof. Gill. Over two hundred photographs of fishes from life have been taken, including sharks and rays in different stages of

development, affording rich material for illustration. Dredging parties have gone out in every direction within a radius of thirty or forty miles, and an immense amount of material, including many new forms and others not before known to exist on this side of the Atlantic, has been accumulated. Among the more interesting discoveries are two Pteropods (*Cavolina tridentata* and *Clio aciculus*) not previously known upon our coast. The invertebrates will form the subject of an elaborate report with numerous plates, by Prof. Verrill and Mr. S. I. Smith. Among the fishes, sixteen species, new to the state, have been obtained and much information collected relative to the nature of the food and rates of growth of the species used as food. We hope in subsequent numbers of this journal to give farther information as to the scientific results of the commission.

Among the visitors to Wood's Hole taking part more or less in the exploration of the commission were Prof. A. E. Verrill, Prof. D. C. Eaton, Prof. W. D. Whitney, Mr. S. I. Smith, Prof. W. H. Brewer, Prof. Todd, and Mr. Thatcher of New Haven; Prof. A. Hyatt and Col. Theo. Lyman of Boston; Prof. L. Agassiz, Dr. Farlow and Mr. Whitney of Cambridge; Dr. A. S. Packard of Salem, Mr. J. Gwyn Jeffreys of London; Prof. Gill, Dr. Palmer, and Mr. Rockwell of Washington, etc.

We learn from the "Academy" that the British Government has expressed its willingness to support Dr. Carpenter's scheme of prosecuting deep sea explorations throughout the Atlantic, Indian, Southern and Pacific Oceans.

Under the title of "An Early Hero of the Pacific" "The Overland Monthly" for August has a very readable account of the life of David Douglas, the botanist, during the ten years, 1824–34, he passed on the Pacific coast.

A new edition, the third, of "Griffith and Henfrey's Micrographic Dictionary" has just commenced passing through the press. John Van Voorst publishes it at No. 1 Paternoster Row, London, at 2s. 6d. per part.—R. H. W.

The French "Cosmos," one of our most valued exchanges before the late war, has reappeared under the title of "La France Scientifique." The first number appeared Sept. 10th. Victor Meunier is the editor.

THE CHICAGO ACADEMY OF SCIENCES.

We take advantage of the delay in the publication of this number of the Naturalist, occasioned by our "Association Number" to place on record the great loss which science has met with in the destruction of the building of the Chicago Academy of Sciences with all its valuable collections and library, during the great fire on the 8th and 9th of October. We had visited the Academy in August and had been fully impressed with the value of its splendid collections, and while watching the telegraphic reports of the fire had hoped that these would at least be spared the fate that once before had befallen the Academy, but the receipt of letters, of which we give abstracts below, showed that our hopes were doomed to disappointment.

CHICAGO, Oct. 10, 1871.

"Among the other buildings involved, was the Chicago Academy of Sciences. It was considered fire-proof; but, in the fiery furnace, its iron shutters warped like pasteboard, and let in the devouring element, and a precious morsel it lapped up. There were the greater portion of the invertebrata collected by numerous explorers and in distant oceans, originally deposited in the Smithsonian Institution, but transferred here for especial study and description by Dr. Stimpson; the collection of mammals and birds made by Dr. Vaille, which cost him years of labor and travel; two skeletons of the mastodon; the collections of Kennicott in the Arctic region; of Stimpson on the Florida reefs and the Gulf Coast; the Cooper collection of shells, purchased by George Walker; an interesting series of implements in pottery and lava—the work of a prehistoric race—exhumed at San Jose, Mexico, presented by J. Y. Scammon; a large collection of minerals, rich in crystalline forms, which was secured through the exertions of Mr. E. S. Chesboro; an extensive suite of the coals and iron ores of the Northwest, and other objects of natural history. The Academy had become the resort for Scientific men desirous of studying not only the natural history of the Northwest, but of the whole country. Dr. Stimpson's MSS. relating to the invertebrates collected on the Japan Expedition, illustrated by numerous drawings—the labor of years, and ready for publication—were also consumed. But a short time ago Mr. J. Gwyn Jeffreys spent several days in examining our collections in reference to deep sea dredgings. But all are gone. The patrons through whose munificence the Academy was built up have shared in the general calamity. Many of the specimens cannot be replaced; but when the Academy shall arise like a Phœnix from its ashes is a matter of doubt. The present is not a time for consultation while the embers are yet alive, and while the smoke is yet ascending."—J. W. Foster.

CHICAGO, Oct. 12.

"**Please stop the sale of the books and papers in the agency**. We have not a copy left of any of them. The Academy building and everything in it was utterly destroyed—not a scrap of paper or a specimen saved. My own books, collections, MSS. and drawings—twenty years' work all gone!"—Wm. Stimpson.

At a meeting of the Essex Institute held Oct. 16th, the president, Dr. Wheatland, read short sketches of the Chicago Historical Society and Chicago Academy of Sciences. From the latter we abstract the following:—In 1856 the formation of a society for the promotion of the Natural Sciences was proposed, and in the following year the Chicago Academy of Natural Sciences was organized. A room was taken and a museum commenced, but owing to the financial crash that came upon the country, very little was done until the year 1859, when it was organized as a corporation under the title of the Chicago Academy of Sciences. In 1862 the lamented Kennicott returned from his three years' exploration in

the Arctic regions, richly laden with specimens, a part of which were to become the property of the Academy. In the winter of 1863-4 advantage was taken of Prof. Agassiz' visit to Chicago to gain his opinion of the value of the collections secured by Mr. Kennicott. His endorsement of Mr. Kennicott's work, and his urging the importance of the formation of a great museum in the Northwest was so strong an incentive that money was at once secured (a large sum being given at an impromptu meeting, afterwards greatly increased by the efforts of Mr. Scammon) and the funds placed in the hands of trustees for the formation of a Museum of which Mr. Kennicott was appointed Director. In 1863 Mr. Kennicott, in order to add to the materials of the museum, accepted the appointment on the Russian American Telegraph Survey. From this ill-fated expedition he never returned. At this time the charge of the museum was given to Dr. Stimpson. On June 7, 1866, a large part of the collection of over forty thousand specimens, and all the plates for the first part of the "Transactions" were destroyed by fire. Soon afterwards the text of the same volume while in the hands of the printer met the same fate. The Academy however started forward with renewed vigor, and erected what in any ordinary fire would have been a fire proof building. Its collections and library were rapidly increased, until, at the date of the present calamity it had within its walls one of the, in many respects, most valuable collections in the country, including the larger part of the crustacea and other invertebrates belonging to the Government and Smithsonian collections, and the crustaceans dredged by Pourtales, which had been sent to the Academy for Dr. Stimpson to describe. The State collection of insects made by the late Mr. Walsh, had also been deposited at the Academy.

The Academy had published its first volume of "Transactions" and forty-eight pages of its "Proceedings." The second volume of "Transactions" was in a forward condition, and many pages stereotyped and several plates printed and stored at the Academy.

After remarks on the great loss which science had met. and a description of the character of the collections destroyed, Mr. F. W. Putnam, vice president of natural history, offered the following Resolutions, which were seconded with remarks by Drs. Bolles and Morse, the president and others, and unanimously passed.

Resolved. That the Essex Institute tenders its sympathy to its sister society, the CHICAGO ACADEMY OF SCIENCES, in her second trial by fire, in which she has lost not only her buildings, but all her specimens, books and publications.

Resolved. That the Institute hereby promises to furnish such of its publications as the Chicago Academy of Sciences may desire, and to render such other assistance as possible in the efforts of the Academy to arise for a second time from the ashes.

May we not, as editors of the NATURALIST, make a special appeal, at this hour of generous free offerings to the suffering people of Chicago, and ask for aid and sympathy for the Academy of Sciences that was doing so much for the cause of education in the great Northwest. Can we not hope, even though so much is yet to be done for the homeless of the great city, and the other towns that have been simultaneously devastated by fire, that the friends of science will aid all they can in giving encouragement to the members of the Academy in this severe trial?

ANSWERS TO CORRESPONDENTS.

M. H. P., Junction City, Kansas.—The common Columbine with full, double, regular flowers destitute of spurs, *i. e.*, with the petals multiplied and transformed into sepals, is a wellknown old plant, not very rare in gardens. But flowers with only five petals and those spurless are unknown to us.

A. H. Y., Hanover, Indiana.—As to new Trillium, considering what vagaries the species sometimes show, it will be in good time to consider the one referred to when any specimen of it is known to be extant, and when we have seen it.

C. G. A., Augusta, Maine.—Your plants are, 1. *Corinia Conradii*: 2. *Geranium dissectum*: 3. *Myontis palustris*: 4. *Empetrum nigrum*: 5. *Vaccinium Vitis Idæa*.

R. C., Cincinnati.—There is as yet no work that comes up to what you want, but we have now in press a work by Dr. Coues that is intended to supply just such wants as yours. It will be a perfect text book of Ornithology and in addition will contain a synopsis of *all* known birds of North America, and an artificial key, by means of which any species of North American birds can be readily identified without previous knowledge of ornithology being necessary. The book will be illustrated with several hundred cuts and several plates.

V. B. L. New York.—Your lichens are—1, Cladonia degenerans; 2, Parmelia tartarea Var. frigida; 3, Sphæria convergens; 4, Lecidea disciformis; 5, Lecanora cinnabarina; 6, Cenangium plicatum; 7, Lecanactis sp.; 8, Lecidea exigua, and Lecidea cerina on the same piece of bark; 9, Parmelia crinita.—J. L. R.

"In the NATURALIST for August, 1870, in the article upon 'Flowerless Plants,' the writer speaks of a species of Clathrus. Can you give me any more of a description of it? For two years, at long intervals, we have had a fungus in a bank at the front of our house, which I think must be this Clathrus. We do not perceive it until the nauseous odor appraises us of its existence. Then we dig it up and burn it; and, following some one's advice, I know not whose, salt the hole from which we dug it. The writer of the article referred to, says it is 'a putrid, revolting, jelly-like mass of raw flesh, just *beneath* the loosely-lifted soil.' The one I speak of seems to come *above* the soil, about two inches before this jelly-like mass appears. Please tell me something about it, if you can, and if there is anything we can do to prevent its recurrence. Perhaps some other reader of the NATURALIST would like to know about it, and you would prefer to answer through its pages."—E. M. B.

We have referred the matter to a well-known botanist, who sends the following reply:

"If the fungus to which you refer be a Clathrus, it begins its growth as a rounded, fleshy cell, which at maturity bursts and discloses a mass of soft, red matter, having a net-like form, with a nauseous odor. This fleshy mass emits an inconceivable quantity of spores, as the generative dust of fungi is termed. It is utterly impossible to eradicate the plant from any spot where it has once distributed its fruit, for the reason that out of these million of reproductive germs, some must inevitably escape any destructive agency. I have known single fungi to appear in places never before detected, and then disappear for years. These spores are so minute that they float in the air like dust, are borne on the percolating water beneath the soil, and are spread abroad by so many natural conveyances that their destruction is impossible. They do not always reappear. Years may pass without their recurrence, and then suddenly, owing to atmospheric influences, these spores, lying perdu in the earth, will germinate luxuriantly.

There are figures of species of Clathrus in many mycological works. Some of them must be very handsome. Should your plant reappear, I would suggest that you should carefully take it up and preserve it in alcohol. By sending it to the NATURALIST the identity could be established.

I should try a dose of carbolic acid, which is not expensive, and could be freely watered over the spot where the fungus appears. Dilute sulphuric acid would prevent the germination of those spores which it touched.—C. J. S.

We also append an account of the European Clathrus from Cooke's "Plain and Easy Account of British Fungi." The second family of fungi is termed Gasteromycetes (*gastes* Gr., a stomach; *mukes*, a mushroom) which have the hymenium or spore bearing surface, enclosed within a covering called a peridium (from *perideo*, Gr. I wrap round) so that all the spores are produced and ripened within a kind of stomach or *gastes*.—Every one knows the puff-ball, a spherical pouch, containing, when ripe, an almost impalpable brownish dust, not unlike Scotch snuff, and which mischievous school boys delight in puffing in each other's faces. The pouch is the peridium or stomach, and the brown dust the innumerable ripened spores.

Certain fungi having this structure are subterranean in habit; in them the hymenium does not become dusty, but remains permanent; nor does it melt away as in other groups, except when it becomes decayed. One of the most striking in appearance, disgusting in odor, and noxious in properties of all fungi, is the Latticed Stinkhorn (*Clathrus cancellatus*) which is, however, so rare as scarcely to merit a notice here except to call attention to its most commendable feature, that of the beauty and singularity of its form. The receptacle resembles a spherical net work or lattice work of coral, but is of so putrescent a nature that its odor materially detracts from its beauty; M. Roques relates of its properties that a young person having eaten a morsel was seized with violent convulsions, lost the use of her speech, and ultimately fell into a stupor which lasted forty-eight hours: prompt attention was given to her, but it appears to have been some months before she was perfectly cured.

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SYMMETRICAL FIGURES IN BIRDS' FEATHERS.

BY GRACE ANNA LEWIS.

In the summer of 1869, whilst examining the feather capsule of a nestling dove, the microscopic slide was suddenly covered with a multitude of exquisite forms. Lost in admiration of the beauty of these brilliants, as seen under the effects of sun-light, for a time I forgot every thing else, but presently remembering that others might enjoy the sight as much as myself, I seized a pencil and rapidly transferred the outlines to paper, continuing until twilight obscured them from view. Resting for an hour, I returned to my microscope, but all had vanished like a dream,—nothing was left but a few drops, looking like perspiration on the face of the glass.

The next day my German farmer climbed to the dove's nest and procured a few more pen-feathers. Some of these were cut into fine shreds, rubbed in a drop of water, and placed under the microscope. In a short period the figures of yesterday were again before me. From the cut surfaces of the portions of the pen-feathers I had placed under the lens, granules appeared to stream forth like blood, covering the microscopic slide in countless numbers. Mingled with these were numerous larger cells of a globular or oval form, having a transparent centre. These and the granules, gave to the water a slightly glutinous consistency. As the fluids on the glass dried, lines at different angles shot across the slide, looking much as though an unseen camel's hair pencil

had been swiftly drawn in opposite directions, sometimes at right angles but frequently at angles more acute. Probably, at the moment of transition from a fluid to a solid condition, the transparent centred, or nucleated, cells assumed the form of a square,

Fig. 119.



Symmetrical Figures in Birds' Feathers.

a lozenge, a starry hexagon, a cross, or any other beautiful figure which could be formed of the parts which suddenly appeared in the spherical cells, these parts seeming at first, in some instances, at least, to consist of minute triangles.

At the same moment the little granules moved to order, and

there before the astonished gaze were diamonds such as Aladdin might have envied, in form as varied, but far more symmetrical than the frost work on a window pane of a winter's morning.

Some of the figures, as I afterwards found on repeated trial, retained their outlines for several hours, in a few instances for days, even when exposed to the moisture of the atmosphere. When examined by lamp-light many, but not all, cast an undoubted shadow. The exceptions appeared to be symmetrical *depressions* instead of raised figures.

These figures must, of course, be common to skilled microscopists. It is not at all probable that forms due to universal causes should remain unseen ever since the invention of the microscope, but to me they were a new revelation, and I watched their formation with intense interest, as the work of polarizing forces whose operation is co-extensive with the universe, and to which all things material are subjected. As the law of gravitation may be observed in a drop of dew as well as in the circling orbs, so it seemed possible for these tiny jewels to elucidate principles of farthest reaching power.

The frost work, annually repeated, is not less beautiful or interesting because it is common, nor do snow crystals grow unlovely because we have seen them before;—the value of neither is lost when they are perceived to be related to certain other symmetrical forms, but on the contrary, all the members of the related groups rise in importance when they are understood to be varying expressions of one eternal omnipresent law of matter,—operating alike in dead and living forms, but according to modes peculiar to unorganized or to organized matter.

One very beautiful form is not given in the cut. It was less distinct then the rest and I waited for a better example to copy. It never appeared again. It was a circle with ornaments at four opposite points, but as I cannot remember the exact style of the ornament, I do not venture to give even a suggestion of the figure. Other very beautiful designs were lost in the same way. Water containing material from the feathers of the common barn-door fowl produced, mainly, simple crosses, the lines usually crossing in the middle, but even in this, some beautiful six-rayed forms were seen. The feathers of the domestic turkey yielded more arborescent forms, as those seen at *b*, which are larger and stronger than those afforded by the feathers of the dove, shown at *a*.

The majority of these symmetrical figures do not possess the sharp outline of crystals, whilst others can doubtless be referred to the mineral salts held in solution in the composition of the feather. There are both rounded and sharply defined figures,—a fact which any one can verify by the microscope. If I am not mistaken, the crystalline forms are derived from the nucleated cells, and the rounded figures from the granular matter.

Of the conditions necessary to produce these forms I know absolutely nothing. I have never yet succeeded in obtaining them from feathers which had long been removed from the *living bird*. This, however, proves nothing as I have frequently failed to procure any from freshly dropped or plucked feathers, which yield them most readily. Of different cuttings from the same feather made during the same minute, and apparently subjected to the same treatment, some presented figures whilst others did not.

BULLOCK'S ORIOLE.

BY ELLIOTT COUES.

Although the beautiful bird referred to in the works cited* has been known by name for nearly half a century, no complete biography has yet appeared: and doubtless many readers of the NATURALIST will be glad to have such information as we can furnish from our study of its habits. We will premise that it is a near relative of the Baltimore oriole, or fire-bird, or hangnest, as it is indifferently called: a bird whose striking colors and brilliant vocal powers, together with its abundance in our streets and orchards, have made it a well-known favorite. Like the Baltimore, it is chiefly black and orange in color, but it differs in having a large white patch on the wings, and the sides of the head and neck orange instead of black. The female, as in all the orioles, is smaller than the male and with hardly a trace of his

Xanthornus Bullocki* SWAINSON, Phil Mag i. 1827, p. 436.—AUDUBON, Orn. Biog. v. 1839, p. 9, pls. 388, 433, and 8vo, ed iv. 1842, p 43, pl 218.—Pacific Railroad Reports, vi. 1857, p. 87; ix. 1858, p. 549; x. 1859, p. 52; xii. 1859, p. 269, and Mex. Bound. survey, ii. pt. 2, 1859, p. 20.—COUES, Proc. Acad Nat. Sci., Philada., 1866, p. 55.—COOPER, Cal. Birds, i, p. 278.—*Psarocolius auricollis*** **of MAXIMILIAN.**

brilliant hues, being plain olive-grey above and whitish beneath with pale yellow on the head, breast and some other parts. The young male at first resembles the female. This is only one of countless cases in which the sexes bear such relations in color. The mother-bird, almost defenceless amidst many dangers, and wholly incapable of protecting her young, is shielded by her humble garb, matching the foliage in which she lives, that she may pass to and from her nest unobserved, and accomplish her important maternal offices in safety. We may judge how well this beneficent design is accomplished, by a glance at any of our large collections where this species is represented; for a dozen or more of the richly attired males will be found for one of the female.

Fig. 120.



Bullock's Oriole.

Of the many beautiful orioles that inhabit Tropical America, only two—the Baltimore and the orchard—range northward through the Eastern United States. In the west, several kinds reach our southern borders, but Bullock's is the only one that proceeds further north. Its distribution in the west corresponds, in a general way, with that of the Baltimore in the east. It inhabits all the wooded portions of the Rocky Mountain and Pacific regions of the United States: in most of its range it is separated from the *habitat* of the Baltimore by the intervening treeless Central Plateau, though the two species approach closely, if indeed they may not be found together, along the Upper Missouri. We have no record of its reaching into British America, but should not be surprised to learn that it extends its range beyond the United States in summer. Being strictly a migratory species, like all of its family, it passes south in the fall, to winter in the

warmer parts of America. It appears in Lower California in March, but does not complete its migration into the United States until some time in the following month, when the forests it loves to dwell in are clothed with verdure. In the pine clad mountains of Arizona and New Mexico, we never saw it until about the middle of April; then, and until the cool weather of September, we were almost daily gratified with the sight of the gaily-hued birds gleaming through the sombre foliage like tiny meteors, and with the sound of their musical voices awakening echoes along the deepening aisles of the woodland.

In the countries just mentioned, the belts of thick cotton-wood and willows that generally fringe the streams are favorite resorts, perhaps because the pliant twigs are best suited to their wants in constructing their nest. All the orioles are wonderful architects, weaving pensile nests of soft pliable fibrous substances with a nicety and beauty of finish that human art would vainly attempt to rival. These elegant fabrics are hung at the end of slender twigs, out of reach of ordinary enemies; and though they may swing with every breath of wind, this is but cradle-rocking for the callow young, and it is a rude blast indeed that endangers the safety of their leafy home.

Little time passes after their arrival before the modestly-attired females, rambling silently through the verdure, are singled out and attended each by her impetuous consort, who sings his choicest songs, and displays the prowess she admires most. His song is an elegant paraphrase of the Baltimore's, with all its richness and variety, though an ear well skilled in distinguishing birds' notes can readily detect a difference. Their courtship happily settled, the pair may be seen fluttering through the thicket they have chosen, in eager search for a building-place; and when a suitable one is found, no time is lost in beginning to weave their future home. It is a great mistake to suppose that birds of the same species always build in the same way. Though their nests have a general resemblance in style of architecture, they differ greatly according to their situation, to the time the birds have before the nest must be used for the reception of the eggs, and often, we are tempted to think, according to the taste and skill of the builders. In their work of this sort, birds show a remarkable power of selection, as well as of adapting themselves to circumstances: in proof of which we have only to examine the three beautiful specimens now lying

before us. Each is differently constructed; and while all three evince wonderful powers of weaving, one of them in particular is astonishingly ingenious, displaying the united accomplishments of weaving and basket making. Before proceeding, we may premise that the idea of the nest is a sort of bag or purse, closely woven of slender pliant substances like strips of fibrous bark, grasses, hair, twine, etc., open at the top, and hung by its rim in the fork of a twig or at the very end of a floating spray.

The first nest was built in a pine tree; and if the reader will call to mind the stiff nature of the terminal branchlets, each bearing a thick bunch of long straight needle-like leaves, he will see that the birds must have been put to their wits' end, though very likely he will not be able to guess how they made shift with such unpromising materials. They made up their minds to use the leaves themselves in the nest, and with this idea they commenced by bending down a dozen or twenty of the stiff slender filaments, and tying their ends together at the bottom. If you have ever seen a basket maker at work, with his upright pieces already in place, but not yet fixed together with the circular ones, you will understand exactly what the birds had thus accomplished. They had a secure framework of nearly parallel and upright leaves naturally attached to the bough above, and tied together below by the bird's art. This skeleton of the nest was about nine inches long, and four across the top, running to a point below; and the subsequent weaving of the nest upon this basis was an easy matter to the birds, though, if one were to examine a piece of the fabric cut away from the nest, he could hardly believe that the thin yet tough and strong felting had not been made by some shoddy contractor for the supply of army clothing. Yet it was all designed in a bird's little brain, and executed with skilful bill and feet.

Perhaps the young birds that were raised in the second nest did not appreciate their romantic surroundings, but their parents were evidently a sentimental pair. If they did not do their courting "under the mistletoe," at any rate they built a cozy home there, tinting the sober reality of married life with the rosy hue of their earlier dreams. The nest was hung in a bunch of the *Arceuthobium oxycedri*, an abundant epiphytic plant that on the western wilds represents the mistletoe, and recalls the cherished memories of holiday gatherings. The nest was a cylindrical purse some

six inches deep and four broad, hanging to several sprays of the mistletoe, which were partly interwoven with the nest to form a graceful drapery. The felting material was long, soft, vegetable fibre of a glistening silvery lustre, in artistic contrast with the dark-hued foliage. A few hairs were sewn through and through, for greater security, and the pretty fabric was lined with a matting of the softest possible plant-down, like that of a button-wood or an Asclepias.

The general shape and the material of the third nest were much the same as those of the last; it was, however, suspended from the forked twig of an oak, and draped almost to concealment with leaves. But it had a remarkable peculiarity, being arched over and roofed in at the top with a dome of the same material as the rest, and had a little round hole in one side just large enough to let the birds pass in. Such a globular nest as this is probably exceptional; but now it will not do to say that orioles always build pensile pouches open at the top.

The eggs of this species are four or five in number, and rather elongated in form, being much pointed at the smaller end. They measure on an average just an inch in length, by about two-thirds as much in greatest diameter, which is much nearer the larger than the smaller end. In color they are very pale bluish, or rather whitish with a faint dull blue shade, and are everywhere irregularly overrun with fine sharp hair lines of blackish brown, or blackish with a slight tinge of purplish. These curious zigzig markings are characteristic of the eggs of a majority of the birds of the family (*Icteridæ*). They have no definite style, but wander at random over the surface, and in no two specimens are they alike. Thus in one specimen the lines, fine as hairs, are wound round and round the butt, with such regularity that they hardly ever interfere; in others, they are snarled up in different places: and sometimes, particularly at a sharp turning-point, the lines spread into little spots; and there are often a few such isolated markings in various places over the egg.*

We need say nothing of the general habits and manners of Bullock's Oriole, for it does not differ from the well-known Baltimore bird in these respects.

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*The nests and eggs above described were collected in California and are now in the Smithsonian Institution, where we have been generously allowed to examine them.

THE CHINESE WHITE WAX INSECT.

BY PROFESSOR B. SILLIMAN.

We find the following note on this insect (a species of Coccus) in an interesting volume by T. T. Cooper.* Chemists have long known the so-called "vegetable wax," "Chinese wax" or "pela," also called "vegetable insect wax," or "vegetable spermaceti," but we have had no definite knowledge before of its history or mode of production.

It was generally stated to be produced on certain trees by the puncture of a species of Coccus. But Mr. Cooper supplies us with the first definite statement we have seen of what proves to be an extensive, and to us novel, industry. Unfortunately, he does not appear to have secured specimens of the insects producing it, nor does he give us more definite information of the plant on which they feed than that it resembles our privet.

It may be interesting to non-chemical readers to know that this insect wax is a definite compound somewhat resembling spermaceti in appearance but not in composition, being a *Cerotic ether* known as *Cerotate* of *Ceryl* of the formula $C^{59}\ H^{118}\ O^2$. It is crystalline, and of a dazzling whiteness like spermaceti, but more brittle and of a more fibrous texture. It does not completely saponify by boiling in potash water, but is completely decomposed when melted with potash, yielding cerotate of potassium and hydrate of ceryl. It is consumed in China for candles and also as a medicine. It melts at about 118° F. It does not appear clearly from the statements of Mr. Cooper, whether this wax is secreted by the insect or is not rather an exudation from the stems of the trees punctured by the insect. Mr. Cooper plainly favors the former supposition; but other writers of more pretensions to science entertain the opposite view. The plant on which the Chinese Coccus lives is stated to be *Ligustrum lucidium*.

There are several sorts of vegetable wax well known to chemists and new to commerce, and we find it stated by Rev. Justin Doolittle in his "Social life of the Chinese" that the "vegetable

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*Travels of a Pioneer of Commerce in Pig Tail and Petticoats, on an overland Journey from China toward India. By T. T. Cooper. London. Murray. 1871. 8vo. pp. 471.

tallow" of China is obtained from the seeds or kernels which grow upon the so-called "Tallow Tree." But he also states that this tallow is hardened by a very hard white wax brought from the western or northwestern provinces of China, which is the very wax described by Mr. Cooper. The 'tallow' is not a wax in chemical constitution, and is the product of a shrub known as *Stillingia sebifera*. Our American myrtle wax (bayberry tallow) is a solid fat melting at about 118° F. and contains a large quantity of palmitic and a small quantity of myristic acid (Moore. Sill. Jour: [2] xxxiii,113.)

From its high melting point and general physical and chemical properties we might infer that the white wax of China was the product of the Coccus, rather than of the plant on which it feeds, seeing the properties alluded to are more like those of bees' wax than of vegetable wax, known to be such. But of this we still lack the proof. Probably some of your entomological correspondents may know the wax producing, or provoking, Coccus.*

Our quotation from Mr. Cooper's instructive volume is as follows:—

"On the third day we entered the white wax country so named from its producing the famous white wax of Szchuan, which has been erroneously called vegetable wax. This district was less undulating than that of the tea gardens, and presented to the eye a view of extensive plains surrounded by low hills. The plains were all under wax and rice cultivation, the wax trees being planted round the embankments of the small paddy fields which were at most thirty yards square. The country thus presented to the passing traveller the appearance of extensive groves of tree stumps each as thick as a man's thigh and all uniformly cut down to a height of about eight feet, without a single branch. The cultivation of wax is a source of great wealth to the province of Szchuan, and ranks in importance second only to that of silk. Its production is not attended with much labor or risk to the cultivator. The eggs of the insect which produces the wax are annually imported from the districts of Hochin or HoKing and Why-li-tzou in Yunnan (where the culture of the eggs forms a special occupation) by merchants who deal in nothing else but Pa-la-tan "white wax eggs." The egg clusters which were described to me

* Westwood (Modern Classification of Insects ii. p. 449) writes thus: "The *Coccus ceriferus* Fabr., described by Anderson in his letters from Madras (1781) and by Pearson in the Phil. Trans. 1794, is employed in the production of a white wax, the body of the females being enveloped in a thick and solid coat of wax." It is now known that this wax as well as that of the honey bee is secreted by numerous minute secretory sacs or follicles lodged just beneath the skin of the abdomen.—Eds.

as about the size of a pea are transported carefully packed in baskets of the leaves of the Pa-la-shu, "white wax tree," which resembles a privet-shrub, and arrive in Szchuan in March, where they are purchased at about twenty taels per basket. The trees by the middle of March have thrown out a number of long tender shoots and leaves, and then the clusters of eggs enclosed in balls of the young leaves are suspended to the shoots by strings. About the end of the month the larvæ make their appearance, feed on the branches and leaves and soon attain the size of a small caterpillar or rather a wingless house-fly apparently covered with white down, with a delicate plume-like appendage, curving from the tail over the back. So numerous are they that as seen by me in Yunnan, the branches of the trees are whitened by them, and appear as if covered with feathery snow. The grub proceeds in July to take the chrysalis form, burying itself in a white wax secretion, just as a silkworm wraps itself in its cocoon of silk. All the branches of the trees are thus completely coated with wax an inch thick, and in the beginning of August are lopped off close to the trunk and cut into small lengths which are tied up in bundles and taken to the boiling houses, where they are transferred without further preparation to large cauldrons of water, and boiled until every particle of the waxy substance rises to the surface: the wax is skimmed off and run into moulds in which shape it is exported to all parts of the Empire.

It would seem that the wax growers find that it does not pay them to reserve any of the insects for their reproductive state, and hence the necessity of importing the eggs from Yunnan. In the district of Ho-chin and Why-li-tzou, where the culture of the eggs is alone attended to, both frost and snow is experienced, so that it would not be difficult to rear the insect in Europe, and considering its prolific nature, the production of white wax might repay the trouble of acclimatizing this curious insect."

INSTRUCTION TO SCIENCE TEACHERS AT SOUTH KENSINGTON.

During the months of June and July, a number of science teachers from various parts of England, Scotland, and Ireland, were assembled in London, for the purpose of attending special classes, arranged for their instruction under the auspices of the Science and Art Department. We propose to give some account of the course of instruction in the principles of Biology

which was directed by Prof. Huxley, to whose suggestion, we believe, liberally accepted by Mr. Forster, and acted upon by the government, this important scheme for raising the character of science teaching in the various schools and classes at present in relation with South Kensington is due. It had long been felt by those who annually examined teachers and pupils for certificates in various branches of science, under the Science and Art Department, that the candidates displayed a sad want of practical acquaintance with the subjects in which they presented themselves for examination: many showed considerable ability and great book knowledge, but a knowledge of the things themselves with which science deals, a proof of personal intercourse with Nature, which after all is the only foundation of scientific knowledge, and without which all the 'ologies are so much book-wormery, was to a very great extent wanting. Under the existing state of things it seemed almost impossible to get out of this vicious condition, for the scholars who were in their turn destined to become teachers were for the most part taught by men who were deficient in practical knowledge; and with the increasing demand for science teaching there appeared to be a probability of the evil being increased by the rapid accession of the book-taught students to the position of instructors. The only way to meet this difficulty was to find teachers who had the requisite familiarity with the "solid ground of Nature," and set them to work to leaven the mass. The readiest means of doing this was undoubtedly that adopted by the authorities — namely, to summon to a central class, the ablest of the teachers at present distributed throughout the kingdom, and to impart to them as much practical acquaintance and personal familiarity with the *things* of which they had read in books, as was possible in a given time. By annual repetition of this plan there can be little doubt that the body of science teachers throughout the country would be materially affected. Being already acquainted with the outlines and much of the detail of their subjects by hearsay, they would readily understand and appreciate the facts and methods of investigating facts placed before them, and after passing through such a course of instruction would be prepared to proceed further in the same direction by their own individual efforts, and what is more important, to teach, not at second-hand, but from experience, not as fluent repeating machines **but as thoughtful students of phenomena.**

Thirty-nine students of whom one was a lady, attended the course of instruction in the principles of Biology, their expenses (involved in coming to London) being defrayed by the Government. The course occupied six weeks: the students attended every day, with the exception of Sundays, from ten in the morning until half-past four in the afternoon (Saturdays until two). Each morning at ten o'clock a lecture, occupying from an hour to an hour and a half, was given by Prof. Huxley, and the remainder of the day was employed in dissection, microscopic work, and demonstrations, in carrying out which Prof. Huxley was assisted by Prof. Michael Foster, Prof. Rutherford, and Mr. Ray Lankester. The students were placed in pairs at large working tables, and each table was provided with a microscope (with inch and one-eighth inch objectives, and two eye-pieces furnished with micrometric square-ruling), with four scalpels, two pairs of scissors, two pairs of forceps, pins, thread, dissecting needles, watch-glasses, beakers, pie-dishes, glass-tubing, and camel's-hair brush.

The practical instruction proceeded *pari passu* with the lectures, the students at once taking their places at the tables after the lecture, and setting to work at materials provided for them to dissect or examine with the microscope in illustration of, or rather as the sequel to, the lecture which they had just heard. Each student was required to send in full reports and drawings as the result of his day's work, many of which proved very excellent: an abstract of the lecture was also given in by each student with the report of his practical work, and the lot were returned at the end of the course (after due examination by the lecturers) to the students for their future reference.

Two prizes — which were two microscopes similar to those used by the members of the class, and provided like them with inch and one-eighth inch objectives — were offered to the students who should be considered to have done best during the course, especial weight being given to excellence in the practical work, as judged both by observation of the student when at work, and by the reports sent in.

The names of the students were placed in two classes of merit at the termination of the course, arranged in alphabetical order.

Now as to the subjects which were gone over in the time, which though limited to six weeks, yet by dint of hard work, was made to take in more than many a six months' course. The yeast

plant occupied the first lecture and each student was provided with some yeast, which was carefully examined and drawn under the microscope. Each student sowed some in Pasteur's solution which he had himself prepared, and on the following day studied its germination. In like manner the Penicillium mould was studied, sections being cut through the crusts, and careful drawings made of mycelium, hyphæ, conidia, etc. The latter were sown, and their development accurately observed and drawn by each student. A solution of hay was given to each, and the formation of a Bacterium film was studied, the form and movements of Bacteria were compared with the Brownian movements of gamboge rubbed up in water. The structure of the higher Fungi was then studied in specimens of a common toad-stool, and thus a general notion of the morphology and life-history of the Fungi was obtained. Protococcus in its various stages, Palmella, and Volvox next formed the subjects of lectures and practical work, and from these simpler forms the students passed on to Spirogyra and Chara. In Chara the advance in cellular differentiation was noted by each student on specimens supplied to him, and the male and female reproductive bodies examined in detail, and the Antherozooids were obtained in active movement. The phenomenon of cyclosis was also very carefully gone over, each student comparing that of Chara with that seen in Valisneria and in the hair of the nettle and of Tradescantia; drawings and descriptions being made and the specimens prepared by every student for himself. During this time a certain amount of familiarity had been obtained by all with the use of the microscope—not half a dozen of the class, be it remembered, having previously ever used the instrument at all, still fewer one of adequate power—and as well as the instrument itself, the use of various reagents had been learnt, such as iodine-solution for demonstrating starch, and for delineating protoplasm, acetic acid, magenta-solution, etc. From Chara the class proceeded to the study of the Fern—the sori and sporangia were examined in the first place, and the general form of the fern-frond; then each student was provided with spores which had been previously allowed to germinate, of two stages of development, the one set with the quite young pro-embryo-like prothallium, the other more advanced exhibiting numerous archegonia and pistillidia, the structure of all of which were examined and drawn; and in many cases active antherozooids were obtained.

The structure of the fern stem followed, exhibiting typical scalariform, dotted and spiral ducts and other forms of tissue; also the leaf of sphagnum; the methods of recognizing starch and cellulose being here again used. From the fern the class passed on to the study of a bean plant as typical of a phanerogam. Its general morphology, the microscopic structure of its tissues, the minute structure of the flower and the histology of the essential reproductive organs were examined during three consecutive days, and finally the development of the seed and the growth of the young bean plant were studied.

In this work each student used a razor for making sections of the parts to be studied, and portions of turnip were made use of for embedding delicate pieces of tissue, such as leaves, in order to facilitate the cutting of thin sections. A few typical flowers (*e. g.*, Campanula, Rosa, Viola, various Orchids) were next studied as examples of the kind of modification of parts exhibited by phanerogamous plants and also the female flowers of a small Conifer. Before proceeding to the animal kingdom, a lecture was devoted to a retrospect of the steps through which the class had passed from the simple to the more complex forms, a comparison of the various methods of reproduction, and an outline of the physiology of vegetable life.

Amœbæ, the colorless corpuscles of the Triton's blood, and the amœboid particles of Spongilla were the first examples of animal life studied, each member of the class making drawings of the various forms due to protoplasmic movement presented by an individual example of each of these cases of simple organism whilst in the field of his microscope. The Gregarinæ of the earth-worm next occupied a day, and every student was able to observe and draw the actively moving nucleated Gregarina, its simple encysted condition, and its various stages of breaking up into pseudonaviculæ.

The structure of Infusoria was next examined, as exemplified in Vorticella and Vaginicola, the nucleus, contractile vacuole, mouth, etc., being fairly observed and drawn by all the students. Specimens of Hydra were provided, on the following day, and the endoderm and ectoderm, thread-cells and reproductive organs studied. To this followed a copious supply of *Cordylophora lacustris* (from the Victoria Docks), in which the class were able to study a typical compound Cœlenterate, and to recognize not only

the male and female gonophores, but the larval "planula-form" as it escaped from the reproductive capsules. Plumatella as a typical Bryozoon succeeded this, and then two days were given to the dissection and histology of Anodon, of which each student was provided with two or three specimens. The lobster as a typical Arthropod was then examined, a fresh specimen being supplied to each table; the heart and vessels were first studied, then the alimentary canal, liver, reproductive organs and green glands. A large piece of mill-board covered with paper was used by each pair of students for placing out in order, numbering, naming and comparing the twenty somites and their appendages, an instructive preparation being thus made. The corresponding parts were again examined, and the microscopic structure of the muscular tissue, blood, liver, and gills, in specimens of the river cray-fish. The careful dissection of the frog next occupied some days and to this succeeded the rabbit.

Simultaneously with the dissection of these vertebrata, the study of the microscopic structure of the various tissues and organs was commenced, so that whilst one student was using the microscope, his companion at the table was dissecting, and *vice versâ*. The blood of the frog and of man, the movements of the colorless corpuscles in both cases, and the action of acids on them, the varieties of epithelium, the various forms of connective tissue and its corpuscles, cartilage, bone, muscular tissue smooth and striped, nerve fibres and cells, the termination of nerve in muscle, and the structure of the more important organs, were examined by the class, *not* in already prepared and mounted "slides," but in specimens which each student took for himself, usually from the animal under dissection, and treated with various reagents, the methods of cutting thin sections and embedding tissues in wax or paraffin being learnt at the same time.

A simple injecting apparatus (formed by two Wolff's bottles and a large vessel of water) was put up, and the method of injecting a frog shown to each student. The best part of a day was spent in a thorough dissection of a sheep's heart, and another in the dissection of the sheep's larynx. Vertical antero-posterior sections of the sheep's head were supplied to the various tables, and in these the parts of the brain and cranial nerves (already made out in the rabbit), the tongue, the relations of the cavities of the mouth, nose, and ear, the ducts of the salivary glands, and the muscles of

the eye were studied. The structure of the eye was again examined by each student, in specimens of those of the bullock, supplied in quantity, and the internal ear and auditory ossicles were demonstrated in rough preparations of the sheep and rabbit.

But little time could be afforded to physiology; and, indeed, it was hardly possible that each member of the class should perform many physiological experiments for himself. The movements of the heart in the frog after excision, and the localization of the nerve-centre, was made out by each student for himself; also the phenomena of reflex action in the frog, after the destruction of the cranial portion of the cerebro-spinal nervous system. Again, each table was supplied with simple galvanic forceps, and the irritation of nerve and of muscle examined, also the action of chemical and mechanical stimuli on the nerve. The action of curare poison on the frog (Bernard's experiment) was examined by every student, and the condition of the poisoned and the unpoisoned leg compared. Every member of the class was made familiar with the simplest way of demonstrating the circulation in the frog's foot, tongue, and mesentery, under the microscope, and repeatedly examined the phenomenon for himself. Rigor mortis and the artificial rigor produced by warm water were examined. The conversion of starch into sugar by the saliva, and the methods of proving the presence of starch and grape sugar, were made the subject of experiment by every individual of the class. The peristaltic movements of the intestine and the absorption of the chyle by the lacteals were exhibited and closely examined. A model of the circulation, consisting of india-rubber tubes and pump, was used for demonstrating the nature of the pulse, the pressure (by means of manometers placed in connection) in the arteries and veins, and the effect of dilatation and contraction of the capillaries and of rate of pulsation on this pressure. Finally, the thorax was opened in a narcotised rabbit and the heart exposed, and each student satisfactorily witnessed the pulsations of that organ and the inhibitory effect of irritation of the vagus nerve; the blood-pressure was exhibited to each member of the class in a similarly narcotised dog by means of the hæmodynamometer, a tube being placed in the animal's carotid artery; and as a concluding demonstration the important fact of the influence of nerves upon gland secretion was demonstrated by the beautiful experiment of Bernard, the chorda-tympana being irritated, whilst a canula was

placed in the duct of the submaxillary gland. Great care was taken that none of the experiments exhibited to or performed by the members of the class should be open to the charge of cruelty, the animals used being either completely narcotised, or (as in the case of the frogs), having the cerebral portion of the nervous system destroyed in the proper manner.

Throughout the course the morning's lecture was made preparatory to or an extension of what was afterwards brought under actual observation. The concluding lecture was devoted to a retrospect of the work which had been gone through, and an exposition of the idea which had guided the scheme of study pursued, the object having been not to make botanists, nor zoologists, nor anatomists of the members of the class, but to give them a practical insight into the structures and activities of living things, in such a way as to enable them to observe for themselves the relations and connections of the various forms of life, and to follow from actual examples the characteristics and increasing complexity of different plans of structure.

The reports of work and lectures daily sent in by the members of the class were entirely satisfactory, and the spirit and enthusiasm displayed throughout proved how greatly the value of the course was appreciated. When it is remembered that with scarcely an exception, these teachers had hitherto never used the microscope, never dissected a single organ or organism for themselves, nor seen one properly dissected, the advantage gained by the experience they have now obtained, even if only a portion of what was condensed into six weeks' work remains with them, is something very considerable, for it is something of a *new kind*, a form of knowledge which they entirely failed to obtain before.

It is exceedingly interesting to find that no difficulty was experienced in going over all these matters in a class which was not confined to men alone, and most heartily do we hope to see in the future a larger proportion of women engaged in this and other branches of scientific study. Those who imagine that women have some innate incapacity, and assert that if admitted to classes now limited to men they would be unable to profit by them, or would hinder the progress of the class by the greater attention they would require in order to keep them to the level of male students, may take this fact to heart—one of the microscopes offered as a prize for the best work done, and the best record of the lectures

and the day's work, was adjudged simply upon the merits of her reports and work to the one lady among the thirty-nine students who formed the class. On the other hand, this fact will probably stimulate that unavowed feeling, akin to the trades-unions' hostility to competition, which is the cause of the arbitrary exclusion of half of the community from our greatest educational institutions. — E. R. L., *in Nature*.

CONTRIBUTIONS TO THE NATURAL HISTORY OF THE VALLEY OF QUITO. — II.

BY PROF. JAMES ORTON.

REPTILES.

The herpetology of mountain regions is very limited, for the number of species diminishes rapidly as we ascend in altitude or latitude. The reptilian life of any district, however, is highly interesting, as it is more natural and well defined than that of other vertebrates, because reptiles have a limited range* and are less likely to be forced out of their original habitats or introduced by man. It has been supposed that in order of altitudinal range, lizards go highest, snakes next, and batrachians and chelonians last. There are no chelonians in the valley as far as we know: but we found frogs as high up as Antisana Hacienda, and no lizards there. Gibbon found no snakes at La Paz.

The only reptiles which we know to exist in the valley are as follows: *Batrachians*—*Atelopus longirostris* Cope (a new species found by the writer at Antisana Hacienda, thirteen thousand three hundred feet above the sea), *A. laevis* Günth., *Hylodes conspicillatus* Günth., *Bufo intermedius* Günth.; *Ophidians*—*Herpetodryas carinatus* Boie, *Streptophorus Drozii* D. B. An active little lizard (a Pleurodont) occurs in the warm, dry parts of the valley; but we failed to secure a specimen.

FISHES.

Considering the size of the Machangara and Pastassa Rivers

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* A remarkable exception is presented by our common Snapping-Turtle, *Chelydra serpentina* Linn., which we found at Guayaquil on the Pacific coast, 2° below the equator.

and San Pablo Lake, it is remarkable that only one species of this class (so far as we can ascertain) occurs in the Quito waters. This is the *Cyclopium Humboldtii* Sw., one of the Siluridæ. It abounds in the Machangara, but we have never seen a specimen over four inches long. According to Dr. Gill it is generically distinct from the *Stygogenes Humboldtii* of Günther; but we cannot distinguish it from the *Pimelodus cyclopum* mentioned by Humboldt* as in-

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*NOTE ON THE PIMELODUS CYCLOPUM OF HUMBOLDT. By F. W. Putnam.

Professor James Orton, in 1870, presented to the Academy a specimen of a small Silurid which he obtained at Quito, Ecuador, and which he supposed was the same as the fish mentioned by Humboldt from the subterranean waters of the Andes. On comparing the fish with the descriptions of the species of *Arges* and *Stygogenes*, given by Cuvier and Valenciennes, and by Günther in his Catalogue, I cannot see any reason for keeping the genera apart, as the specimen in hand unites the characters of the two. Agreeing in every detail with the short description given by Günther of *Arges brachycephalus*, with the additional character of having a short broad spine in front of the adipose dorsal, it has the serrations on the outer rays of the several fins which he mentions as characteristic of *S. Humboldtii*.

Our specimen has the following characters, which, it will be noticed, are taken almost word for word from the descriptions given by Günther of *A. brachycephalus* and *S. Humboldtii*. Head one-fifth of the total length of the fish. Eyes situated on top and about in the middle of the length of the head, very small, black. Nostrils are much nearer the extremity of the snout than to the eyes. Upper jaw slightly projecting. Lips thick, under lip, or labial fold, emarginate behind. Teeth in three or four rows, more or less notched; those on under jaw a little the broadest and with slightly deeper notches. The outer rays, or spines, of first dorsal, pectorals, ventrals, anal and caudal fins slightly prolonged and provided throughout their length with small spines projecting backward. Adipose fin moderately long, low, and reaching to base of upper caudal ray, a short broad spine at its front base *buried in the skin*. This spine is hardly equal in length to one-eighth of the length of the head. Longest rays of pectoral and ventral about equal in length. Pectoral rays reaching a little beyond the base of the ventrals. Ventral ray filament reaches to anus. Ventrals situated about under origin of dorsal. Color of the specimen brownish with dark mottlings. Lateral line distinctly marked by raised pores, and extending the whole length of the body. Maxillary barbles about one-half the length of the head. Anal and dorsal fins fold into slight grooves.

	Fin formula of					
	D.	A.	C.	P.	V.	
Academy specimen,	I+7, I.	I+5.	I+5+6+I=13.	I+8.	I+5.	
A. brachycephalus,	I+6, 0.	6.	. . . . .	I+9.	6.	Günther.
S. Humboldtii.	6, I.	6.	13.	8.	6.	"

This slight variation in the fin rays would give the following for the three specimens. 1st dorsal, 6 to 8. 2d dorsal, 0 to 1. Anal, 6. Caudal, 13. Pectoral, 8 to 10. Ventral, 6; or allowing for a variation of two rays in the first dorsal and pectoral fins (which might very easily be an error in counting) we have the difference in the fin formula of the three specimens reduced to the presence or absence of the spine of the adipose dorsal, which could very easily be overlooked unless special search was made for it, as in the specimen under examination, in which it was found covered by the skin of the fin.

Under these considerations I can but think it probable that Humboldt overlooked the spine in his specimen, and also that it is possible that Günther overlooked it in his specimens of *A. brachycephalus*. At all events I cannot regard its presence as of any generic or even specific value on the present data.

habiting the subterranean waters of the Andes and thrown out in the eruptions of Imbabura and Caraguairazo. There are several species of the same family in the Esmeraldas, as *P. cinerascens*. ***P. elongatus*** and ***P. modestus***.

MOLLUSCS.

There is little variety of molluscan life on the Andes. The land-snails predominate, belonging to the *Helicidæ* and *Cyclostomidæ*. The presence of the old world genus Clausilia, wanting in North America, becomes a significant fact, as Woodward observes, when taken in connection with the affinities of the higher animals of South America and Africa. "These imply a land-way **across the Atlantic at some very remote period.**"

The known fresh-water shells in the valley are few in number, and the exact localities of these cannot be positively given. *Castalia Crosseana* Hid., and *C. Pazi* Hid., are credited to Imbabura; *Hemisinus Pazi* Tryon, *H. simplex* Tryon, *H. Osculati* Villa, *Ampullaria modesta* V. d. Busch and *A. solida* V. d. Busch to Quito; and *A. Quitensis* V. d. Busch to Ecuador. But Mr. Tryon informs me that the locality of Hemisinus is not certain; and as I collected none myself, I am doubtful of all the others except Castalia. *Hemisinus Binneyi* Tryon, may be added to this provisional list.

The type of the genus Arges (*A. sabalo* C. and V.), from the position of the eyes and ventral fins, may possibly remain as the type of a genus under that name, distinct from Günther's genus Stygogenes, which I consider as covering my specimen as identical with his *S. Humboldtii* and *A. brachycephalus*, which I consider the same as Humboldt's *Pimelodus cyclopum*. As Cuvier and Valenciennes had this last as a species of their genus Arges, and as Günther includes it (doubtfully) as a distinct species in his genus Stygogenes, and as Swainson also named it *Cyclopium Humboldtii*, we have a singular confusion of names, which, following the strict law of priority of names given, should be rendered thus:—

CYCLOPIUM (SW.) CYCLOPUM (HUMB.)

Synonyms.

1. ***Pimelodus cyclopum*** **Humboldt, 1803.**
2. ***Cyclopium Humboldtii*** **Swainson, 1838–9.**
3. ***Arges cyclopum*** **Cuv. and Val., 1840.**
4. *Arges brachycephalus* Günther, 1859.
5. *Stygogenes Humboldtii* Günther, 1864.
6. *Stygogenes cyclopum* Günther, 1864.

Of these six names given as synonyms, Nos. 1, 2, 3 and 6 were unquestionably proposed for the same fish, and No. 5 was separated from them wholly because Humboldt did not mention the spine of the 2d dorsal. No. 4 was considered as distinct, and placed in a separate genus on account of the spine not being present. The specimen now under examination has a spine, and with it all the characters given of the species, hence I unite them all as one under the terribly non-euphonic designation of *Cyclopium cyclopum*, adding one more name to the list, which will be adopted, or classed as a synonym, according to individual views, but which, nevertheless, is the name that should be used to designate the species if the strict law of priority is followed.

The following *Notes on the Terrestrial Mollusca of the Valley of Quito, with a Catalogue of the species*, have been contributed by the eminent conchologist, Mr. Thomas Bland.

Looking at the subjoined catalogue* of the Terrestrial Mollusca attributed to, or which are known to inhabit, the valley of Quito,

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* The following catalogue has been compiled from the various works to which I have had access. The genera and species are arranged in the order given by Pfeiffer in his Monographs, and the figures refer to the sections into which he divides the species. The subgeneric names of *Bulimus* in small capitals and of others in italics are from the last edition of Albers by v. Martens. The species, the names of which are in italics have been described since the publication of the latest editions of Pfeiffer's Monographs: —

Helix Quitensis Pfr. — Quito. (*Hyalina.*) § 11.
" Flora Pfr.—Quito. (*Ammonoceros.*) §35.
" Æquatoriana Hid.—Ecuador, Paz. §102.
" cymatodes Pfr. — Quito, Pfeiffer; Napo, Martinez. (*Isomeria.*)
" æquatoria Pfr. — Ecuador, Fraser.
" Juno Pfr. — Quito, v. Martens and Orton; Baeza, Martinez. (*Isomeria.*)
" Bourcieri Pfr. — Otovalo, Bourcier: Nanegal, Martinez and Orton. (*Isomeria.*)
" claromphalos Dev. et Hupe. — Quito, Paz; Cuzco, Hupe. § 113.
" Martinii Bern.—Quito, Bernardi. (*Isomeria.*) §118.
" bituberculata Pfr. — Quito, Paz and Martinez; Tunguragua, Bourcier. (*Isomeria.*)
" entodonta Pfr. — Cuenca, Fraser. §121.
" atrata Pfr. — Quito, v. Martens and Orton; Puntophaya, Bourcier; Macas and Napo, Martinez; Marmato, N. Granada, Bland. § 123.
" Hartwegi Pfr.—El Catamaija near Loja, Hartweg. (*Isomeria*).
" *Ortoni* Crosse. — Between Quito and Napo? Orton.

Bulimus Phœbus Pfr. — Ecuador, Pfeiffer. §3.
" Popelairianus Nyst. — Quito, Isern; Bodegas, Paz; Napo, Martinez, and Orton. (BORUS.) §6.
" irroratus Rv. — Quito, v. Martens and Orton: La Mocha and Guaranda, Paz; Macas and Nanegal, Martinez; New Granada, Pfeiffer. (DRYPTUS.)
" Fungairinoi Hid. — Quito, Hidalgo and Orton; Cuenca, Paz and Martinez.
" *Corydon* Crosse. — Quito, Paz.
" *Aristæus* Crosse. — Quito, Paz and Orton.
" integer Pfr. — Quito. Ida Pfeiffer. (DRYPTUS.) §8.
" Fraseri Pfr.—Cuenca, Fraser; Chimborazo, Paz.
" abscissus Pfr.—Quito, Pfeiffer. §9.
" Bourcieri Pfr.—Pichincha, Bourcier. (*Thaumastus*).
" coloratus Nyst.—Near Quito, Lattre; Prov. Cumana, Columbia, Nyst. (DRYPTUS). § 10.
" cardinalis, Pfr. — Quito, Pfeiffer and Paz; Quito and Nanegal, Orton; Napo, Martinez. (EURYTUS.)
" Memblielinus Crosse.—Ecuador, Paz and Hidalgo; Napo, Martinez. §18.
" lautus Gould.—Near Quito, Couthouy. §37.
" Nystianus Pfr. — Quito, Martinez; Machache, Paz; Valley of Pomasqui, Bourcier. (*Thaumastus.*)
" decoratus Lea. — Near Quito, Paz; Chimborazo, Pfeiffer; Carthagena, Lea. (*Drymaeus.*)

Bulimus fallax Pfr. — Tunguragua, Bourcier; Quito, Paz and Martinez. (*Thaumastus.*)
" Hartwegi Pfr. — El Catamaija near Loja, Hartweg; Quito and Cuenca. Paz and Orton. (*Thaumastus.*) §39.
" Thompsoni Pfr. — Near Quito, Pfeiffer and Orton; Machache and Cuenca, Paz. (ORPHNUS.)
" Taylorianus Rv. — Quito and Chimborazo, Bourcier: Quito, Paz and Orton. (EURYTUS.) §40.
" haplostylus Pfr. — El Catamaija near Loja, Hartweg. § 44.
" Cuencanus Pfr. — Cuenca, Fraser.
" Anthisanensis Pfr. — Antisana, 14000 ft., Bourcier. (*Scutalus*) § 48.
" caliginosus, Rv. — Tunguragua and Chimborazo, Bourcier: Chimborazo, Paz. (*Scutalus.*) §49.
" subfasciatus Pfr. — Antisana, Bourcier.
" ambustus, Rv.—Tacunga and Ambato, Bourcier; La Mocha, Paz; Alchipichi, Martinez. (*Thaumastus.*)
" Quitensis Pfr. — Quito, Delattre: Ibarra and Otovalo, Martinez. §51.
" irregularis Pfr.—Near Quito, Lattre, Ibarra, Otovalo and Pillaro, Martinez.
" Cotopaxiensis Pfr. — Cotopaxi, Pfeiffer; Antisana and Pichincha, Martinez; La Mocha and Chimborazo. Paz; var. B. Cayembe, Bourcier. (*Scutalus.*) § 54.
" Loxensis Pfr. — El Catamaija near Loja, Hartweg. (*Thaumastus.*) §56.
" chamæleon Pfr. — Quito, Bourcier; La Mocha, Paz; Cumbaya, Baeza and Nanegal, Martinez; Peru, Almagro. (*Thaumastus.*)
" æquatorius Ptr. — Sincholagua and Chimborazo, Bourcier; Quito, Paz, Orton and Martinez; La Mocha, Paz. *Scutalus.*) §57.
" Catlowiæ Pfr. — Near Quito, Bourcier; Ambato, Paz. (*Scutalus.*)
" Limensis Rv. — Near Lima and Quito, Pfeiffer.

Orthalicus Mars Pfr.—Ecuador, Fraser. § 3.
Achatina magnifica Pfr.—Near Quito, Delattre. §1.
Oleacina saccata Pfr.—Ecuador, Fraser. § 6.
Clausilia Bourcieri Pfr.— Tunguragua, Bourcier. (*Nenia*) §3.
Cyclotus Quitensis Pfr.—Quito, Paz and Orton; Napo, Martinez; New Granada, Bland. § 1.
" Dunkeri Pfr. — Riobamba, Pfeiffer; New Granada and Venezuela.
" Popayanus Lea.—Chimborazo, Linden; New Granada, Bland.
" granulatus Pfr.—Quito, Paz.
" *Fischeri* Hid. — Quito, Paz; Aguarico, Martinez.

it does not appear that any considerable number of the species have passed beyond its limits. The most interesting question respecting their distribution, is to ascertain if any occur both on the Pacific and Atlantic slopes of the Equatorial Andes, and so far as I am informed there are scarcely any. While several of the valley species are found also to the south in Peru, and a larger number to the north in New Granada, others are common to the valley and the eastern slope towards the headwaters of the Amazon.

The species mentioned in the catalogue, which from the habitats given appear to occur on the Pacific and Atlantic slopes, are *Bulimulus chamæleon* Pfr. referred to Nanegal on the former and Baeza on the latter, *Bulimus irroratus* Rv. from Guaranda and Macas, and *B. Popelairianus* Nyst, from Bodegas and Napo. Further exploration may increase the species known thus to occur, but the difference in the land-shell faunas on the Pacific and Atlantic slopes on the west coast of North America, warrants the belief that such species are few.

The absence in the Quito valley, and generally on the west coast of South America, of various New World genera is worthy of remark, but they belong to the faunas of Brazil, Mexico, and the West Indies, with which those of the west coast have a scarcely appreciable alliance.

In South America generally, and the valley of Quito is no exception, the genus Bulimus has far more representatives than Helix (using both generic terms in the wide sense employed by Pfeiffer in his monographs), but the reverse is the case in North America. In the Galapagos Islands there are a number of peculiar Bulimi, but I believe no Helices, while in the islands off the west coast of southern California species of Helix occur but none of Bulimus. On the Atlantic side of the Continents, the islands (Cuba, Jamaica etc.) situate on the northern margin of the Caribbean sea, with numerous species of Helix, have very few of Bulimulus, while the islands on the eastern side, near to the South American coast (St. Lucia and St. Vincent to Trinidad) have the only representatives of Bulimus in the West Indies and a larger proportionate number of species of Bulimulus.

Cyclotus *Pazi* Crosse.—Ambato, Paz.
Cyclophorus Cumingi Sow.—Quito, Paz. § 15.
" hæmatomma Pfr.—Quito, Paz.
" *Hidalgoi* Crosse.—Ecuador, Paz.
Cyclophorus *Crosseanus* Hid.—Ecuador, Paz.
Bourciera helicinæformis Pfr.—Quito, Paz.; [Yaraqui Valley, Bourcier.
Bourciera Fraseri Pfr.—Cuenca, Fraser.

The form of Helix prevailing in, and which may be said to be characteristic of the Quito Valley is Isomeria, peculiar to the northern portion of the southern continent. Both Bulimus and Bulimulus are essentially characteristic of South America.

The genus Orthalicus is also South American, but belongs rather to the eastern than to the western side of the continent. *Achatina magnifica*, as Pfeiffer suggests, is probably an Orthalicus. Oleacina is most numerously represented in Mexico and Central America, and the nearest adjacent islands of the West Indies. One species is said to inhabit Ecuador, but the exact locality is not given.

Clausilia is a European genus, but has representatives in Asia, and a few species of the sub-genus Nenia in South America,—one only in the West Indies, *C. tridens* Chem. of Porto Rico. Species of three operculated genera occur in the Quito Valley,—Cyclotus, Cyclophorus and Bourciera. The latter, peculiar to Ecuador, is placed by Pfeiffer, in the sub-family Realia of the family Cyclostomacea, but it would seem to belong to Helicinacea, with which, as pointed out by Troschel, its dentition agrees, although in form of shell it is allied to Realia. Cyclotus has several species in Mexico and Central America, more in South America, but forty-two species in the West Indies, of which thirty-four belong to Jamaica. It may be mentioned that half of the species attributed to the valley of Quito, occur also in New Granada.

Cyclophorus has its principal development in Asia and adjacent islands, but it is curious, as I have elsewhere noticed, that while there are a few species found in Mexico, Central and South America, seven occur in the West Indies, and all in Guadeloupe, Dominica and Martinique.

NOTES ON THE GEODES OF ILLINOIS.

BY PROF. GEORGE H. PERKINS.

Not least interesting among the many localities in the Mississippi valley that attract the geologist and mineralogist is the Illinois Geode region. This extends for twenty-five or thirty miles

along the Illinois side of the Mississippi, reaching from a short distance above Niota on the northern border of Hancock County southward beyond Warsaw; and indeed the formation in which these specimens occur reaches as far south as the mouth of the Illinois River, but by far the greater part that have been collected were obtained between Niota and Warsaw, where they occur in very much the greatest abundance. Very many fine specimens have been obtained across the river in Iowa, and the region over which they are distributed is probably larger in this state than in Illinois. So far as my own observation goes, the geodes do not occur in Illinois at any great distance from the river, nearly all the best localities being within three or four miles from the banks; but I do not speak with entire confidence in regard to this as nearly all my personal investigation has been confined to localities near the river and on the Illinois side. For this reason what may be said at this time will refer mainly to the region between Niota and Warsaw. The geodes from this region are, many of them, very beautiful, being often lined with most brilliant crystals of quartz, appearing like miniature caves lined with diamonds, or, less brilliant but more exquisite, some are lined with a frost-work of small white crystals of the same substance, or with satin crystals of calcite and pearl spar. They are imbedded in a soft, brittle, argillaceous shale, which is sometimes a little calcareous, and in a very few instances passes into limestone, although the outer coating of the geode is always aluminous. This mass of shaly rock forms what is called the "Geode bed," a member of the Keokuk group of the Subcarboniferous age. The thickness of this bed varies in different places, but is nowhere very great. At Warsaw it is well exposed in a railroad cut, and here, according to Mr. Worthen, the thickness is forty feet. (Ill. Geol. Rep., Vol. 1, p. 335.) No trace of fossils has been discovered in the shale, but in some places thin layers of limestone are intermingled with it, and these afford the characteristic fossils of the Keokuk limestone. Whatever the inner coating of these geodes may be, the shell, or crust, is always siliceous. The outer surface, however, is usually coated with the same clay-like material as that which composes the shale in which they occur. Very often there is an outer layer of siliceous clay which forms a part of the crust and sends out numerous sharp, irregular projections into the next layer which is, probably always, chalcedony. It should be remembered that these.

and other not yet mentioned "layers" of the crust are so called more for convenience, than because they exist sharply defined in every specimen, for such is not the case; in most they shade into each other by almost imperceptible degrees. The outer surface is generally light colored—either yellow, or drab, or yellowish brown; but when there is much oxide of iron present the color deepens to chestnut brown. The general form of the geodes is more or less spherical and in a majority of the specimens it is quite regularly so, but the character of the interior seems to have some influence in shaping the whole mass. In my own collecting, at least, it has uniformly been true that those geodes that contained only quartz were most regular in form and those lined with crystallized quartz are rather more regular than those lined with chalcedony. Those specimens that contain oxide of iron are often quite flat, as are those with calcite, though these latter are usually flattened more on one side than on the other and in various ways made irregular.

Although sometimes packed almost as thickly as possible in the shale, the geodes are for the most part entirely distinct from each other; but sometimes two or more are found adhering to each other, either two of nearly equal size forming a dumb-bell shaped mass, or, more commonly, a large one is surrounded by several much smaller. These are not often so firmly attached that a sharp blow will not separate them entire. When broken these smaller geodes are usually solid. Sometimes small, pocket-like geodes are found in the crust of large and heavy ones, and sometimes these extend so far over the surface that the geode becomes like a ball coated outside and in with crystals, with occasionally a thin clayey crust over a part of the outside.

The geodes are not exactly alike in different portions of the region. In some places nearly all are small, while large ones are not infrequent in others, in one place most are regular spheres, in another most are quite irregular, in some parts of the bed they lie so thickly as to crowd each other, in other parts they are far apart. Not only do these and similar differences occur in places at some distance from each other, but in the same place upper, lower or middle portions of the bed may differ widely in the number, form, size and contents of the geodes. Everywhere many of the geodes are solid, and the first thing for a collector to learn is to judge by the weight of any given specimen whether it

is solid or hollow, and also how hard a blow is needed to break it open, if he finds it light enough to be hollow: for a heavy blow, such as is necessary to crack a thick crust, would dash a thinner one into small fragments. Those large geodes that contain much calc spar are usually solid, while those that are smaller and lined with small crystals of this material are frequently quite hollow. The quite large specimens are more apt to have thick walls, or to be entirely solid, than those of less size whatever the filling. The cavity of a geode does not often correspond with the exterior, as the walls are constantly varying their thickness. Many are lined with a single, plain layer of crystals, others have this crystalline surface raised in rounded prominences, some of them long and cylindrical, others low and mound-like. In some, besides the lining there is a partition, extending across the cavity, lined with crystals on both sides. Rarely, the collector may find a thin crust lined with small bright crystals, within which is a hollow ball, but little larger than the cavity and attached at one or two points to the side, covered with somewhat smaller crystals. So, in innumerable ways do we find these singular objects varied and, as the outside gives little or no indication of the inside, the charm of uncertainty is added to the excitement and pleasure of the collector. So far as my own experience goes those specimens that are from one to three inches in diameter are least likely to be solid, though very fine ones may be obtained six or even ten inches in diameter without great difficulty. The range in size is quite large, as very pretty specimens not over half an inch in diameter may be found, while the largest I have seen were fully eighteen inches across the broken halves. But these larger geodes, aside from being very scarce, are not very desirable acquisitions as they are very heavy, weighing fifty pounds or more in the best examples. The geodes are most abundant, and hence most easily collected, in the beds and along the sides of those streams which intersect the geode bed, as nearly all those around Hamilton and Warsaw do. The geodes are dislodged from their resting place by high water, frost, etc., and are carried down by the streams, so that near the mouth, or in a basin, the ground is often paved with them, but good specimens are not rare along the sides of the streets, in cuts, or wherever the earth has been washed or dug in the neighborhood of the bed in which they lie. Few things are more unpromising or unattractive than a geode when first taken

from its cavity in the rock, and unless its regular form caught the eye, it would be passed without a second glance as wholly undeserving of notice. A mere ball of clay would possess fully as much elegance. But pick up that dull, dirty-looking ball, and, if it be a good specimen, its extreme lightness attracts attention and excites curiosity, and now the impulse is to see what there is inside. A few strokes of the hammer and it breaks in halves, and as it falls apart lo! what wonders are presented to us! Who would have imagined that so uncouth and rough an exterior concealed such a splendid interior,—a crystal grotto, which flashes and sparkles when the sunlight strikes it as if made of gems of the first water. The geodes contain quite a number of different minerals which are very variously arranged in different specimens.

Some of these minerals have been already alluded to, but they deserve a somewhat fuller treatment. As all the geodes are siliceous on the outside, so by far the most common variety is that composed wholly, or nearly so, of quartz. The structure of these is almost invariably as follows; first, the outer, earthy coating; second, a thin layer of white or whitish chalcedony; third, a layer of clear quartz more or less granulated; and fourth, a layer of crystalline quartz, with simple, pyramidal terminations lining the inside. The granular layer does not always extend around the entire sphere, but often the crystalline quartz rests directly on the chalcedony, and in some there is scarcely any or no granulated appearance, but it is present in most that have come under my notice. The crystals of the inner layer are usually clear and colorless, but many times they will be tinged a more or less deep yellow by oxide of iron, and a few crystals have been found lying detached in the cavity of the geode, so bright a yellow as to cause them to resemble the topaz very closely, and some have been cut and sold as topazes. Not infrequently the crystals have a slight bluish tinge which, instead of the brilliant white lustre, gives them a soft and liquid hue, as if just ready to melt into purest water. Crystals of smoky quartz are occasionally found, and I once had the good fortune to break a rather clumsy specimen about three inches by four inches in size, the inner coating of which was rose quartz. Instead of a simple layer of crystals, either plain or variously convoluted, specimens are not uncommon in which the crystals, many of them doubly terminated, are piled upon each other in all directions, and sometimes these clusters are

loose in the cavity, or the latter may be filled with single crystals, often so small as to appear like fine sand. The crystals are not always clear, but may be covered with a layer of chalcedony sometimes so thin as not to modify the form of the terminations, sometimes thick enough to make a papillose surface. This coating may be either light blue, flesh color, yellowish white, or a bluish opal-white, all of them appearing semi-transparent or of an opaque, chalk white. Many of this last color have the crystalline terminations so modified as to appear cubical. In a few very beautiful specimens that I have seen, a clear white chalcedonic surface was sprinkled all over with small, perfectly colorless crystals, looking like fine dew drops on a white flower. This coating becomes thicker and thicker, until all trace of the crystals is lost, and then we have a layer of chalcedony with a perfectly smooth botryoidal or mamillary surface, outside of which is a layer of crystalline quartz, then, usually, a granulated layer and then the outer chalcedony layer. The inner layer is sometimes very thick, being twice the thickness of all the rest.

The color of the chalcedony is most often a reddish purple, but not very seldom we find a greenish yellow or bluish white and rarely a chalk white. In rare cases there are two layers of different color, such as pure white over dark brownish purple. In a few cases the surface of the chalcedony is sprinkled with crystals of pyrites or other substances, but yet the geodes afford a marked contrast in this respect to those lined with crystalline quartz, for while the former are remarkably free from what might be termed foreign substances and never, so far as I have seen, is any considerable part of the cavity filled with them, in the latter variety we find, resting upon the quartz, all the different minerals *found* in the geodes, and often two or three together nearly filling the cavity. Besides the isolated crystals of calcite and dolomite found resting on the quartz crystals, we have some in which the lining is made up entirely of one or the other of these substances. Like all the rest these are siliceous on the outside. In the calcite geodes the crystals are usually small and of rhombohedral form, which is often obscured by their crowding together or piling upon each other. In color they differ, some being colorless and transparent, many white, or yellowish, or flesh color, and some few dark purple or chestnut brown, and in one case a layer of dark brown crystals was ornamented with here and there a cluster of pure white ones. Two or more forms of crystallization may occur

one upon the other in the same specimen, as, for example, a scalenohedral crystal resting upon differently modified rhombohedrons. Sometimes the cavity of the geode is filled with a mass of white or, rarely, flesh colored calcite. Isolated crystals, or groups of crystals of pearl spar or dolomite, are of quite common occurrence both in the quartz and calcite geodes, but a complete layer of this mineral is less common. The crystals are generally quite large as compared with the size of the geode.

According to Prof. Brush (Ill. Geol. Rep., Vol. 1, p. 91). this dolomite contains "a large per cent. of carbonate of iron with the carbonates of lime and magnesia." Although the usual color of the dolomite is either a light yellowish brown or silvery gray of different shades, it is often stained a rusty brown by oxide of iron.

The collector will once in a while meet with a geode, probably of quite small size, filled with a fine white powder. Prof. Brush states this to be a "hydrous silicate of alumina." The only metals thus far found in the geodes are iron and zinc. The iron occurs in the form of oxide, in small crystals and in powder ;, one geode about one and a half inches in diameter lined with small quartz crystals was filled with the powdered oxide. Besides this, long, slender, hair-like crystals of pyrites occur as well as those of cubical form. These are scattered over chalcedony, quartz crystals and calcite, and are also imbedded in the calcite. Zinc blende is quite common occurring either in crystals, some of them quite highly polished, or in a mass in the centre of solid geodes when it is associated with calcite.

In the northern part of Hancock county a few geodes, all that I have seen being lined with quartz crystals, contain asphaltum. Prof. Brush describes one of these as "apparently more than half filled with asphaltum, breaking with a clear conchoidal fracture, having a high lustre and jet black color and containing imbedded in it detached crystals of quartz" (Ill. Geol. Rep., Vol. 1. p. 92). This was four by three inches in size. Instead of asphaltum some are filled with petroleum. Besides those minerals enumerated, Prof. Brush reports finding in a very few cases minute crystals of gypsum and in one of arragonite. Water is found in some of the geodes which is bitterish to the taste, and contains, according to Prof. Brush, a small per cent. of the sulphates of lime and magnesia and a slight trace of silica. As the crust of the geodes is wholly impervious to water, this must have been inclosed when the crust was formed. As Mr. Worthen remarks

it is worthy of notice that, while the geodes are always surrounded by material rich in alumina, no crystallized forms of this mineral have yet been discovered in them. Geodes of fine quality occur in Missouri, and Prof. White reports calcareous geodes, some of them entirely free from silica, in a soft magnesian lime-stone, in North Eastern Iowa.

Any one who for the first time sees a fine geode and notes its regular form, its uncouth exterior and brilliant interior is sure to ask "How was it made?" The more specimens he sees the more is his curiosity excited, and if he visits the locality and sees them *in situ* his wonder and interest increase to the highest pitch. There are very many difficulties to be overcome in trying to account for the presence of the geodes and their formation, and it may be only presumption to attempt that which so many skilful mineralogists have passed in silence. However, a careful study of the geodes, both in cabinets and in their native bed, has convinced me that they must have been formed in some such manner as that here presented. What now constitutes the geode bed, was at one time a mass of plastic clay filled with siliceous and calcareous fluids. That it was plastic is shown by facts obvious to any one who has ever visited the locality. If now this mass were acted upon by steam or some other vapor, or gas, as dough is acted upon by carbonic acid, it would like the dough be filled with cavities of all sizes of a more or less spherical form, and irregularly distributed through the mass. Into these cavities the solutions of silica etc. would filter and in some cases crystallize, in others simply deposit the solids held in solution, according to circumstances. The form, arrangement, etc., of the various substances would be determined, I suppose, by their densities and the laws of crystallization. After all the materials had hardened, the soft brittle clay would easily separate from the harder filling of the cavities and this would then fall out shaped by the mould in which formed.

REVIEWS.

THE PEABODY MUSEUM OF AMERICAN ARCHÆOLOGY AND ETHNOLOGY.* — The fourth annual Report contains much that is of gen-

*Fourth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology. Boston, 1871. 8vo. p. 27.

eral interest. Professor Wyman, the curator, gives some exceedingly valuable "Observations on Crania and the parts of the Skeleton," with comparative measurements of the fifty-six skulls from Peru, presented by Mr. Squier, together with thirty-eight from the mounds of Kentucky, obtained by Mr. Lyon. and eighteen from the mounds of Florida collected by the curator. He remarks that:—

"The average capacity of the fifty-six Peruvian crania measured agrees very closely with that indicated by Morton and Meigs, viz., 1230 c.c., or 75 cub. inches, which is considerably less than that of the barbarous tribes of America, and almost exactly that of the Australians and Hottentots as given by Morton and Meigs, and smaller than that derived from a larger number of measurements by Davis. Thus we have, in this particular, a race which has established a complex civil and religious polity, and made great progress in the useful and fine arts, as its pottery, textile fabrics, wrought metals, highways and aqueducts, colossal architectural structures and court of almost imperial splendor prove, on the same level as regards the quantity of brain, with a race whose social and religious conditions are among the most degraded exhibited by the human race.

All this goes to show and cannot be too much insisted upon, that the relative capacity of the skull is to be considered merely as an anatomical and not as a physiological characteristic, and unless the quality of the brain can be represented at the same time as the quantity, brain measurement cannot be assumed as an indication of the intellectual position of races any more than of individuals. From such results the question is very naturally forced upon us whether comparisons, based upon cranial measurements of capacity as generally made, are entitled to the value usually assigned them. Confined within narrower limits they may perhaps be of more importance. But even in this case the results are often contradictory. If the brains of Cuvier and Schiller were of the maximum size, so were those of three unknown individuals from the common cemeteries of Paris — while that of Dante was but slightly above the mean, and Byron's was probably even below it."

He also refers to the singular perforations of the humerus, which seems to occur in white, Indian and black races, but more commonly in the blacks; it is also quite general though not constant in the apes.

The flattening of the tibia has been noticed in the reindeer period in Europe, and Professor Wyman finds that it prevails largely, but in a variable degree in our Indians. In regard to the

bearings of these facts on the relations of man to the apes we quote as follows: —

"From a comparison of the skeleton of the human races, as far as made, it is quite clear that in several respects some of them have peculiarities which seem to assimulate them to the apes. These peculiarities are not, however, confined to a single race, but are distributed in different degrees through several, and it is not improbable that future studies will show a still greater variety of resemblances, and a wider distribution of them, than is now known. The increased length of the forearm, as compared with the humerus, is almost equally shared by the blacks and the recent Indians. The Indians, from the mounds of various parts of the country, as well as the inhabitants of the ancient cave dwellings of Europe, have the flattened tibia. The Indians, ancient as well as modern, in common with the Hawaiian Islanders, have the most backward position of the foramen magnum, while the Negro, on the other hand, with his lengthened forearm, has this foramen almost as central as in the white man. The small brain is not, as might at first well be supposed to be the case, found in the most degraded races alone, but in these, in common with a race which had, as already stated, risen to a semi-civilization; nor is it constantly associated with the lengthened forearm, since in the Australians this is even shorter than in the white man. From these results it seems obvious that we cannot give to the alleged resemblances between the human races and the apes their full meaning, until we have much wider comparisons than have as yet been made."

The Position of the Caddis Flies.* — This paper, containing detailed descriptions with excellent illustrations, may be regarded, as the author remarks, as the continuation of several memoirs on exotic Trichoptera published in the "Transactions" of the Entomological Society of London. Quite a number of the species are from California, one is from the White Mountains, another from Newfoundland, another from New York, while the remainder are from other parts of the world. The descriptions of genera and species are elaborated with the author's usual care and thoroughness, and great attention is paid to the illustration of details of structure, which gives the paper a lasting value.

We are also indebted to the author for his views on the systematic position of the Trichoptera, and for a very courteous criti-

*On new Forms, etc., of Extra-European Trichopterous Insects. By Robert McLachlan. Extracted from the Linnæan Society's Journal.—Zoology. Vol. xi. London. 1871. 8vo. pp. 43, with 3 plates.

cism of the positions taken by the reviewer as to the classification of the Neuroptera. We will first quote the opinions of this able and experienced observer, and show wherein and why we differ from his conclusions:—

"But it is necessary, first of all, just to glance at the position generally accorded to the *Neuroptera*. It has long been seen that the order as defined by Linné, is composed of most incongruous materials; and Erichson attempted an amelioration of this condition by grafting all those families with incomplete metamorphosis upon the *Orthoptera*, still maintaining the two orders in juxtaposition. Since his time various authors have made this division, termed *pseudo-Neuroptera*, a veritable refuge for the destitute. To it have been added, from time to time, *Mallophaga*, *Thysanura*, *Thysanoptera*, and even the *Strepsiptera*, for no other reason, so far as I can see, than that they would not fit in satisfactorily elsewhere; and the characters of the order being so elastic, it was easy to find some peculiarities which gave these outlying families admission therein. That the Linnæan families grouped now with *Orthoptera* have more affinity thereto than to the *Neuroptera* as usually constituted, is evident; yet I see no reason whatever why the *Odonata* should not form an order apart, possessing as they do, characters absolutely *sui generis*. The admission of them into *Orthoptera* renders an already heterogeneous order an absolute chaos. For my part, I have been content to consider the *Neuroptera* as an order, in the Linnæan sense, divisible into three great divisions, *pseudo-Neuroptera*, *Planipenna*, *Trichoptera*,—but this only as matter of convenience; for I am convinced that contained therein are constituents of several orders, each of equal value with such as *Lepidoptera*, and *Coleoptera*, and that the day will arrive when, from an increase of knowledge in embryology and anatomy, the order *Neuroptera*, as constituted by Linné, will be scattered widely—a dismemberment that would have occurred long since, only that there still exists a lingering disinclination to thoroughly upset the Linnæan system.

Dr. Packard's arrangement is founded on the idea that in insects as in all other divisions of the animal kingdom, there are certain groups more elevated, others more "degraded" than the rest. Acting upon this, he places the *Hymenoptera* as structurally and psychically, if I may use the term, superior to all other insects. Then follow *Lepidoptera*, *Diptera*, *Coleoptera*, *Hemiptera*, *Orthoptera*, and last of all, the *Neuroptera*, in the Linnæan sense (but including *Thysanura*), an order which, according to him, "mimics every suborder of insects," being "comprehensive or synthetic types, combining the structure of all the other suborders". I would here particularly call attention to the relative positions occupied by *Lepidoptera* and *Trichoptera*, the latter forming nearly the last division of *Neuroptera*. I emphatically enter

my protest against such a wide separation of the two groups, considering, as I do, that, whatever may be the condition of the *Trichoptera* with regard to others of the Linnæan groups of *Neuroptera*, their relationship to the *Lepidoptera* is close, and that an attempt to thus widely separate them is an outrage on both. In metamorphosis the resemblance is nearly complete, the fact of the pupal limbs not being enclosed within a common integument not availing much when their condition in certain *Microlepidoptera* is taken into consideration: the possession of mandibles by the Trichopterous nymph is not of much importance, insomuch as these organs bear no relationship to the aborted mandibles of the imago: they simply replace the acid or mechanical means by which a Lepidopterous imago frees itself from its cocoon. The imago in *Lepidoptera* is almost constantly furnished with scales on the wings and body, scales of a peculiar nature, the analogues of which are seen only in *Lepisma*; but many Trichopterous insects have, in the male, a modification of these scales in the form of short inflated hairs, generally intermingled with ordinary hairs; and in some genera this tendency towards a scaly clothing is as marked as is its absence in some *Lepidoptera*. The neural arrangement is not at all incompatible with a close relationship; nor are the parts of the mouth, excepting the absence of a developed haustellum; yet many of the larger *Trichoptera* frequent flowers for the purpose of extracting the nectar; and though I am unable to say by what means this is effected, it seems probable that it is done by prolongation, at will, of the upper portion of the œsophagus into a sort of false haustellum. Perhaps the strongest mark of demarcation is the presence, in most Lepidopterous imagos, of a spine-like process near the base of the costa of the hind wings, wanting in all *Trichoptera*. That this process is a modification of a vein is almost certain; and I apprehend that, when the homologies of neuration are better understood, this negative character in *Trichoptera* will not be found of much importance. My own inclination tends strongly towards maintaining *Trichoptera* as a separate order in juxtaposition with *Lepidoptera*."

First: we fully agree with the author that the admission of the Odonata (Libellulidæ) into the Orthoptera "renders an already heterogeneous order an absolute chaos." But on the other hand, we think the burden of proof that the "Odonata" are not true Neuroptera rests on those who regard the group as an independent order. Where respectable authorities (taking it for granted that their characters are neither Neuropterous nor Orthopterous, which we do not admit), regard them as a division of Neuroptera, no one having, as far as we know, considered them as Orthoptera before Erichson's time; and others equally respectable regard them as

Orthopterous, or Pseudoneuropterous, we would abide by embryological data to decide the question. The embryology of the Libellulidæ is perhaps as thoroughly known as that of any other group of insects. During the past summer the writer has observed with considerable care the embryology of Chrysopa, a type of the "true" Neuroptera, in the restricted sense. In the earliest and later stages the development of this genus is almost identical with that of the dragon flies, as regards the structure and relations of the "ammion" and "visceral membrane," the relations of the primitive band, the early form of the embryo, and its position just previous to exclusion from the egg (see this journal, p. 564). The differences are merely such as we would expect to find between two families of the same order. Thus embryology gives us the most unexpected and independent testimony as to the close alliance at least of the Libellulidæ and Hemerobidæ. Should our conclusions stand the test of the observations and criticisms of abler naturalists, then have we not demonstrated the close relationship of these two divisions of (what we regard as) Neuroptera? We conceive the greatest gap in the Neuroptera (in the Linnæan sense) to be between these two families. The Libellulidæ, through the Ephemeridæ, their nearest allies, pass into the Perlidæ and Psocidæ: on the other hand, the Hemerobidæ are connected by many characters with the Panorpidæ, and to the latter, as we believe, the Phryganeidæ (Trichoptera) are more nearly related than any other group of insects, whether we take into consideration the structure of the adults, or the form of the larva and pupa, and their metamorphoses. The gap between the Libellulidæ and Hemerobidæ is indeed a wide one, but have we not seen that the foundations of the bridge have been laid in the embryonic stages, and may we not feel authorized in view of recent discoveries of paleozoic net-veined insects, in believing that the superstructure, the arches and timbers of the bridge, has been swept away by the storms and floods of past geologic ages? Evidence is accumulating and growing stronger each year, if we interpret the facts aright, that the gaps between what we consider the families of the Neuroptera are due to the extinction of genera and species in paleozoic and mesozoic times. So that instead of a "dismemberment" of the Neuroptera, we shall really have a more thoroughly compacted and natural group than as yet recognized by systematists.

Secondly, as to the relationship of the Trichoptera to the Lepidoptera. It seems to us that we each look upon this matter from a different standpoint. We would claim that the characters which Mr. McLachlan relies upon as allying the caddis flies to the moths are adaptive and of secondary importance. Let us leave them out of sight for the moment, and look at what the reviewer deems the more essential ones. Strip our examples of moths and caddis flies of their wings and legs up to the coxæ, removing the antennæ and palpi, and place the naked trunks side by side. We shall find a wonderful uniformity of structure in the head and body of the Lepidoptera, to which we have previously called attention.* We shall observe that the three portions of the lepidopterous head, the occiput, epicranium, and clypeus, always preserve much the same relation to each other. The front of the head is formed by the epicranium and clypeus, the latter usually being the larger of the two parts, though in the Tineids the two pieces are of nearly the same size. Looking at the thorax, another essential character of the Lepidoptera is the very short metathorax, and the absence of the præscutum. In one moth, the degraded Hepialus, the metathorax is much longer than in any other moth known to us, and the præscutum is well developed,† resembling the "true" Neuroptera in this respect. The head of the Phryganeidæ, though varying greatly in the different genera, differs invariably from that of the moths in the front of the head consisting of the clypeus alone enclosed in the broad orbits, while the broad vertex consists of the epicranium, which is as large as the entire front of the head; the head is wider and the eyes much smaller than in the moths; and another important character is the broad, deeply excavated front edge of the clypeus, this part in the moths being invariably narrower and much rounded.‡

The metathorax of the caddis flies is always much longer than in the moths, often twice as long, and the præscutum is nearly always well developed. These characters of the head and thorax

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*Notes on the family Zygænidæ. Proc. Essex Institute. IV. 1864. p. 14.

†For further remarks and figures in illustration see our remarks "On Synthetic Types in Insects." Journal of the Boston Society of Natural History. viii. 1863.

‡These remarks are based on careful observations of *Hallesus* sp, *Limnophilus despectus*, *Philopotamus* sp., and *Setodes exquisita*. From an examination of these portions of the body in these and other genera we would inquire whether neuropterists have not overlooked the source of most excellent and stable generic characters: those most in use, such as the venation and spurs varying in different sexes of the same species.

noticed in the caddis flies are just those characterizing the Neuroptera. If we place our trunk of a caddis fly by the side of that of any one of the Hemerobidæ we shall find a much greater similarity to this family than the moths. So far as we are aware neuropterists have never paid sufficient attention to the parts of the trunk to which we have referred, just as lepidopterists have uniformly overlooked the characters noticed above, and which are of the first importance in establishing families.*

As to the less essential characters, called secondary or adaptive by naturalists, we have gone as far as any one† in noticing their remarkable analogy to those of the Lepidoptera. But we should not feel authorized on this account to remove the caddis flies from the Neuroptera, and place them in an independent group next to the Lepidoptera. On the same principle we might remove the Psocidæ and place them in an independent order next the Aphidæ: or remove the tailed Batrachians and place them among the lizards.

Turning to the larvæ, we find that their most essential characters ally them to the aquatic Hemerobidæ and Sialidæ, the larvæ of some genera closely resembling in their essential characters that of Corydalus; in the pupa, the limbs are as free as in those of the two neuropterous families Hemerobidæ and Sialidæ. While in the majority of lepidopterous pupæ the limbs are soldered to the body, yet where they are partially free, as in some Tineidæ, the form of the lepidopterous pupa is throughout adhered to more strictly than would be inferred from Mr. McLachlan's statement.

Our author says that the mandibles of the pupa "bear no relationship to the aborted mandibles of the imago." May we ask with what organs he homologizes the mandibles of the Phryganeid pupa, if not with those of the larva and adult?

Taking up the points of resemblance to the Lepidoptera, brought forward by our author, we would agree with him that they are for the most part very remarkable and suggestive, but would suggest that they are not of much value when used as ordinal characters. He does not seem to notice the fact that insects of other groups than the Lepidoptera and Trichoptera have scales on their bodies. We would go farther than him and say that the scales of Lepisma and we would add of all the Thysanura (except in a few scaleless genera) are truly homologous, rather than "analogous" with those

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*See remarks in "Notes on the family Zygænidæ."

†Synthetic Types, etc.

of the Lepidoptera. Certain Diptera, such as the Culicidæ, have scales mingled with the hairs on their bodies, as many years ago shown by Mr. Jabez Hogg, and more recently by Müller: the species of Amphientomum of the family Psocidæ, as he is undoubtedly well aware, have scaly bodies; so that this character is by no means peculiar to the two groups mentioned by our author. Did the Trichoptera possess the hook and bristle in the wings of the Lepidoptera (a most inconstant character even in the moths) why should such a trivial character be considered as of any importance **in ranking ordinal (or subordinal) groups?**

Our own view, judging not only from the structure of the adults, but also of the larvæ and pupæ, is that the Lepidoptera rank next above the Diptera, the Tineids and Pterophoridæ having many points of agreement with the Culicidæ and Tipulidæ, which seem to us to be as deeply seated as the resemblance to the Phryganeidæ. In an evolutional point of view we have been accustomed to regard the moths as having perhaps sprung from these dipterous families. Hence we have been unable to agree with the opinion of E. Müller (see this journal, vol. v, p. 288) that the Lepidoptera have sprung from the Phryganeids, though we can easily see that many will be convinced by his statements. But he has, we venture to think, erred in the same way as our author, in overlooking the fundamental characters of the Phryganeidæ, and regarding the adaptive, superficial characters, drawn mostly from the appendages, as of primary value.

Supplement to the Catalogue of Ophiuridæ of the Cambridge Museum.*—This paper is particularly interesting from the excellent figures illustrating the most important species dredged at great depths between Cuba and the Florida Reef. The note on nomenclature and classification deserves mention in connection with the article on this subject by Mr. Alex. Agassiz, published on p. 354 of the present volume of this journal. As to the matter of changing the *authority* with each change in the *combination* of the name of a genus and species, Gen. Lyman opposes the view of Dr. Lütken, the distinguished zoologist of Copenhagen in the following terse language:—

"For instance, we have, in 1854, *Ophiura nodosa* Ltk. I after-

* Illustrated Catalogue of the Museum of Comparative Zoology, at Harvard College. No vi. Supplement to the Ophiuridæ and Astrophytidæ. By Theodore Lyman. Cambridge, 1871. Royal 8vo. pp. 18. With 2 plates.

wards attempted to show that *Ophiura* was preoccupied, and made a name, *Ophioglypha*, to take its place; and the question now is, shall it be written *Ophioglypha nodosa* Ltk. or *Ophioglypha nodosa* Lym? Dr. Lütken has no cause for astonishment. There are two parties to this question. That to which he belongs insists on considering *credit* or *honor* the real reason for using names of authors; and always speaks of the 'injustice' done when an author's name is lost sight of. The party whose views I hold maintains that nomenclature is *a system of exact registration*, and that, with the present enormous mass and confusion of titles, no other guide is possible; and further, that the credit of a zoologist does not rest on his monogram, but on something better. . . . . To sum up, *Astrophyton costosum* Seba, and *Ophioglypha nodosa* Lyman, mean just what they should mean, and nothing more; to wit, that in the writings of these two persons will be found these names definitely used for the *first time*. They do not distinguish these persons as good or as poor zoologists, nor do they show that such names are the correct ones; but they are simply the 'trademarks' of workmen."

We may add that the following rule regarding this subject was adopted (1868) by the Council of the Peabody Academy:—"Voted: that in labelling the collections the name of the person who first united the generic and specific appellations shall be given as the authority for the name, and that when the name of the original describer of the species is given it shall be in parenthesis."

NATURAL HISTORY MISCELLANY.

BOTANY.

The Parasitic Fungi Found in the Human Ear have recently been studied by Dr. Karsten. He confirms the statement made by Hallier and other previous observers, that when the spores of these fungi are sown elsewhere they assume very different forms, according as the matrix on which they are sown is rich or poor in material for nutrition; and that fungi described by early writers as distinct species, or even as belonging to different genera, are frequently merely different forms of the same plant.

Vitality of Cambium Layer of Bark. — Permit me to call attention to a curious fact, relating to the "cambium layer." While spending vacation in Andover, Mass., in July and August of this year, I observed an apple tree upon the premises of Geo. Ripley, Esq., from which the bark had been entirely removed in May, 1870, for the whole distance between the ground and the branches. The tree is about one foot in diameter, and its branches are some seven feet from the ground. Though this tree had been so thoroughly girdled, a new and healthy bark had formed upon its trunk, and the tree appeared vigorous and had a good crop of fruit upon its branches. Upon inquiry, I found that this girdling operation had been performed from no malicious purpose, but for the sake of improving the health and fruitfulness of the tree! I sought the acquaintance of the botanical magician who had proved himself so skilful in producing good from evil, and found him to be an old man of 86 years — Mr. Joseph Davis. He showed me several trees in an adjoining orchard, upon which the same operation had been performed some six weeks previous, each tree manifesting all the signs of healthful vigor and having a new, but very thin bark already formed upon its trunk. Mr. Davis insisted that the removal of the bark should be made about the first of June, when the new wood is most rapidly formed, and that the hand of the operator and every other object should be kept from contact with the stripped trunk for several days. He also stated that a heavy rain storm would kill the tree if occurring within a day or two of the loss of its bark, and pointed out a dead line upon one of the trees, running from the top to the bottom of the trunk, caused by the trickling down of rain produced by a light shower which fell within twenty-four hours of the girdling.

I had never before seen so clear an illustration of the wonderful vitality of the "cambium layer," a portion of which (called "mucilage" by Mr. Davis) must have remained upon the trunks of these trees, and being protected from disturbance performed all the functions of the entire bark, besides speedily restoring the lost portions. — Frank H. Snow, *Lawrence, Kansas.*

Influence of the Period of Fecundation on the Sex of Plants. — The author of the "Vestiges of Creation" advanced the theory that "all beings are at one stage of the embryotic progress female, a certain number of them are afterwards advanced

to be of the more powerful sex;" and Thury of Geneva believed that the moment of fertilization relative to the maturity of the ovule, exercises a decisive influence on the sexuality of the product, the ovules fertilized earliest producing females, and those fecundated at a later period producing males. Professor Hoffmann of Giessen has recently attempted to test the truth of this theory in the case of diœcious plants, the species on which the experiments were made being *Spinacia oleracea*, *Mercurialis annua*, *Lychius vespertina*, and *Rumex acetosella*. In each case the female plants were separated into two portions, one being fertilized artificially as early as the stigmas were developed, the other after they had been mature for a considerable period. The result of his experiments was, on the whole, decidedly opposed to Thury's theory: nevertheless he found that the period of fecundation had an unmistakable influence on the plant; and also that a remarkable difference exists between the results of artificial and of natural impregnation which he was quite unable to account for.—A. W. B.

Diatoms in the Hot Springs of Nevada.—Dr. Blake exhibited, before the California Academy of Sciences, under a powerful microscope, specimens of Diatoms from a hot spring in Nevada, the temperature of which was one hundred and sixty degrees. Dr. Blake said they were more numerous there than in any other locality, six or eight hundred occurring in a bit of mud the size of a pin's head. Most of them were identical with the fossil species described by Ehrenberg, from near Salt Lake, but many were new. He mentioned particularly the red algæ, living in the spring and found in salt beds in many parts of the world. He found about fifty-two species, of which thirty are the same as Ehrenberg's, who mentions about sixty-eight.

ZOOLOGY.

Fossil Mesozoic Mammals.*—The interest which in the year 1854 centred around the important discoveries of Mr. Beckles in a small and apparently insignificant seam in a scarcely noticeable stratum of the upper Oolitic series has during the past few months risen to satisfaction at our knowledge of the fact that the speci-

* "Monograph of the Fossil Mammalia of the Mesozoic Formation." By Professor Owen, F. R. S., D. C. L. (Printed for the Palæontographical Society. 1871.)

mens derived from the Purbeck beds have been at last fully and entirely described by Professor Owen. Sir Charles Lyell eloquently and suggestively pointed out, with reference to the importance of the Purbeck discoveries, "when the geologist inquires if any land animals of a higher grade than reptiles lived through any one of these three periods, the rocks are all silent, save one thin layer a few inches in thickness. This single page of the earth's history has suddenly revealed to us in a few weeks the memorials of so many species of fossil mammalia that they already outnumber those of many a subdivision of the tertiary series and far surpass those of all the other secondary rocks put together!"

In this locality Mr. Beckles worked for many years at his own expense; and the result was the discovery of an extensive series of fossils, which were placed in the hands of Professor Owen for description. Some of these in the meanwhile were described by other palæontologists; and a controversy was carried on, both in the "Quarterly Journal of the Geological Society" and in some ephemeral publications, as to the nature and value of the principal genus of mammalia that was discovered in the Purbeck "dirt bed."

This species, *Plagiaulax*, contained in itself one of those text-examples on which the truth and verity of all our physiological deductions may rest. And it is rather with a view of offering our readers some notion of the intellectual canons on which a scientific man may determine the affinities of a species than of describing the form itself, that we briefly call attention to what, perhaps, is one of the most interesting genera which modern science has unveiled to us.

The jaw of a very minute animal presented, as was thought by Dr. Falconer, its original describer, some points of analogy with the characters exhibited by the jaw of the kangaroo-rat (*Hypsiprymnus*), and much controversy was expended at the time of its discovery and shortly afterwards, as to the precise value of those features which led one eminent scientific man (alas! since deceased) to affirm from the form of the jaw and shape of one of the teeth that it was an herbivorous animal; while Professor Owen, on the other hand, declared it to be a carnivorous marsupial. That two such eminent men could in this way differ on the most simple, the most elementary, and the most obvious fact in the science, naturally leads students to suspect either that the infallible can-

ons of the science of palæontology must be wrong, or that errors both of fact and of definition must have been committed by one or other of the intellectual combatants.

Varius Sucronensis ait, Æmilius Scaurus negat; utii creditis, quirites?

Though the species of animal, therefore, is of trifling dimensions, and though the technical argument is too complex to be entered into on the present occasion, we must examine how far the canons of the science have been obeyed. Cuvier has said, "La premiére chose à faire dans l'étude d'un animal fossile, est de reconnaitre la forme de ses dents molaires; on détermine par là s'il est carnivore ou herbivore." The few and small molars of *Plagiaulax*, however, bore no relation whatever to the like molars in any other herbivorous animal; while many other characters—*e. g.* the cutting and salient angle of the molar and premolar teeth; the broad, high, and nearly vertical coronoid process; and the very low position of the articular condyle—amply demonstrate to the satisfaction of Professor Owen and his disciples the absolute reverse of Dr. Falconer's theory. Plausible as the latter was, resting entirely on the apparent resemblance of one solitary tooth (and that one not even a molar) with the premolar tooth of the kangaroo-rat, the words of Owen are amply confirmed, "that the prominent appearances which first catch the eye and indicate a conformable conclusion are deceptive; and that the less obtrusive phenomena which require searching out, more frequently when their full significance is reasoned up to, guide to the right comprehension of the whole. It is as if truth were whispered rather than outspoken by Nature."

The lesson, therefore which students ought to learn is that the true affinities of an animal do not lie on the surface of the specimen; that one solitary premolar tooth is inadequate on which to found a theory of the "saltatory" nature of the animal to which it belonged; and that the theory of Dr. Falconer, adroitly though it has been supported by many apparent or accidental coincidences has not stood its ground before the more elaborate, more profound, and at the same time more simple interpretation of the affinities of *Plagiaulax* originally suggested by Professor Owen.

After the lapse of some years (in fact since 1847) the oldest known mammal is still the *Microlestes* of the Triassic beds of Wurtemberg. This perhaps bears some slight resemblance to

Plagiaulax, although the allegation of affinity between *Plagiaulax* and *Microlestes* rested upon one of those "hasty blunders" which detract from the safe and accurate progress of any science. Professor Owen we believe on one occasion ("Palæontology," 1st edit., p. 302; 2nd edit., p. 339) pointed out that some of the teeth of *Plagiaulax* bore resemblance to some teeth in *Microlestes*, in a sentence which was plainly and lucidly expressed. The incapacity as it seems, to apprehend the meaning of an ordinary sentence leads us also to doubt the capacity of judging of the nature or degree of the demonstration of the affinity of *Plagiaulax* to *Hypsiprymnus* which a superficial observer may believe himself to find in the more exact writings of Falconer or Flower.

Relegating, therefore, the unhappy little jaw of *Plagiaulax* far away from the sect of the "Jumpers" (*Saltantia*) to its proper position in the scale of insect or flesh feeding marsupials, associated with its congener, the large marsupial tiger of Australia (*Thylacoleo carnifex*), the affinities of which as a *bona fide* carnivore Professor Owen also amply proves, we have to glance at the number of new forms of animal life described by Professor Owen in the present memoir. Eight new genera of mammalia and seventeen new species are described in detail, all of which afford marked points of distinction from anything of which the palæontological student in his wildest day dreams could have ever realized. Nearly all of these forms are unquestionably marsupial and allied to the pigmy "opossums" of Australia, differing not only from each other, but from anything previously known to science. We can only wonder at the enormous amount of variety of "differentiation" which appeared at so remote a period of the earth's history, and the mode in which the places which nowadays in the Dorsetshire fields are filled by moles, hedgehogs, and shrewmice, were, at the time of the deposition of what is now called the "Purbeck bed" occupied by animals which, while they closely resembled in many of their characters the existing opossums, yet differed from them in retaining the more "generalized" type, from which it is not merely rational but probable to believe that our forms of marsupial animals existing at the present day have sprung.—*Pall Mall Budget*.

Former Eastward Range of the Buffalo.—The occurrence of the buffalo in Virginia up to the close of the last century, can

be substantiated beyond question. Surgeon J. Simpson, U. S. A., who was well acquainted with Nathan Boone (son of Daniel Boone the pioneer, and then a captain in the service*), informs me that he had the fact, in 1843, from Nathan Boone himself, who killed Buffalo in Virginia in 1793–'97–'98.

Dr. Simpson has handed me a letter addressed to him by Dr. Charles McCormick, Surgeon U. S. A., dated Fort Gibson, Cherokee Nation, August 18th, 1844, in which the particulars are given. The occasion for that part of the letter which relates to the buffalo arose in this way:—An officer to whom Dr. Simpson mentioned Capt. Boone's statements being inclined to doubt them, Dr. Simpson wrote to Dr. McCormick, desiring the latter to ask Capt. Boone, who was then at Fort Gibson, to put the facts in writing. This, it seems, Capt. Boone promised to do, but neglected to keep his promise, owing, probably, to the singular indisposition of men of his class to put anything on paper. The following extract, however, from the letter in question, is sufficient:—

"I have just seen Capt. Boone," writes Dr. McCormick, "and he promises to write and tell you all about it. In the meantime, he says he killed his first buffalo, somewhere about 1793, on the Kenawha in Virginia. He was then quite a small boy. He has also killed buffalo on New River and near the Big Sandy in Virginia in '97 and '98."

I have thought best to be thus circumstantial in detail of persons, places and dates, in order to fix precisely an important item in the natural history of our country. But this occurrence of the buffalo in Virginia is only of a part with its general former range, as attested by accounts of other observers.—Elliott Coues. *Fort McHenry, Md.*

Land Shells of Western Massachusetts.—In Vol. I. of the Naturalist, was published a paper on the "Land-Snails of New England." During the following summer I was myself engaged in making a small collection of the land-snails found at West Stockbridge, Berkshire Co., Mass., and to my surprise, many of my results were directly at variance with those given by Mr. Morse in the above-mentioned article. The reason for this difference was

*Captain of Rangers, 23 March, 1812; out of service to June 16, 1832; then made Captain of Mounted Rangers; Lieutenant Colonel, 2d U. S. Dragoons, July 25, 1850, and until death at Springfield Illinois, July 15, 1853.

apparent when I considered my locality. Berkshire Co. occupies the extreme western end of Massachusetts, and therefore its fauna closely resembles that of New York; and further, it is eminently a limestone country, and for this reason, the land-snails exist in wonderful abundance. Frequently in a morning's walk I have met with twenty or thirty of the larger species and quite a number of the smaller ones. *Helix fuliginosus* Binney and *H. inornata* Say were found in great abundance and in nearly equal numbers. In some localities, near the marble quarries, I found *H. alternata* Say in wonderful profusion, but in general it was an uncommon shell. *H. tridentata* Say, of which Mr. Morse says, it "occurs only rarely in the western part of Mass.," was very common in my immediate vicinity. Next to *albolabris*, *inornata* and *fuliginosis*, it was the most common shell found. *H. monodon* was rather rare; *hirsuta* was still more so, as between myself and a friend collecting with me, we only obtained three or four specimens. Of *H. palliata*, recorded as being found at "Copperas Hill, Vt.," I found one perfect specimen: of *H. Sayii*, I found five or six perfect specimens and several bleached ones. Of the smaller shells, none could be considered common except *H. labyrinthica*, and *Zua lubricoides*. The former I found most common on moss-covered rocks, comfortably packed away in the moist earth and roots, between the moss and the rock. The latter were always found at the base of rocks, among the moist leaves and in the earth itself. Judging from the collections made by myself and friend, I should say that the relative abundance of snail shells in that locality is expressed in the following numbers: *H. fuliginosis*, ten; *inornata*, ten; *tridentata*, five; *albolabris*, four: *alternata*, three; *monodon*, three; *labyrinthica*, two: *Zua lubricoides*, two: *H. Sayii*, one; all others only occasional. This excludes the locality where *alternata* was so plenty; if that be counted, it would place that species at two or three times all the others combined. I have given these notes because they show how much local variation may exist in the distribution of the land shells, and how much the extreme western part of Mass. resembles the Middle or Western States, so far as its snail-life is concerned. — W. G. Freedley, *Philadelphia.*

Conchological Notes — Mr Stearns called the attention of the California Academy of Sciences to the indefiniteness and errors in the catalogues of various families of the Mollusca, which are being

published by the Conchological Section of the Academy of Sciences of Philadelphia; these faults occur in the *habitat* of many of the species, while no new light has been thrown upon their geographical distribution. In some instances, certain West American species which he named, had a range of a *thousand miles* further north than credited in the catalogues, and in some cases species had been credited to this coast that were exotic and whose true station was *thousands of miles* away. Such errors by an American author in connection with American species, were to say the least discreditable; the errors of Reeve, Sowerby and Kiener were repeated, while the labors of our own authors were practically ignored, and their more accurate work though equally accessible, was overlooked. He presented a paper upon the subject for publication.

Mr. Stearns also gave a description of the animal of Trivia Californica, with blackboard illustrations of the same, and of the corals upon which it feeds; worn beach specimens of this Trivia are the *T. depauperata* of Sowerby.

The Fauna of Lake Superior at Great Depths. — An examination of the fauna of the depths of Lake Superior has been undertaken the past season by the U. S. Lake Survey, and dredging in different parts of the lake has been conducted by Mr. S. I. Smith. In all the deeper parts of the lake examined, the bottom is composed of fine clay, or clayey mud, apparently unfavorable to a great variety of life. The principal animals obtained below one hundred fathoms were, a species of Hydra, several worms, species of Ostracoda, with a few other forms of Entomostraca, one or two species of Amphipoda, a species of Mysis,* insect larvæ belonging to the dipterous genus Chironomus and a species of Pisidium. In the more shallow waters, a much greater variety of animals was obtained. The species of Mysis was found at a number of points from eight to one hundred and forty-eight fathoms, and Mr. Smith regards its occurrence only as evidence that Mysis is another to be added to the list of genera common to fresh and salt water. Dredging was carried on down to one hundred and sixty-nine fathoms, the deepest known point in the lake, and water brought up from that depth was perfectly fresh. The temperature in all the deeper parts of the lake is near 39°, or about that of the maximum density of fresh water.

* *Mysis relicta* Lovén, and *Pontoporeia affinis* Lindst., both living in Lake Wetter in Sweden!

Sensitive Surface in Mouse's Ear. — We learn from the "Quarterly Journal of Microscopy" that Dr. Schobl, who lately published a remarkable paper on the wing of the bat, has made similar researches on the ear of the white mouse, with very interesting and surprising results. The first thing which attracted his attention was the immense richness of the ear in nerves. Even the bat's wing is but poorly supplied in comparison. Calculating from the average size of the ear of a common mouse, he found that there are on the average 3,000 nerve terminations on each of its surfaces, making 6,000 on each ear, or 12,000 altogether. The function of this elaborate arrangement would seem to be, like that in the wing of the bat, to supply by means of a very refined sense of touch the want of vision to these subterranean animals.

Development of Noctiluca. — All that has been known as to the mode of development of this minute animal (Fig. 121), that causes a great part of the phosphorescence of our seas, is that they multiply by division and internal budding. Prof. Cienkowski, as the "Quarterly Journal of Microscopy" states, has traced the formation of spores like those of some fungi, and seen them swimming around like the zoospores of sea weeds. He has also observed the mode of sexual union of these animals.

Fig. 121.



Relations of Embryology to pathology. — Dr. Dohrn reviews in the "Academy" some observations made in the Pathological Institute of Jena by Prof. W. Müller, and published in the "Jena Zeitschrift." The papers contain a singular mixture of embryology and pathology, and embrace a field of comparative embryology that has hitherto remained wholly uncultivated. In regard to the chorda dorsalis, Müller shows that it plays a secondary part in the formation of the skeleton of Vertebrates. We can very well imagine animals, Dohrn says, with bones in their interior, and even animals with a vertebrate skeleton, which present no traces of a chorda, while on the other hand we may meet with the chorda in invertebrate animals, such as the larvæ of Ascidians, which develop no trace of an internal skeleton.

Müller's papers also show that a new era in pathological anat-

omy is dawning, since comparative anatomy and embryology will aid in recognizing the nature of pathological processes and formations. Dohrn insists that "in addition to anatomy and physiology, which are subjects of equal importance, embryology and comparative anatomy should also be regarded as absolutely essential to the completion of medical education" and urges that a new and special chair be devoted to these subjects in medical universities and schools; and if this be a necessity for Germany, where the study of the history of development has of late years received such great extension, it holds still more for England, where scarcely any embryology is taught or made an object of study. How lamentably deficient our own medical schools are in these branches is sufficiently apparent.

Cause of Phosphorescence in Animals.—M. Panceri presented to the recent congress of naturalists and physicians at Turin (Italy) the results of some investigations as to the cause of phosphorescence in animals, and especially in fishes. He has come to the conclusion that the cause of this phenomenon is the slow oxidation of fat, which he finds to be always present when the phosphorescence is observed in animal substances. In the case of fish the oxygen of the air very readily penetrates the skin, and acts upon the subcutaneous adipose tissue. The phenomenon is promoted by placing the phosphorescent substance in oxygen, but is entirely arrested by its immersion in carbonic acid, fresh water, alcohol, or any solution not containing oxygen. Phosphorescence usually commences immediately after death, and continues until decomposition sets in, with disengagement of ammonia, when it invariably ceases.—A. W. B.

Pieris rapæ Parasite.—It will doubtless be an interesting item of intelligence to many of the readers of the Naturalist, that the parasite, so anxiously looked for, as the only hope of preserving the cabbage crop of our country from the destruction threatened it by the ravages of *Pieris rapæ*, has already entered upon its labors, and in so efficient a manner as to promise immediate beneficial results.

During the latter part of September, I was informed that a number of chrysalides of *P. rapæ* which had been collected by a gentleman in this city, with a view of obtaining specimens of the

images for drawing, instead of disclosing the butterfly, gave out a number of small flies from each. Some of them having been brought to me in compliance with my request, I was delighted to find them to be of the genus *Pteromalus* which includes so many of our valued parasitic friends, and probably of the species which has been found so serviceable in Europe, in destroying the several cabbage butterflies there existing — viz., the *Pt. puparum* of Linnæus.

From the close resemblance which many of the *Pteromali* bear to one another, it is not safe to assert positively that we have really been favored with the importation of the European parasite, to aid in the work of subjugation of the European pest, but should further examination prove this to be the case, it will be not only a most interesting event in its scientific aspect, but also in the pecuniary results which must necessarily follow it.

In another number, I may give your readers the observations — quite limited, I regret — which I have been able to make on this welcome parasite. — J. A. Lintner. *N. Y. State Museum of Nat. Hist.*

[We have also raised this parasite in considerable abundance and also received specimens from Vermont. We have likewise reared a Dipterous parasite from the cocoons. — Eds.]

The Fauna of Madagascar. — M. Alfred Grandidier has recently returned from his third voyage of discovery to Madagascar, and has shown that the riches and eccentricities of its fauna have not yet been exhausted. His collections, which have only recently reached the Jardin des Plantes at Paris, although brought to France before the political storm of last year commenced, have not yet been fully examined. But they are said to include very full series of several species of Lemuridæ, the comparison of which is likely to lead to important results, besides examples of a new genus of Rodentia, and many other mammals of high interest. M. Grandidier has also paid much attention to the fossil deposits of Southern Madagascar, which contain the remains of the extinct gigantic bird, *Epyornis maxima*, and has arrived at some important results (such as the former presence of Hippopotamus in Madagascar), which may ultimately tend to modify some of the views generally held concerning the true nature of the fauna of this island and its origin. — A. W. B.

WALDHEIMIA SEPTIGERA AND TEREBRATELLA SEPTATA IDENTICAL. *To the Editors of the American Naturalist.* Sirs:—Having in the course of a too short visit to North America been honored by remarkable kindness and attention on the part of my brother naturalists in this great hemisphere, I am rather disappointed at seeing in your excellent periodical a notice of the report submitted to the Royal Society of London by my colleagues and myself on the deep-sea exploration of parts of the North Atlantic, in H. M. S. Porcupine, during the summer of 1869. The writer of that notice, Mr. W. H. Dall, criticises in what I cannot help considering over-severe terms my views "in regard of the specific and generic limits of animals;" and he gives as an instance, *Waldheimia septigera* and *Terebratella septata*, which he states belongs to different genera, although I have included both under the same specific name. I do not agree with Mr. Dall in his statement. Having had opportunities of examining the types or original specimens of *Terebratula septigera* Lovén, at Stockholm, and of *Terebratula septata* (Philippi), at Berlin, and having carefully compared these specimens with the published descriptions and figures, I am convinced that both belong not only to the same genus, but to the same species. What seems to have been in the mind of Mr. Dall when he penned his hasty critique, was that Professor Seguenza of Messina had referred a species of *Terebratella* from the Sicilian tertiaries to Philippi's species, and a species of *Terebratula* found in the same formation to Lovén's species. The former may be the *Terebratella Mariæ* of Mr. Arthur Adams from the Japanese seas; the latter I have ascertained to be rather widely distributed in the North Atlantic. I have the honor to be, Sirs, your very obedient servant.

J. GWYN JEFFREYS, *Montreal, Oct.* 6, 1871.

AFFINITIES OF COCCOLITHS AND OF SPONGES.—Mr. H. J. Carter has enunciated the theory that the coccoliths and coccospheres which are found in deep-sea mud, and have recently been identified as a constituent of some very ancient geological strata, are not, as held by Prof. Huxley, lowly formed animal organisms, but are of vegetable origin. This theory will, the writer considers, explain the apparent anomaly of the presence in deep seas of a large amount of animal life without vegetable organisms for their subsistence. To the same magazine in which this theory is propounded, the "Annals and Magazine of Natural History," the

same authority contributes a paper on the ultimate structure of the calcareous sponges, confirming what has already been written on the same subject by Prof. H. James Clark of Lexington, Ky. The opinion of these two writers is, that the sponges as a group are most nearly allied to the Flagellate Infusoria, and not, as Prof. Haeckel has proposed, to the Cœlenterata. Mr. Carter has expressed his opinion that they are more closely related even to the compound Tunicata, a view which is, however, dissented from by Mr. W. S. Kent, who regards them as a distinct group of the Protozoa, allied on the one hand to the Flagellate Infusoria, in virtue of their uniciliated and funnel-bearing cells, and on the other to the simpler Rhizopoda, in the presence of the general pervading sarcode layer, subservient to the secretion of the common supporting skeleton. While opposed to Prof. Hæckel's proposition of uniting the Spongiadæ and Cœlenterata under one sub-kingdom, Mr. Kent does not deny to the latter the position of the next round of the ladder in the ascending scale of organized beings, though he at present considers there are too many links missing to permit of their fusion.—**A. W. B.**

Lacordaire's Coleoptera.—I learn from that agreeable source of entomological information, the "Petite Nouvelles Entomologiques," that M. Chapuis has undertaken to complete M. Lacordaire's great work, which was interrupted by the lamented death of its talented author. M. Chapuis wishes to obtain specimens of the following genera, in which he is still deficient:—Megamerus, Prionesthis, Rhynchostomis, Atalesis, Ametella, Chiloxena, Polyoptilus, Macrolema, Eubaptus and Ateledera, etc. I am informed that our friend, Mr. J. S. Baly, who possesses the finest collection of Chrysomelidæ in the world, has offered it to M. Chapuis to make every use of; and I trust other entomologists will follow so generous an example.—*Newman's Entomologist.*

The Stilt Sandpiper in Massachusetts.—A single specimen of this species, *Micropalama himantopus*, was taken here by Albert E. Mills, at Blacksmith pond, July 24, the present year. This is the first recorded instance of its capture in this State, although its occurrence had been anticipated. (Proceedings Essex Inst., V. 294, and Amer. Nat., III, 639.) It was in company with a solitary sandpiper, *Rhyacophilus solitarius*, which was also secured. Both were adult females.—Otis Fuller, *Needham, Mass.*

Gigantic Salamander from China. — Father David, a missionary priest of the order of Lazarists, for many years resident at Pekin, and an enthusiastic naturalist, has discovered in China, besides several new and extremely interesting species of animals, a gigantic aquatic salamander, allied to the great Sieboldia of Japan. The remains of a closely allied reptile (Andrias) are found in the tertiary fresh water deposits of Central Europe.

New Habitat of Helix lineata. — Among the North American landshells that are remarkable for a wide range of distribution is the little *Helix* (Hyalina?) *lineata* of Say, already credited with a range in latitude from "Gaspé to Texas," with a longitude from the Atlantic to "New Mexico." I was much surprised to find specimens in a box of Helices recently collected on the banks and in the neighborhood of Salmon River, Idaho, and sent to me by Henry Hemphill, Esq. The internal peripheral teeth I should judge to be coincident with varical development or periodical growth, and rather eccentric in occurrence and number; not always being in "pairs"* — but sometimes showing only one. — R. E. C. Stearns.

New Entomological Books. — The 14th fasciculus of Mulsant's "Opuscula Entomologica" is just published. The 3rd volume of the "Natural History of the Hemiptera of France" will be ready in a few days, and will contain four tribes. M. Mulsant has published the new edition of his "History of the Lamellicorns of France," as well as the 1st part of the "Staphylinidæ." A new edition of the "Iconography and Natural History of Larvæ of Lepidoptera," by MM. Duponchel and Guenée, is about to be issued: the work gives descriptions and figures of a great number of the larvæ of European Lepidoptera, of course including English species; these figures are contained in ninety-three plates, excellently coloured: the work is published in forty fascieuli, at one franc each. Of the Iconography and Description of unpublished Lepidoptera of Europe, by P. Millière, twenty-five fascieuli have been published, and these contain more than a thousand descriptions of larvæ, pupæ and perfect insects, with the plants on which the larvæ feed, and other details of their life-history: the work is worthy the support of all lovers of the science; nothing

*Vide Binney and Bland's Land and Fresh Water Shells of North America, Part I. p. 82, fig. 84. — Smithson. Pub.

can exceed the delicacy and finish of the figures.—*Newman's Entomologist.*

GEOLOGY.

The Drift Period.—In a paper read at the Lyceum of Natural History, New York Oct. 24, 1870, Prof. Newberry observed:—In the sequence of events included in our Drift period there is a marked break, a middle period, during which, over most of the north-western states, no Drift deposits were made, and when most of this area was covered with a forest growth and sustained many and large animals. At a subsequent period, all parts of this area, less than five hundred feet above the highest of our present great lakes was submerged, and most portions of it covered to greater or less depth, with new Drift deposits, clays, sands, gravel and boulders, a large part of northern and remote origin. Nearly all the large boulders of the Drift belonging to this later epoch are sometimes of great size (one hundred tons) and have been *floated* to their present positions, as they overlie undisturbed stratified sands and clays, which would have been broken up and carried away by glaciers or currents of water moving with sufficient velocity to transport these blocks. Hence they must have been floated from the Canadian highlands, the place of origin of most of them, by *icebergs*. This epoch of the Drift period I have therefore termed the Iceberg Epoch. During this epoch the submergence of the land in the interior of the continent, was greater than in the epoch of the deposition of the Champlain and Erie clays, and all the area north of the Ohio was covered with water up to a height of over five hundred feet above Lake Erie, or one thousand one hundred feet above the ocean level. The highlands of south eastern Ohio, and most of the country south of the Ohio river were not covered by this flood and now bear no drift deposit of any kind. Tracing out the line of ancient water-surface, we find that the depression was greater towards the north, so that the Alleghanies and their foot-hills, and also a wide area of comparatively low country in the southern states formed not only a shore, but a continental limit to the great interior iceberg-ridden sea of the later Drift Epoch. In the western reaches of this sea, which was of fresh water in the later centuries of its existence, was deposited the Löess or "Bluff" which I have elsewhere desig-

nated as the later lacustrine, non-glacial drift. During the deposition of the Löess the interior sea was already narrowing and growing shallower by the cutting down of its outlet or by continental elevation, or both. The descent of the water-level and decrease of water-surface have been going on perhaps constantly, but not uniformly, to the present time, when the area of the great lakes is the insignificant eighty-five thousand square miles it now is. In the descent of the water-level, retarded at certain periods, terraces and beach lines were formed at various places by the shore waves. With these history begins. This then is the classification I would suggest of the drift deposits as they occur in the valley of the Mississippi, premising that here, as in other geological periods, the column is nowhere absolutely complete :—

Period.	Epochs.	Strata.	Notes.
Quaternary.	Terrace.	Terraces, Beaches, Löess.	Sand and gravel beaches with logs, leaves, and fresh-water shells. Löess with fresh-water and land-shells.
		Iceberg Drift. Löess.	Boulders, gravel, sand, and clay, drifted logs, elephant and mastodon teeth and bones.
		Forest Bed.	Soil-peat with mosses, leaves, logs, stumps, branches, and standing trees, mostly red cedar. Elephas, mastodon, Castoroides, etc.
	Glacial.	Erie Clays.	Laminated clays with sheets of gravel, occasional rounded and scratched northern boulders, many angular pieces of underlying rocks.
		Glacial Drift.	Local beds of boulders and rarely boulder clay resting on the glaciated surface.

From the above table it will be seen that the remains of elephant, mastodon, and the gigantic beaver, occur in the forest-bed and in all the succeeding drift deposits. It should also be said that they are found in still greater abundance in peat-bogs and alluvial deposits which belong to the present epoch. We have seen that the submergence of the later drift epoch, though so widespread, left a large part of the area lying between the Mississippi and Atlantic uncovered. This area the elephant, mastodon, great beaver, etc., inhabited during the continuance of the flood that covered the forest bed. From this retreat they issued with the subsidence of the water, following the retreating shore-line, till they occupied all the region now exposed about the great lakes.

By what influence they finally became extinct, we cannot yet say. It has been claimed that they continued to exist down to the advent of man, and that he was an agent in their destruction. This statement may be true but requires further proof before it can be accepted with confidence. The vegetation of the forest bed indicates a cold climate, thus confirming what we had otherwise learned of the habits of the extinct elephant. He was clothed with long hair and wool, was capable of enduring, and probably preferred a subartic climate, and was associated in this country as in Europe, with the musk ox and the reindeer. We may therefore infer that progressive increase in the annual temperature, drove most of the animals of the Forest-bed northward, and caused to gather on the shores of the Arctic sea, the herds of elephants whose remains so much impress all travellers who visit that region. This was probably the scene of the last vigorous and abundant life, and of the death of the species; an event consequent, perhaps, on the action of local causes, which we shall comprehend when we have opportunities of studying the record. One remarkable statement in regard to the Forest-bed requires notice. In more than one instance, parties digging wells in south-western Ohio, have reported not only that they found a black soil and logs, but "some of the logs bore marks of the axe, and were surrounded with chips." These stories I formerly rejected as pure fabrications; but in the light of recent observations, they seem to me to be in part true, and not difficult of explanation.— *Nature.*

The Structure of Fossil Cryptogams.—At the recent meeting of the British Association for the Advancement of Science held at Edinburgh, Prof. W. C. Williamson read a paper in which he suggested a new mode of classification of fossil cryptogams. He proposes to separate the vascular cryptogams into two groups, the one comprehending Equisetaceæ, Lycopodiaceæ and Isoetaceæ, to be termed the Cryptogamiæ Exogenæ, linking the Cryptogams with the true Exogens through the Cycads; the other, called the Cryptogamiæ Endogenæ, to comprehend the ferns, which will unite the Cryptogams with the Endogens through the palms. He considers the fossil arborescent Cryptogams allied to Lycopods including the Lepidodendra, Stigmariæ, Sigillariæ, etc., to be true cryptogams with an exogenous woody axis, and not entitled to the epithet of Acrogens. They differ from ferns in not having closed

fibro-vascular bundles; but their growth results from the development, within the stem, of a vascular woody cylinder, which grew thicker year by year, such thickenings being the result of additions to the exterior of the previous growth. Professor Williamson's theory was, however, sharply contested by Mr. Carruthers and Professors NcNab and Dyer, who adhered to the old view of the essential identity of structure of all woody cryptogamous stems.—**A. W. B.**

Supposed Vegetable Fossils.—At a recent meeting of the Geological Society of London, Mr. W. Carruthers enumerated a number of bodies which he believes to have been erroneously described as vegetable fossils. Among these are dendritic markings which have been treated as foliage; two genera and three species of supposed fossil fruits which are really impressions of air-bubbles in moist clay; reptilian eggs in the Stonefield Slate and Wealden of the Isle of Wight which have been considered to be fruits; and the curious prehensile hooklets, arranged in rows on the arms of a calamary, found fossil in the lithographic stone of Solenhofen, which have been figured and described by Count Sternberg as a fossil vegetable.—**A. W. B.**

The Geology of the White Mountains.—The geology of these mountains is most intricate. It is not known whether its granite and slate rocks are of Laurentian, Silurian, or Devonian age alone, or whether all of these formations may not be represented. Prof. C. H. Hitchcock, the state geologist of New Hampshire, has made the interesting discovery of upper Silurian corals in Littleton, N. H. The limestone containing these corals has been traced for about three miles, and appears to be overlaid by a clay slate, containing a few worm trails. The limestone rock appears identical, as we learn from the "American Journal of Science," with that cropping out upon Lake Memphremagog.

Origin of Ocean Currents.—It seems that the views of ocean currents advocated by Prof. Carpenter were first recognized by Prof. J. D. Dana, in 1852, in the reports of "Wilkes's Exploring Expedition" and the "American Journal of Science." Prof. Dana remarks that facts elicited by Carpenter from deep sea explorations "remove all remaining doubt with regard to the universality of the movement and the oneness of the system. At the same

time there does not appear to be any good reason for separating from the system the Gulf Stream, as is done by Dr. Carpenter." Prof. Dana also seems to agree with Croll as to the thermal work of the Gulf Stream.

New Carboniferous Spider.—Mr. Woodward describes, as stated in "Nature," from the Dudley coal field, a Phrynus-like spider which he named *Eophrynus Prestvicii*. A fossil Lycosa-like spider had previously been found, also a Phalangium-like species from the same formation. The present animal represents a third group of Arachnids which lived during the Coal period.

Singular Albino.—The Museum of the Agricultural Department at Washington, contains an "albino" Bob-o'-link (*Dolichonyx oryzivorus*), shot in that vicinity, illustrating a rare and curious condition. It is of a uniform clear pale *yellow*, exactly like a canary-bird.—Elliott Coues.

MICROSCOPY.

Proceedings of the Section of Microscopy of the Boston Society of Natural History, Oct. 11, 1871.—Mr. Greenleaf stated in reference to the living Amœbæ shown at the last meeting, that he had not found the slightest trace of any return movement in those organisms. He had seen a central forward current, but never the two return side currents, so often described. He considered these merely optical.

Mr. Stodder said he had tried collecting germs from the atmosphere. He had always found great difficulty in obtaining microscopically pure distilled water. This last summer he had used a glass vessel filled with ice, on which the moisture of the air condensed outside. In this manner nothing not in the air was obtained. In his examinations he had followed the method given by Dr. Maddox in the Feb. (1871) number of the "Monthly Microscopical Journal."

He first placed his germs in molasses, but subsequent examinations showed that this contained germs of its own. He next took pure crystals of sugar dissolved in the water collected, and placed on a slide. To keep the moisture present he had used the method given by Dr. Maddox.

His first collection, made Aug. 11, developed in a few weeks sphores, mycelium, and spores of fungi in great abundance. Other collections of the same date have as yet developed but little life. He had found that in these experiments no animal life was developed.

Mr. Greenleaf showed a slide with a small hole drilled in the centre. By resting the slide on the edge of a shallow tray containing water, so that the hole shall be below the water level, we have a self-supplying water cell, which is completed by placing a thin glass cover over the hole.

Mr. Stodder said, "Dr. Woodward has, I think, carried microphotography to greater perfection than any one else. I have here several photographs of great beauty, delicacy and accuracy, taken with high powers and of very difficult objects." He then showed the following: *Amhipleura pellucida*, with Powell and Lealand's so called $\frac{1}{16}$, a Tolles' $\frac{1}{15}$ and $\frac{1}{10}$ and another $\frac{1}{16}$, and Powell and Lealand's $\frac{1}{8}$, and with a Tolles' $\frac{1}{6}$, all immersion lenses, and all magnified to nearly 1000 diam. Also positives on glass of the same objects with Tolles' $\frac{1}{6}$ 920 diam. with eye-piece and 256 without. All these show the transverse striæ distinctly. Also *Stauroneis Stodderi* Greenleaf 1000 diam. and 3750 diam. and *S. Baileyi* with Powell and Lealand's $\frac{1}{16} =$ 3000 diam.

Mr. Bicknell spoke of the difficulty of using the microscope vertically, a position which is often necessary in such work as observing living animals in fluid, picking out Foraminiferæ from sand, etc. He had obviated this difficulty by using an ordinary Nachêt camera lucida. By placing the camera on the eye-piece in the usual manner, and looking into the *underside* of the camera, at an angle of about 30° from the horizontal, a perfect view of the objects on the stage of the microscope is obtained. The position is thus very easy and entirely free from the usual constraint attending the use of the microscope when in a vertical position.

Mr. Bicknell also exhibited an achromatic condenser, made in the form of an eye-piece. Dr. Beale in "How to work with the Microscope" has recommended the use of the Kellner eye-piece as a condenser, and says "by stopping off the greater part of the light passing through the condenser, by placing over the upper lens a thin plate with a very small central hole, a great advantage results in working with high powers." In the condenser shown by Mr. Bicknell the amount and direction of the light is controlled

by a revolving diaphragm placed between the lenses in the place where the diaphragm is usually placed in an eye-piece. There are three holes of different sizes for direct light, one hole with a central stop for dark field, which gives an admirable effect with objectives under 30°; and two oval openings, and one oblong opening especially for the binocular. The oval openings are opposite each other and are in use at the same time, giving two oblique pencils of light, converging to a point, and which are very useful for the binocular. This condenser was used with various objectives from $1\frac{1}{2}$ inch to a $\frac{1}{50}$ of an inch, giving ample light for the latter with the highest eye-pieces.

Mr. Bicknell stated that with this condenser and a $\frac{1}{5}$ of only 100° aperture, he had seen the same test object which had required a $\frac{1}{10}$ or a $\frac{1}{12}$ of 150° when used without it.

The State Microscopical Society of Illinois has issued a prospectus of "The Lens," a Quarterly Journal of Microscopy and the Allied Natural Sciences: with the Transactions of the State Microscopical Society of Illinois; the first number to appear on the first of October. It will be an octavo, each number containing at least forty-eight pages of reading matter. Terms, two dollars per annum in advance. Address Charles Adams, Secretary of the Publishing Committee, 1000 Michigan Avenue, Chicago, or the the Editor, S. A. Briggs, 177 Calumet Avenue, Chicago. Though its appearance has been delayed by the fire, we learn that it will soon be issued.

The Use of the Microscope in Studying the Embryology of the Skull.—His work had not direct reference to the subject of teleology, nor to the structure of the tissues; but his object had been to work out the metamorphosis of the skull, and to see the tissues as they begin to differentiate and modify to form the embryo. The subject was a very large one, and had been principally labored at by the great German embryologists. He had spent the last two years in studying the development of the frog's skull, in watching the different and numerous stages which that creature undergoes, and the relations it bears to other creatures of the vertebrate type, always remembering that the frog was essentially a fish. He had been in some degree unprepared for the extent of the metamorphic changes that the frog underwent. He had worked out this subject into ten artificial stages, the first of which he had obtained when the frog was in the egg. In the first stage of its

morphological development the animal was two stages below the youngest *described* embryo of the lowest kind of fish, but one.

The larva of the lamprey was the earliest condition of a fish's skull with which we are acquainted. He had succeeded in getting two stages below the larva of the lamprey. From this stage he had worked up the development of the frog until he came to the tadpole, which is the representation of the types of rays and sharks. As he ascended in the various stages the likeness to the other vertebrata became very apparent. In an adult frog (*Rana temporaria*) he had obtained a metamorphic development of such height that it bordered upon our own class, the Mammalia. At the same time it should be stated that other parts of that frog's skull retained the simplicity of the adult lamprey. In the frog we had a creature who had run across the whole circle of types, creeping gradually up to the Mammalia and yet never losing his relation to the original type, but retaining its structure and relation to the very end, although subdividing and metamorphosing certain of the facial arches into the very number of parts that we have in our own inner ear. The chain of bones in the human ear (the hammer, the anvil, the round bone and the stirrup) had caused a great deal of trouble to anatomists in their attempts to trace the series of metamorphic changes. He had, however, made this clear by tracing the history of the facial bones of a frog, a creature which was but a fish in respect of its earliest embryonic conditions. Supposing the doctrine of development to be true, it would seem that we ourselves have come originally in some line sub-parallel to the frog (he would not say from the frog itself, although man had repeated the form tail-less). Even in the highest oviparous vertebrates no sub-division of a facial bar to form that tiny but really important part of the human skull, the *os orbiculare*, ever obtained. In this respect the frog comes nearer to the Mammalia than any bird. Birds have branched out in a direction quite away from the ordinary line, and have culminated in their own glorious types. If it is desired to trace the development of the Mammalia, inquiries must commence with the Batrachia, and in such inquiries the thought constantly occurs that between us and the Batrachia there have been lost whole groups of creatures. We were only just beginning to see the manner in which the work of tracing the development of the higher forms of animal life was to be carried on. —*From Address of H. W. Parker, before the Royal Microscopical Society, in the Monthly Microscopical Journal.*

NOTES.

The death of Sir Roderick Impey Murchison occurred on the 22d of October, at the age of seventy-nine. He was not a graduate of either of the great universities, but like Faraday, Miller and several other prominent English scientists is said to have had in early life only an ordinary education. He studied at the Military College at Marlow, and was an officer in the army from 1807 to 1816. In 1831 he began to study geology practically and at the end of five years published his celebrated Silurian system. In 1836 he was employed in the geological survey of Russia. He contributed over a hundred memoirs to scientific journals, and was among the first to call attention to the Australian gold fields. He was long President of the Geological Society of London, and at the time of his death was President of the Royal Geological Society.

The U. S. Coast Survey Steamer F. R. Hassler, commander P. C. Johnson, U. S. N., now arrived at Boston, will be despatched as soon as ready to the coast of California for the survey for which she is designed.

Prof. Peirce, Superintendent of the Coast Survey, to make this long voyage by way of the Straits of Magellan as profitable as possible to science, has offered to Prof. Agassiz the direction of a scientific party to sail in her, and pursue during the voyage deep sea researches and investigations in natural history at the different points of stoppage. The party will consist of Prof. Agassiz as director (accompanied by Mrs. Agassiz.) Ex-President Hill of Harvard College as physicist, Assist. L. F. Pourtales of the Coast Survey in charge of deep sea dredgings, Dr. Steindachner as ichthyologist, Mr. Blake as ichthyologist and draughtsman. Some of the officers of the ship have also qualified themselves to assist in various researches. The point at which the steamer will probably stop will be Bermuda, Trinidad, Rio Janeiro, Montevideo, the Falkland Islands, the Straits of Magellan, Juan Fernandez, the Gallapagos. The ship is fitted out with a special view to deep sea soundings and dredgings, and with all possible contrivances for catching fish, etc.

ANSWERS TO CORRESPONDENTS.

E. M. B.,—The *Sesia pelasgus* is described in Morris's Synopsis of the Lepidoptera of U. S. published by the Smithsonian Institution.

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THE MAMMOTH CAVE AND ITS INHABITANTS.

BY THE EDITORS.

After the adjournment of the meeting of the American Association for the Advancement of Science, held at Indianapolis, in August last, a large number of the members availed themselves of the generous invitation of the Louisville and Nashville Railroad Company, to visit this world renowned cave, and examine its peculiar formation and singular fauna.

The cave is in a hill of the subcarboniferous limestone formation in Edmondson County, a little to the west and south of the centre of Kentucky. Green river, which rises to the eastward in about the centre of the state, flows westward passing in close proximity to the cave, and receiving its waters thence flows northwesterly to the Ohio.

The limestone formation in which the cave exists, is a most interesting and important geological formation, corresponding to the mountain limestone of the European geologists, and of considerable geological importance in the determination of the western coal fields.

We quote the following account of this formation from Major S. S. Lyon's report in the fourth volume of the Kentucky Geological Survey, pages 509–10.

"The sinks and basins at the head of Sinking creek exhibit in a striking manner, the eroding effect of rains and frost — some of the sinks, which are from forty to one hundred and ninety feet

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deep, covering an area of from five acres to two thousand. The rim of sandstone surrounding these depressions is, generally, nearly level: the outcropping rocks within are also nearly horizontal. Near the centre there is an opening of from three to fifteen feet in diameter; into this opening the water which has fallen within the margin of the basin has been drained since the day when the rocks exposed within were raised above the drainage of the country, and thus, by the slow process of washing and weathering, the rocks, which once filled these cavities, have been worn and carried down into the subterranean drainage of the country. All this has evidently come to pass in the most quiet and regular manner. The size of the central opening is too small to admit extraordinary floods; nor is it possible, with the level margin around, to suppose that these cavities were worn by eddies in a current that swept the whole cavernous member of the subcarboniferous limestone of western Kentucky; but the opinion is probable that the upheaving force which raised these beds to their present level, at the same time ruptured and cracked the beds in certain lines; that afterwards the rains were swallowed into openings on these fractures, producing, by denudation, the basins of the sinkhole country, and further enlarging the original fractures by flowing through them, and thus forming a vast system of caverns, which surrounds the western coal field. The Mammoth Cave is, at present, the best known, and, therefore, the most remarkable."

So much has been written on the cave and its wonders, that to give a description of its interior would be superfluous in this connection, even could we do so without unintentionally giving too exaggerated statements which seems to be the natural result of a day underground, at least so far as this cave is concerned, for after reading any account of the cave, one is disappointed at finding the reality so unlike the picture. As the Association party was accompanied by one,* who while a most enthusiastic collector and explorer, was also a calm recorder of statements made by the geologists of the party, we can not do better in conveying to our readers the general geological character and structure of the cave than to copy his account.

"As we expected to remain within the cave a long time, our trusty guide, Frank, had provided himself with a well-filled can of oil, to replenish our lamps, and with this strapped upon his back he led the way into the thick darkness. We shall attempt no description of the cave. Its darkness must be felt to be appreciated, and no form of expression, understood by mortals who have never descended to its cavernous depths, nor trod its gloomy

*W. P. Fishback, Esq., of the Indianapolis Daily Journal.

corridors, can convey any thing like an adequate idea of the place. After spending fifteen hours within its chambers, it is absolutely nauseating to read the descriptions which have been current in the letters of newspaper correspondents for a quarter of a century, and even the vigorous and picturesque language of Bayard Taylo becomes tame and commonplace when it attempts to describe thisr subterranean wonder of the world.

How and when the cave was made, were the leading questions in the minds of the geologists. They do not believe that the cave was the immediate result of some violent upheaval of the strata, which left these vast crevices and chambers of which the cave is composed; neither do they share the popular belief that the rapid and violent action of some subterranean stream of water has worn these deep channels through the limestone: on the contrary, they find conclusive evidence that the same agencies are at work and the same changes in progress to-day that have been slowly, steadily and quietly, through vast periods of time, accomplishing the marvellous wonders that now astonish the beholder. The cave is wrought in the stratum known as the St. Louis limestone, which, in some places reaches a thickness or depth of four hundred feet. This stone is dissolved whenever it is subjected to the influence of running or dripping water impregnated with carbonic acid gas. Water exposed to the air readily absorbs this gas, and surface water percolating through small fissures of the limestone, dissolves it. Another fact should be stated. When, during this process of solution, the water becomes thoroughly impregnated with lime, it loses its power to dissolve the stone. The following conditions, then, were essential to the productions of the cave, assuming what is not disputed by geologists, that the place where the cave now is, was once nearly solid limestone. First, that there should be fissures in the strata, allowing the ingress of the surface water. Secondly, there should be a place or places of exit for the water charged with limestone in solution. Without the latter, the water would become charged with lime, fill up the crevices, and the dissolving process would cease. These conditions are all present to-day, and have remained the same during the countless ages that have passed away while the work has been in progress. There have doubtless been times in the history of the cave, when, owing to a greater flow of water, the work has progressed more rapidly than at present, but that the results have been accomplished in the manner stated, rather than by the process of attrition by rapid currents of large volumes of water, seems to be the general opinion of scientific men. This theory is strengthened by the fact that where the cave attains its greatest heights, and reaches its lowest depths, the dripping waters have never ceased their labors, and are busily at work to-day. In the Mammoth Dome, for instance — rarely seen by visitors, on account of the dangers and fatigue incident to the journey — where the chasm attains a height and depth of more

than two hundred and fifty feet, a cascade falls from a great height, and keeps the entire surface of the rocks covered with dripping water. This, falling into a deep pit below, finds an exit through which it bears away a portion of the lime composing the rock. After a walk of thirteen hours, our guide informed us that he would conduct us to the Mammoth Dome if we felt able to bear the fatigue of the journey. Foot-sore and weary, we were not in a favorable condition for so arduous an undertaking, but Mr. Thomas Kite of Cincinnati, who had visited the locality thirty years ago, urged us to go, and told us the sight of this Dome was worth all the rest. Provided with magnesium and calcium lights, we crawled and climbed our way to the brink of the pit, the bottom of which was reached by a rickety ladder, slippery and dripping with water. A portion of the party descended, and when all were ready the lights were ignited, and the immense dome was revealed to us in all its majestic beauty. Upon our return, three hearty cheers were given to the good friend at whose earnest solicitation we undertook this part of our journey.

We are indebted to Professor Alexander Winchell, of the University of Michigan, for the following abstract of his views concerning the formation of the cave.

'The country of the Mammoth Cave was probably dry land at the close of the coal period, and has remained such, with certain exceptions, through the Mesozoic and Cenozoic ages, and to the present. In Mesozoic times, fissures existed in the formation, and surface waters found their way through them, dissolving the limestone and continually enlarging the spaces. A cave of considerable dimensions probably existed during the prevalence of the continental glaciers over the northern hemisphere. On the dissolution of the glaciers, the flood of water which swept over the entire country, transporting the materials which constituted the modified drift, swept through the passages of the cave, enlarging them, and leaving deposited in the cave, some of the same quartzose pebbles which characterize the surface deposits from Lake Superior to the Gulf of Mexico. Since the subsidence of the waters of the Champlain epoch, the cave has probably undergone comparatively few changes. The well one hundred and ninety-eight feet deep, at the further end of the cave, shows where a considerable volume of the excavatory waters found exit. The Mammoth Dome indicates probably, both a place of exit and a place of entrance from above. So of the vertical passages in various other portions of the cave.'

We believe that the views of Professor Winchell are in harmony with those of the other eminent geologists of the party, and when it is considered that the geologists of this excursion stand in the front rank of the most eminent scientific men of the world, their views upon this interesting subject are well worthy of attention. Before dismissing this branch of the subject, we will take occasion

to correct a popular error concerning the formation of the beautiful structures that adorn the ceilings of some portions of the cave. In the drier localities, where the floors are dusty and everything indicates the prolonged absence of moisture, the ceiling is covered with a white efflorescence that displays itself in all manner of beautiful shapes. It requires no stretch of the imagination to discover among these, the perfect forms of many flowers. The lily form prevails, and the ceilings of many of the chambers are covered with this beautiful stucco work, surpassing in delicacy and purity the most beautiful workmanship of man. These are not produced, as many suppose, by the dripping of water, and the gradual deposit of sulphate of lime upon the outer portions. The stalactite is formed in this manner, but these are neither stalactiform, nor are they produced in a similar way. Dripping water is the agency that forms the stalactite, while the efflorescence in the dryer portions of the cave cannot take place where there is much moisture. The growth of these beautiful forms is from within, and the outer extremities are produced first. They are the result of a sweating process in the limestone that forces the delicate filaments of which they are composed through the pores upon the surface of the rock, their beautiful curved forms resulting from unequal pressure at the base, or friction in the apertures through which they are forced. Mr. L. S. Burbank, of Lowell, Mass., has kindly furnished us with the following abstract of his opinions upon this interesting subject.

'The rosettes, wreaths, and other curved fibrous forms of gypsum, in the Mammoth Cave, occur only in particular strata of the limestone which do not appear in the first part of the long route.

Their formation may be explained in this way: that portion of the rock where they are found consists of carbonate of lime, with some impurities, and contained originally the sulphide of iron, or iron pyrites, disseminated in small grains or crystals, and also in rounded nodules or concretions, sometimes of considerable size.

By exposure to air and moisture, oxygen unites with both the sulphur and the iron, producing sulphuric acid and oxide of iron, which combined, form a sulphate of iron. Then a double decomposition takes place; the sulphuric acid unites with the lime to form the gypsum; the carbonic acid of the limestone combines with the oxide of iron, forming a carbonate of iron, and this, on further exposure, parts with the carbonic acid, and leaves the brown coating of oxide, which is seen in many places on the surface of the rock.

The gypsum is thus constantly forming in the rock, and, being soluble, is carried by the water to the exposed surface where it crystallizes.

The crystals appear to grow out from the rock by additions from beneath, which continue to push the ends first formed, and if these do not become attached to other parts of the rock, straight needle-

like fibres are often produced. Very commonly, however, the crystals begin to form when a small nodule of the iron ore is exposed at the surface; the parts first formed become attached to the surface around the edges, and as the chemical action proceeds towards the centre of the nodules successive leaf-like layers are thrown out, and the rosette form is the result. Along lines of fracture in the surface of the rock, the crystals are curved in opposite directions.

The wreaths and other figures formed by the chains of the rosettes, may be caused by the chemical action described taking place around the edges of large masses or concretions of the iron ore.

These crystalline forms occur only in the dryer parts of the cave. Where there is more moisture, as in the 'Snow-ball room,' the gypsum merely forms white, rounded concretions, originating from nodules of the iron ore on the roof and sides of the cave.'"

With these general remarks on the cave we give a brief account of its interesting fauna, comprising representatives of the Fishes, Insects, and Crustaceans. No Mollusks or Radiates have as yet been discovered, but the lower forms of life have been detected by Tellkampf, who collected several species belonging to the genera *Monas*, *Chilomonas*, and (*?*) *Chilodon*.

On the Blind Fishes of the Cave. By F. W. Putnam.

[This part of the article is unavoidably postponed till the January number, as it was found necessary to illustrate it with two steel plates which could not be engraved in time for the present number.]

On the Crustaceans and Insects. By A. S. Packard, Jr.

Representatives of all the grand divisions of the Insects and Crustaceans have been found in this cave, and if no worms have yet been detected, one or more species would undoubtedly reward a thorough search.

We will enumerate what have been found, beginning with the higher forms. No Hymenoptera (bees, wasps, and ants) or Lepidoptera (moths) are yet recorded as being peculiar to caves. The Diptera (flies) are represented by two species, one of Anthomyia (Fig. 122), or a closely allied genus, and the second belonging to the singular and interesting genus Phora (Fig. 123). The species of Anthomyia usually frequent flowers; the larvæ live in decaying vegetable matter, or, like the onion fly, attack healthy roots. It would be presumptuous in the writer to attempt to describe these orms without collections of species from the neighborhood of the

cave, for though like all the rest of the insects they were found three or four miles from the mouth, yet they may be found to occur outside of its limits, as the eyes and the colors of the body are as bright as in other species.

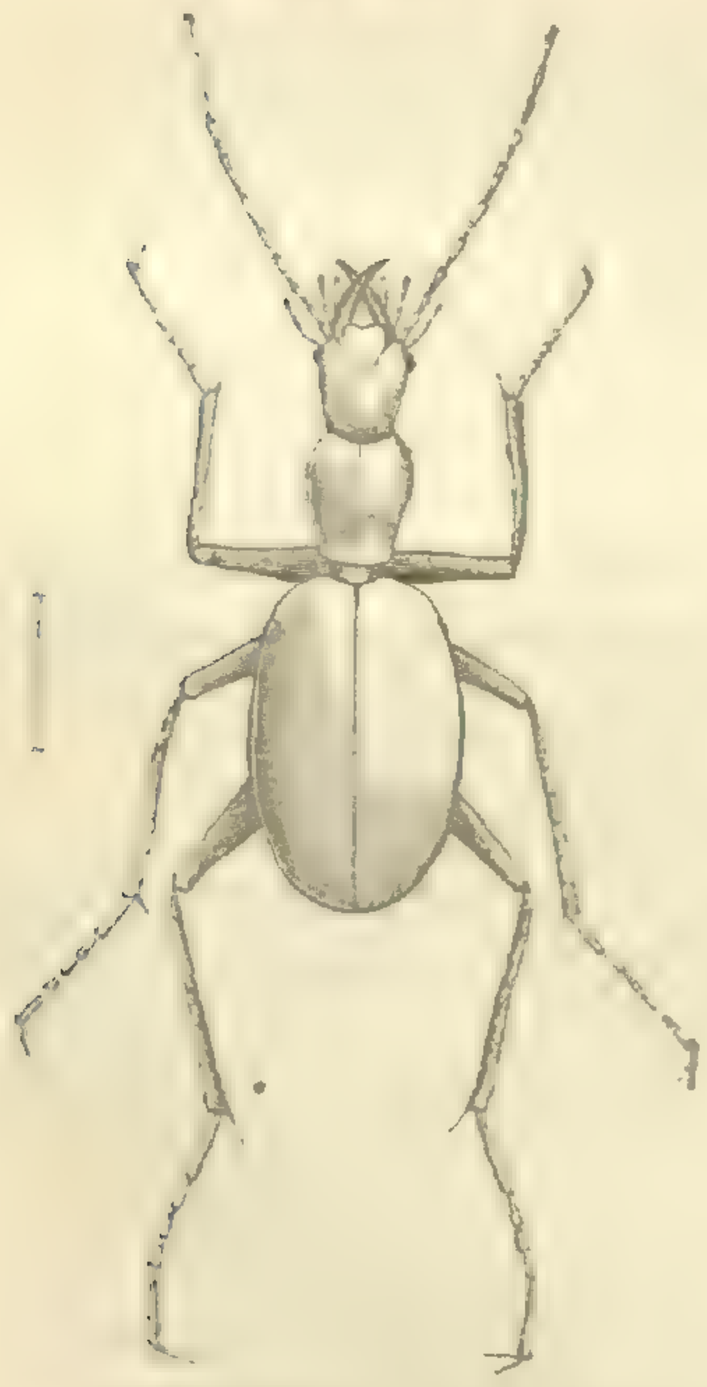
Fig. 122.



Anthomyia.

Among the beetles, two species were found by Mr. Cooke. The *Anopthalmus Tellkampfii* of Erichson, a Carabid (Fig. 124), and *Adelops hirtus* Tellkampf (Fig. 125) allied to Catops, one of the Silphidæ or burying beetle family. The Anopthalmus is of a pale reddish horn color, and is totally blind;* in the Adelops, which is greyish brown, there are two pale spots, which may be rudimentary eyes, as Tellkampf and Erichson suggest. No Hemiptera (bugs) have yet been found either in the caves of this country or Europe. Two wingless grasshoppers (sometimes called crickets) like the common species found under stones (*R. maculata* Harris), have been found in our caves; one is the *Raphidophora subterranea* (Fig. 126 nat. size) described by Mr. Scudder, and very abundant in Mammoth Cave. The other species is *R. stygia* Scudder, from Hickman's cave, near Hickman's landing.

Fig. 124.



Anophthalmus Tellkampfii

Fig. 123.



Phora.

Fig. 125.



Adelops hirtus.

* In Erhardt's cave, Montgomery Co., Virginia, Prof. Cope found "four or five specimens of a new Anopthalmus, the *A. pusio* of Horn, at a distance of not more than three hundred feet from its mouth. The species is small, and all were found together under a stone. Their movements were slow, in considerable contrast to the activity of ordinary Carabidæ." Proc. Amer. Phil. Soc. 1869. p. 178.

upon the Kentucky river. It is closely allied to the Mammoth Cave species. According to Mr. Scudder, the specimens of *R. stygia* were found by Mr. A. Hyatt "in the remotest corner of Hickman's Cave, in a sort of a hollow in the rock, not particularly moist, but having only a sort of cave dampness. They were found a few hundred feet from the sunlight, living exclusively upon the walls." Even the remotest part of that cave is not so gloomy but that some sunlight penetrates it.

The other species is found both in Mammoth Cave, and in the adjoining White's Cave. It is found throughout the cave, and most commonly (to quote Mr. Scudder) "about 'Martha's Vineyard' and in the neighborhood of 'Richardson's Spring' where they were discovered jumping about with the greatest alacrity

Fig. 126.



Rhaphidophora subterranea.

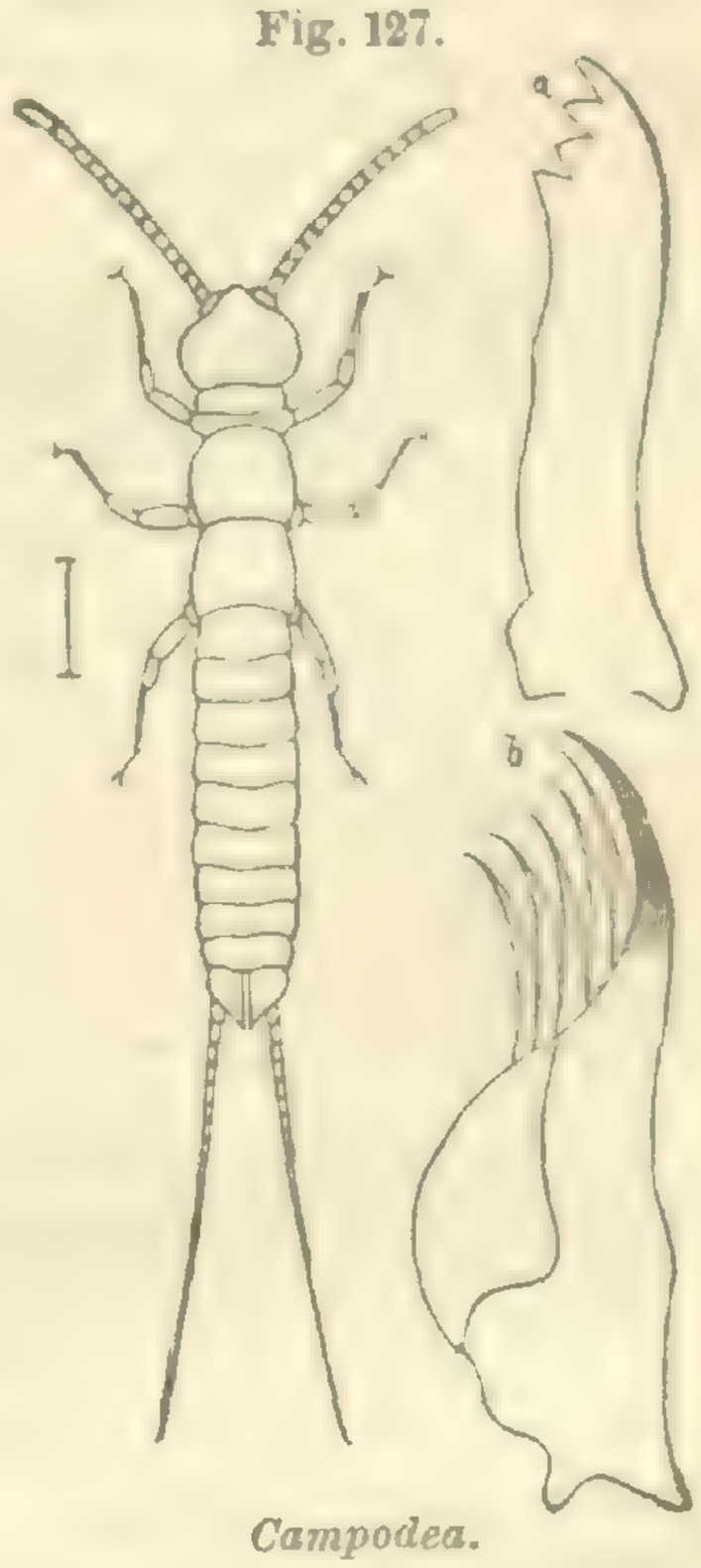
upon the walls, where only they are found, and even when disturbed, clinging to the ceiling, upon which they walked easily; they would leap away from approaching footsteps, but stop at a cessation of the noise, turning about and swaying their long antennæ in a most ludicrous manner, in the direction whence the disturbance had proceeded; the least noise would increase their tremulousness, while they were unconcerned at distant motions, unaccompanied by sound, even though producing a sensible current of air; neither did the light of the lamp appear to disturb them; their eyes, and those of the succeeding species (*R. stygia*) are perfectly formed throughout, and they could apparently see with ease, for they jump away from the slowly approaching hand, so as to necessitate rapidity of motion in seizing them."

The Thysanurous Neuroptera are represented by a species of Machilis, allied to our common *Machilis variabilis* Say, common in Kentucky and the middle and southern states. So far as Tell-

kampf's figure indicates, it is the same species apparently, as I have received numerous specimens of this widely distributed form from Lexington, Kentucky, collected by Dr. Josiah Curtis.

It was regarded as a crustacean by Tellkampf, and described under the name of *Triura carernicola*.* He mistook the labial and maxillary palpi for feet and regarded the nine pairs of abdominal spines as feet. The allied species, *M. variabilis* Say, is figured in vol. v. pl. 1, fig. 8, 9 (see also p. 94 of this journal).

Fig. 127.



Campodea.

An interesting species of Campodea† of which the accompanying cut (Fig. 127) is a tolerable likeness, though designed to illustrate another species (*C. staphylinus* Westw.) was discovered by Mr. Cooke. Both the European and our common species live under stones in damp places, and the occurrence of this form in the water is quite remarkable. The other species are blind, and I could detect no eyes in the Mammoth Cave specimen.

A small spider was captured by Mr. Cooke, but afterwards lost; it was brown in color, and possibly distinct from the *Anthrobia monmouthia* Tellkf. (Fig. 128) which is an eyeless form, white and very small, being but half a line in length. The family

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*Professor Agassiz in his brief notice of the Mammoth Cave animals, does not criticise Tellkampf's reference of this animal to the crustacea; and so eminent an authority upon the articulates as Schiödte remarks that while "Dr. Tellkampf's account affords us no means of forming any conclusion as to its proximate relations," that, however, it "appears to belong to the order of Amphipoda, and to have a most remarkable structure." Tellkampf's figure of Machilis is entirely wrong in representing the labial and maxillary palpi as ending in claws, thus giving the creature a crustacean aspect; and indeed he describes them as true feet!

†*Campodea Cookei* n. sp. Closely allied to *C. Americana*, but it is much larger; the antennæ are 24-jointed instead of 20-jointed as in *C. Americana*, and reach to the basal abdominal segment, while in *C. Americana* they reach only to the second thoracic; the terminal joints are much longer than in that species, the penultimate joint being one-third longer. Last three abdominal segments unequal (equal in *C. Americana*) the penultimate very short, not half as long as the terminal, which is longer and slenderer than in *C. Americana*, while the three are much narrower in proportion to the rest of the body than in the other species. Hind femora longer than in *C. Americana*. Entirely white and pilose. Length .25 inch, the largest *C. Americana* being .15 to .20 inch. (Anal styletes broken off.) Several specimens were seen by Mr. C. Cooke, but only one was captured in a pool of water, two or three inches deep, in company with the Cæcidotea.

of Harvest men is represented by a small white form, described by Tellkampf under the name of *Phalangodes armata* (Fig. 129) but now called *Acanthocheir armata* Lucas. The body alone is but half a line long, the legs measuring two lines. It should be borne in mind that many of the spiders, as well as the Thysanura, live in holes and dark places, so that we would naturally find them in caves. So, also, with the Myriopods, of which a most remarkable form * (Figs. 130, and 130 *a* front of head) was found by Mr. Cooke, three or four miles from the mouth of the cave. It is the only truly hairy species known, an approach to it being found in *Pseudotremia Vudii* Cope. It is blind, the other species of this group which Professor Cope found living in caves having eyes. The long hairs arranged along the back, seem to suggest that they are tactile organs, and of more use to the Thousand legs in making its way about the nooks and crannies of a perpetually dark cave than eyes would be. It was found by Mr. Cooke under a stone.

Fig. 128.



Anthrobia monmouthia.

Prof. Cope has contributed to the "Proceedings of the American Philosophical Society" (1869, p. 171) an interesting account of the

* *Spirostrephon* (*Pseudotremia*) *Copei* n. sp. Head with rather short, dense hairs; no eyes, and no ocular depression behind the antennæ, the surface of the epicranium being well rounded to the antennal sockets; behind the insertion of the antennæ the sides of the head are much more swollen than in *S. lactarius*. Antennæ slender, with short thick hairs; relative length of joints, the 6th being longest; 6th, 4th, 5th, 3d, 8th, 7th, 1st, the 7th joint being much thicker than the 8th. Twenty-eight segments besides the head; they are entirely smooth, striated neither longitudinally nor transversely; a few of the anterior segments rapidly decrease in diameter towards the head. The segments are but slightly convex, and on each side is a shoulder, bearing three tubercles in a transverse row, each giving rise to a long stiff hair one-half to two-thirds as long as the segment is thick; these hairs stand up thickly all over the back, and may serve at once to distinguish the species. No pores. Feet long and slender, nearly as long as the antennæ, being very slender towards the claws. Entirely white. Length of body .35 inch; thickness .04 inch.

It is nearly allied to *Pseudotremia Vudii* of Cope. It will be noticed that Professor Cope characterizes the genus Spirostrephon as having "no pores"; though we find it difficult to reconcile this statement with that of Wood who describes *S. lactarius* as having "lateral pores." Cope separates Pseudotremia from Spirostrephon for the reason that the segments have "two pores on each side the median line." The present species has no pores, but seems in other characters to be a true Spirostrephon, and we are thus led to doubt whether Pseudotremia is a well founded genus.

cave mammals, articulates and shells of the middle states. He says that "myriopods are the only articulates which can be readily found in the remote regions of the caves [of West Virginia] and they are not very common in a living state." The *Pseudotremia cavernarum* which he describes, "inhabits the deep-

Fig. 129.



Acanthocheir armata.

est recesses of the numerous caves which abound in Southern Virginia, as far as human steps can penetrate. I have not seen it near their mouths, though its eyes are not undeveloped, or smaller than those of many living in the forest. Judging from its remains, which one finds under stones, it is an abundant species, though

Fig. 130.

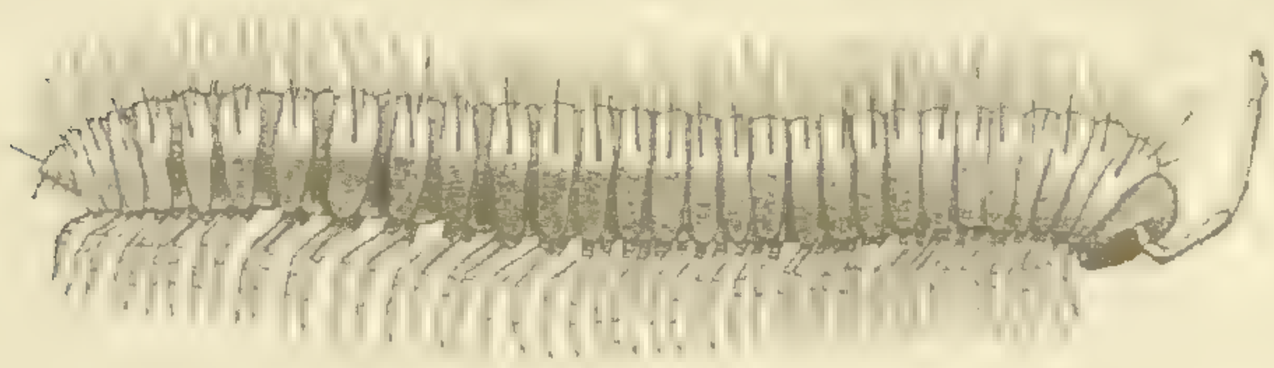


Fig. 130*a*.



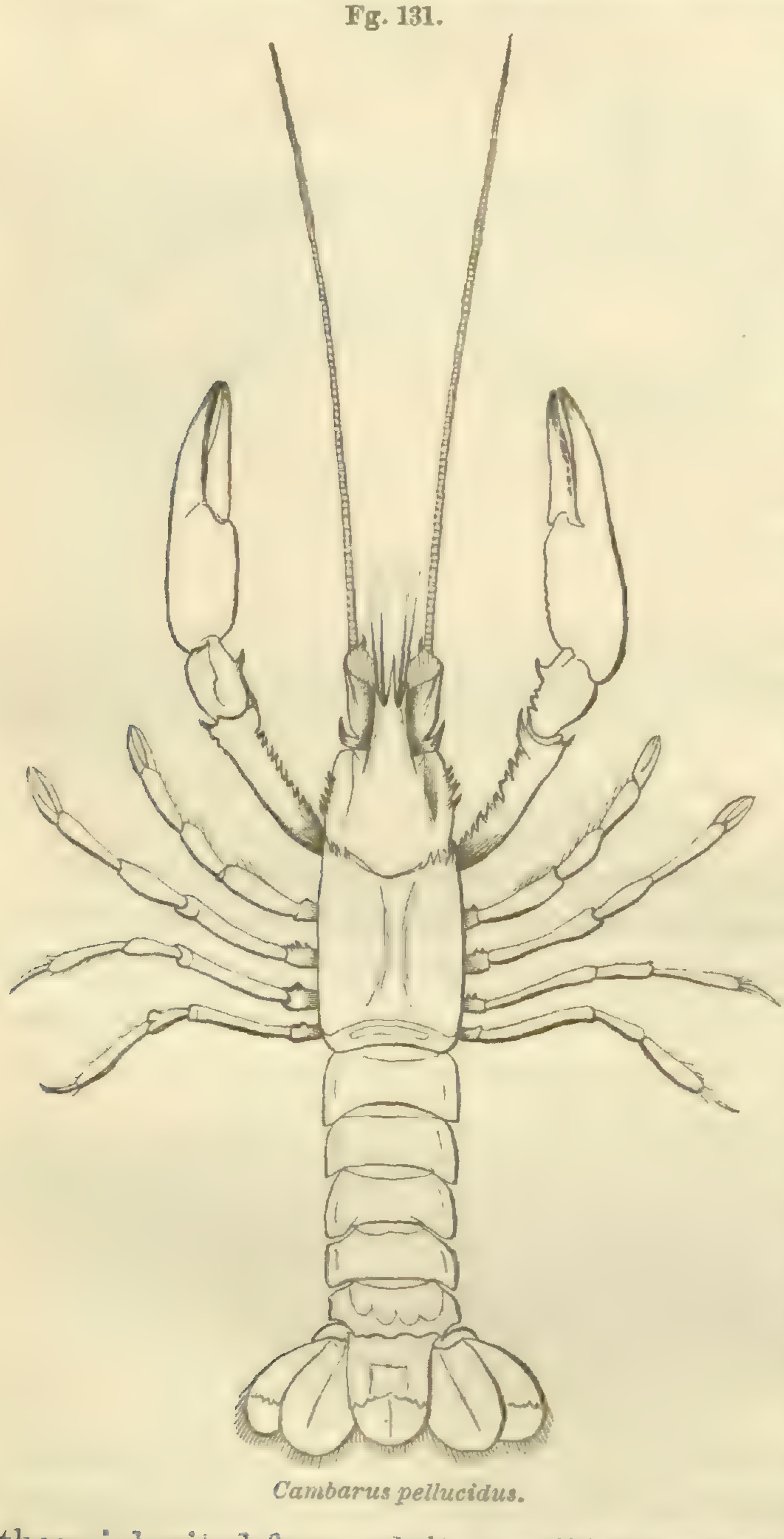
Spirostrephon Copei.

rarely seen by the dim light of a candle even after considerable search. Five specimens only were procured from about a dozen caves." The second species, *P. Vudii* Cope, was found in Montgomery Co. and he thinks it was not found in a cave. Professor Hyatt informs me that he saw near the "Bottomless Pit" in Mam-

moth Cave, a brownish centipede-like myriopod, over an inch in length, which moved off in a rapid zigzag motion. Unfortunately, he did not capture it.

Next to the blind fish, the blind crawfish attracts the attention of visitors to the cave. This is the *Cambarus pellucidus* (Fig. 131, from Hagen's monograph of the North American Astacidæ) first described by Dr. Tellkampf. He remarks that "the eyes are rudimentary in the adults, but are larger in the young." We might add that this is an evidence that the embryo develops like those of the other species; and that the inheritance of the blind condition is probably due to causes first acting on the adults and transmitted to their young, until the production of offspring that become blind becomes a habit. This is a partial proof at least that the characters separating the genera and species of animals are those inherited from adults, modified by their physical surroundings and adaptations to changing conditions of life, inducing certain alterations in parts which have been transmitted with more or

Fig. 131.



Cambarus pellucidus.

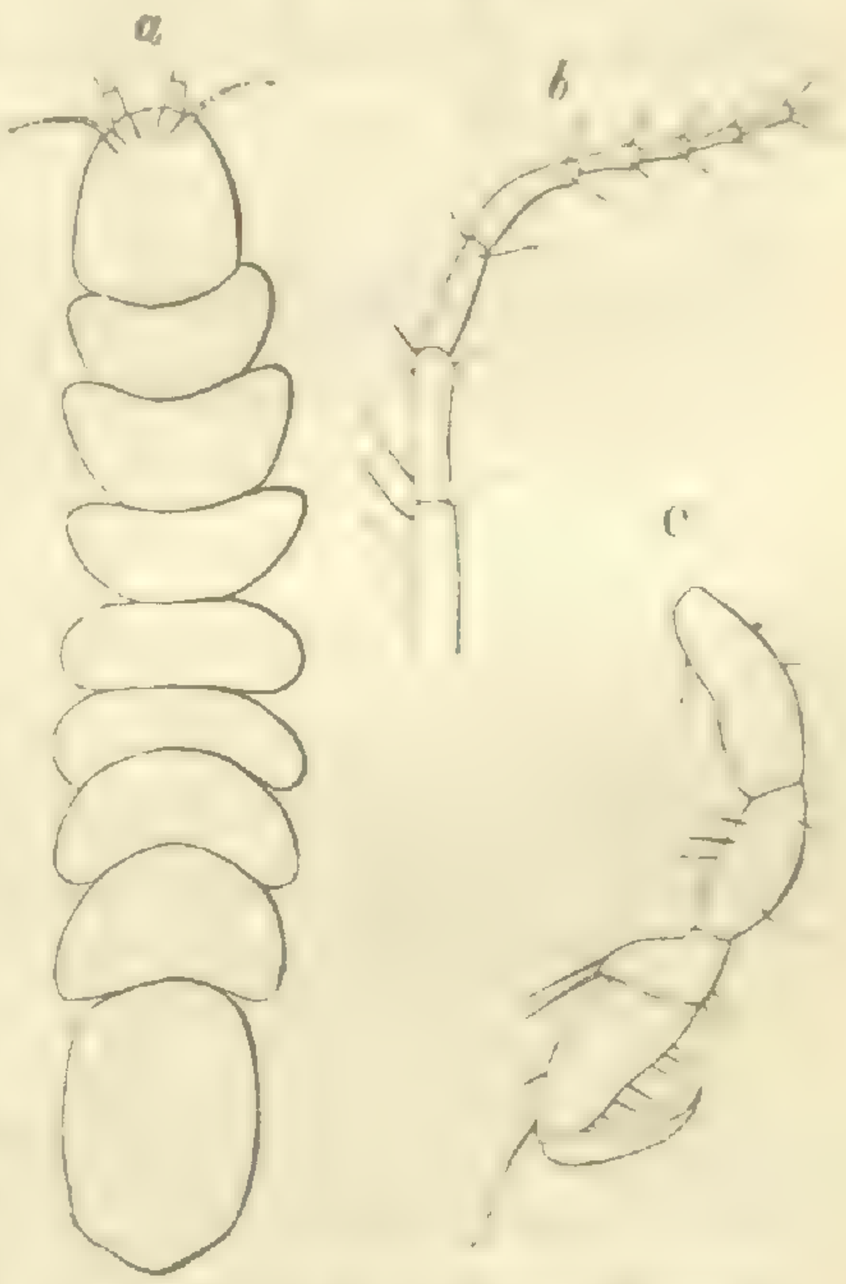
less rapidity, and become finally fixed and habitual. Prof. Hagen has seen a female of *Cambarus Bartonii* from Mammoth Cave, "with the eyes well developed," and a specimen was also found by Mr. Cooke. Prof. Hagen remarks that "*C. pellucidus* is the most aberrant species of the genus. The eyes are atrophied, smaller at the base, conical, instead of cylindrical and elongated, as in the other species. The cornea exists, but is small, circular, and not faceted; the optic fibres and the dark-colored pigments surrounding them in all other species are not developed." It seems difficult for one to imagine that our blind craw fish was created suddenly, without the intervention of secondary laws, for there are the eyes *more perfect in the young than the adult*, thus pointing back to ancestors unlike the species now existing. We can now understand, why embryologists are anxiously studying the embryology of animals to see what organs or characteristics are inherited, and what originate *de novo*, thus building up genealogies, and forming almost a new department of science: comparative embryology in its truest and widest sense.

Fig. 132.



Cæcidotea stygia (side view).

Fig. 133.



Cæcidotea stygia (dorsal view).

Of all the animals found in caves, either in this country or Europe, perhaps the most strange and unexpected is the little creature of which we now speak. It is an Isopod crustacean, of which the pill bugs or sow bugs are examples. A true species of pill bug (*Titanethes albus* Schiödte) inhabits the caves of Carniolia, and it is easy to believe that one of the numerous species of this group may have become isolated in these caves and modified into its present form. So also with the blind *Niphargus stygius* of Europe, allied to the fresh water Gammarus so abundant in pools of fresh water. We can also imagine how a species of Asellus, a fresh water Isopod, could represent the Idoteidæ in our

caves, and one may yet be found; but how the present form became a cave dweller is difficult of explanation, as its nearest allies are certain species of Idotea which are all marine, with the exception of two species: *I. entomon*, living in the sea and also in the depths of the Swedish lakes, as discovered by Loven, the distinguished Swedish naturalist, while a species representing this has been detected by Dr. Stimpson at the bottom of Lake Michigan. Our cave dweller is nearly allied to Idotea, but differs in being blind, and in other particulars, and may be called *Cæcidotea stygia.** (Fig. 132 side view, enlarged; Fig. 133 dorsal view; *b*, inner antenna; *c*, 1st leg.) It was found creeping over the fine sandy bottom, in company with the Campodea, in a shallow pool of water four or five miles from the mouth of the cave.

This closes our list of known articulates from this and other caves in this country, the result of slight explorations by a few individuals. The number will be doubtless increased by future research. It is to be hoped that our western naturalists will thoroughly explore all the sinks and holes in the cave country of the western and middle states. The subject is one of the highest interest in a zoological point of view, and from the light it throws on the doctrine of evolution. Professor Schiödte, the eminent Danish zoologist, has given us the most extended account of the cave fauna of Europe, which has been translated from the Danish into the Transactions of the Entomological Society of London (new series vol. 1, 1851).

He examined four caves; namely, that of Adelsberg, the Magdalena and Luege caves, all in the neighborhood of Adelsberg,

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*Generic characters. Head large, much thicker than the body, and as long as broad; subcylindrical, rounded in front. No eyes. First antennæ slender, 8-jointed (2d antennæ broken off). Abdominal segments consolidated into one piece. Differs chiefly from Idotea, to which it is otherwise closely allied, by the 8-jointed (instead of 4-jointed) 1st (inner) antennæ, the very large head, and by the absence of any traces of the three basal segments of the abdomen usually present in Idotea.

Specific characters. Body smooth, pure white: tegument thin, the viscera appearing through. Head as wide as succeeding segment, and a little more than twice as long. Inner antennæ minute, slender, the four basal joints of nearly equal length, though the fourth is a little smaller than the basal three, remaining four joints much smaller than others, being one-half as thick and two-thirds as long as either of the four basal joints; ends of last four joints a little swollen, giving rise to two or three hairs; terminal joint ending in a more distinct knob, and bearing five hairs. Segment of thorax very distinct, sutures deeply incised; edges of segments pilose: abdomen flat above, rounded behind, with a very slight median projection; the entire pair of gills do not reach to the end of the abdomen, and the inner edges diverge posteriorly. Legs long and slender, 1st pair shorter, but no smaller than the second. Length .25 inch.

and the Corneale cave at Trieste. The only plant found was a sort of fungus, *Byssus fulvus* Linn. The only vertebrate is the singular salamander, *Hypochthon* (Proteus) *anguinus*, found in the Magdalina river. No shells were found. Regarding the articulates he writes:

"On searching along the walls within the entrance of the caves, among the rubbish and the vegetable debris along the sides of the river, we meet with a considerable number of Insecta, Myriopoda, Arachnida and Crustacea, of various families which shun daylight; being such species only as inhabit promiscuously other places, provided they are moist and feebly illumined. We find species of Pterostichus, Pristonychus, Amara, Quedius, Homalota, Omalium, Hister, Trichopteryx, Cryptophagus, Atomaria, Ptinus, Ceraphron, Belyta, a grasshopper of the Locust family, probably the *Raphidophora cavicola* Fischer, as it was only seen in the larva state, Trichoptera, Sciara, Psychoda, Phora, Heteromyza, Sapromyza, Tomoceras, Linyphia, Gamasus, Cryptops, Julus, and Asellus. In proportion as we recede from the entrance the number of species as well as individuals greatly decreases, and at the distance which entirely excludes the light, only single individuals are found. In the deepest recesses these species are entirely wanting, except some few which have been transported by the current; only a few Diptera are found; namely, a species of Phora, very near *P. maculata* Meig., *Heteromyza flaripes* Zett., and *Sapromyza chrysophthalma* Zett., extending also very far into the caves, even to the remotest accessible places in Adelsberg cave, more than half an hour's walk from its entrance. Dead moths are occasionally found far in the caves, being left there by the bats; and likewise accidental specimens of the parasites of the latter. Of the five earlier known animals which inhabit these caves, I found *Pristonycha elegans* Dej. rather frequently, and *Homalota spelæa* Er. in considerable numbers. Besides these are *Anophthalmus Schmidtii*, which is very rare, and the wood louse, *Titanethes alba*. The new forms he found were a beetle (*Bathyscia byssina*) allied to our Adelops;* *Staphylinus troglodytes*, an aberrant genus of Silphids; a Podurid, *Anurophorus Stillicidii*; and the two blind arachnidans, one a spider allied to Dysdera, the *Stalita tenuria*, and a false-spider, *Blothrus spelæus*. Among the crustacea he found *Niphargus stygius*,†

* Ludwig Müller enumerates four other species of Adelops from these caves, and three species from France, and *Machærites speiaus*, in Verhandl. Zool. Bot. Vereins. Wien, 1855, p. 505. See also Heller's Beitrage zur ö-terreich. Grotten-Fauna. (Myriopoda and Crustacea.) Vienna, 1858. He describes a myriopod with rudimentary eyes (*Trachysphæria Schmidtii*) allied to Glomeris, and another blind species *Brachydesmus subterraneus*) allied to Polydesmus; also a new *Tithanothes* *T. granuiger*, and notices *Monolistra cæca* Gerst. Wankel (1861) also found a new Phalangid *Leiobunum troglodytes*) with distinct eyes and four species of mites in the caves of Eastern Austria. The mites are *Scyphius spelæus*, *Linopodes subterraneus*, *Gamasus loricatus* and *G. niveus*, and an additional species of Trachysphæria (*T. Hyrtlii*). See also Ehrenberg's list of cave insects (Monabsberichte der Akad. Berlin. 1861.)

† Several species of Niphargus occur in the wells and hot springs in Europe. Accord-

allied to Gammarus, which lives in small pools of water and is white and blind; and the cave pill bug, *Titanethes albus* (Koch.)."

In conclusion Schiödte remarks that:—

"We may with propriety apply the collective term *Subterranean Fauna* to those animals which exclusively inhabit caves, and are expressly constructed for such habitations. Still there is nothing in this name which would indicate that these animals have any claim to be considered as a separate group, beyond the mere peculiarity of their common place of abode. While a few of them possess such an extraordinary structure as to stand in no comparison with those animals which inhabit the light, there are others, forming only more characteristic links in the groups of animals more or less shy of light, of which many are found common in the localities of the caves; and some belong to genera having a wide local, as well as geographical, extension. We are accordingly prevented from considering the entire phenomenon in any other light than something purely local, and the similarity which is exhibited in a few forms (Anophthalmus, Adelops, Bathyscia) between the Mammoth Cave and the caves in Carniola, otherwise than as a very plain expression of that analogy, which subsists generally between the fauna of Europe and of North America. Besides, it is clear to me that the fauna of the caves of Carniola consists of two divisions, of which the essential character is referable on the one hand to the dark locality, and on the other to the additional confinement to stalactitic formations; as yet we are not

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ing to Bate and Westwood (British Sessile eyed Crustacea) "the British examples have been obtained from artificially excavated wells connected with houses for domestic purposes. In some instances the wells have been old, in others but recently dug. In their geological condition the habitats have been equally various. At Corsham the well exists in the Oolite formation, at Ringwood in chalk-flint gravel, at Mannamead in slate. At Corsham and Mannamead they are found on a hill, at Ringwood they lie low. The appearance of some of these animals in a well soon after its being excavated, raises a question of considerable interest. Thus they were found at upper Clafford, near Andover and at Mannamead, near Plymouth, but not a trace of them was to be found in the surrounding streams; in fact they perish in the light. It is impossible to regard them as an extreme variety, or modification of our only fresh water Amphipod, *Gammarus fluviatilus*, since various parts not only differ in form, but some are altered in character; for example, the extraordinary elongation and slenderness of one of the branches of each of the last pair of caudal appendages seem to be a special structure, having for its object the antenna-like use of a delicate apparatus at the extremity of the body. . . . . Although we can find no fresh water ally to this genus in the rivers and streams of Europe, yet Bruzelius has taken in the deep sea, near Bohusia, a form which he has described under the name *Eriopis elongata*, approximating so nearly to it that it appears to be scarcely generically distinct.

We are inclined to think that *Gammarus pungens* of Milne Edwards, from the warm springs of Cassini in Italy, also belongs to this genus." Of Niphargus these are the following species known besides *N. stygius*; *i.e. N. aquilex* Schiödte (*Gammarus puteanus* Koch, the embryology of which has been studied by V. St. George) *N. fontanus* Bate, *N. Kochianus* Bate. Another generic form is *Crangonyx* founded by Bate, which also belongs to the subterranean fauna. "A single species as yet is all that has been found in England; but we have little doubt but that *Gammarus Ermanni* of Milne Edwards which was found by M. Ermann in the warm springs of Kamtschatka belongs also to this genus. It is curious that we should have to record that while the animals of this genus, as in the preceding (Niphargus) inhabit the deep artificial wells, without being known to exist in our rivers and streams, its nearest allied form is to be found in a marine genus, Gammarella."

able vigorously to discriminate between the two. We shall accordingly look upon the subterranean fauna, or more properly faunas, as small ramifications which have penetrated into the earth from the geographically-limited faunas of the adjacent regions; and which, as they extended themselves into darkness, have been accommodated to surrounding circumstances. Animals not far remote from the ordinary forms, prepare the transition from light to darkness. Next follow those that are constructed for twilight; and last of all those destined for total darkness, and whose structure is quite peculiar. Among these some are adapted for special localities, those which inhabit dry localities or detached little reservoirs being totally blind, while others, destined for running streams, have eyes of imperfect construction, so as to receive the impression of rays of light, but no proper image of illuminated objects. We may therefore with tolerable precision arrange the inhabitants of caverns under the following heads:—

Shade animals.—Extensive genera and species inhabiting caverns near their entrance, and, generally, all cool, shady and moist localities. Of these, those that fly occasionally enter far into the caverns (Diptera).

Twilight animals.—They belong to widely spread genera, but are peculiar to the caves, and distinguished by their small eyes. They are principally found near the entrances to the caves, but proceed deeper into the darkness than the shade-animals, and although wingless, they penetrate often the whole extent of the dark space.—(*Pristonychus elegans*, *Homalota spelæa*.)

Cave animals.—They form, at least in part, peculiar genera, are wingless and colorless, as far as the consistency of their integuments will admit, and exist exclusively in total darkness. The terrestrial division is blind; the aquatic has a perception of light. To this group belong all the animals in the Mammoth Cave, and among those of the caves of Carniola, Anophthalmus, Bathyscia, perhaps likewise Anurophorus and Hypochthon, which, however, may belong to the following group.

Stalactite cave animals.—Insects, Arachnidans and Crustaceans appertaining to peculiar genera, wingless, blind, brightly colored according to the nature of their integuments, either light brown, yellowish white, or snow white, perhaps according to the preponderance of the chitine; living in total darkness, peculiar to stalactite caves, in part occupying the columns and constructed accordingly, either for ascent or hovering over them. Here belong most of the animals treated of in this memoir—Stagobius, Blothrus, Stalita, Niphargus, and Titanethes." *

A pertinent question arises as to the time of the formation of these caves and when they became inhabitable. As previously stat-

*In a note appended he adds to the list "a new cave crustacean, *Palomon anopthalmus* Kollar, said to serve as food for Hypochthon [the Salamander], of which last genus he discriminates six species."

ed, the caves of the western and middle States are in lower Carboniferous limestone rocks, though the Port Kennedy cave explored by Wheatley and Cope† is in the Potsdam limestone. They could not have been formed under water, but when the land was drained by large rivers. This could not have occurred previous to the Triassic period. Prof. Dana in his "Manual of Geology" shows that the Triassic continent spread westward from the Atlantic coast "to Kansas, and southward to Alabama; for through this great area there are no rocks more recent than the Palæozoic." "Through the Mesozoic period [comprising the Triassic, Jurassic, and Cretaceous periods] North America was in general dry land, and on the east it stood a large part of the time above its present level." Though at the close of these periods there was a general extinction of life, yet this was not probably a sudden (one of months and even years), but rather a secular extinction, and there may be plants and animals now living on dry land, which are the lineal descendants of mesozoic and more remotely of Carboniferous forms of life. So our cave animals may possibly be the survivors of Mesozoic forms of life, just as we find now living at great depths in the sea remnants of Cretaceous life. But from the recent explorations in the caves of Europe and this country, especially the Port Kennedy cave, with its remarkable assemblage of vertebrates and insects, we are led to believe from the array of facts presented by Prof. Cope that our true subterranean fauna probably does not date farther back than the beginning of the Quaternary, or Post pliocene, period. We quote his "general observations" in his article on the Port Kennedy fauna.

"The origin of the caves which so abound in the limestones of the Alleghany and Mississippi valley regions, is a subject of much interest. Their galleries measure many thousands of miles, and their number is legion. The writer has examined twenty-five, in more or less detail, in Virginia and Tennessee, and can add his testimony to the belief that they have been formed by currents of running water. They generally extend in a direction parallel to the strike of the strata, and have their greatest diameter in the direction of the dip. Their depth is determined in some measure by the softness of the stratum, whose removal has given them existence, but in thinly stratified or soft material, the roofs or large

†A notice of the animals found in this cave will be found in the Proceedings of the American Philosophical Society, April, 1871. The insects there enumerated would probably not come under the head of cave insects.

masses of rocks fall in, which interrupt the passage below. Caves, however, exist when the strata are horizontal. Their course is changed by joints or faults, into which the excavating waters have found their way.

That these caves were formed prior to the postpliocene fauna is evident from the fact that they contain its remains. That they were not in existence prior to the drift is probable, from the fact that they contain no remains of life of any earlier period so far as known, though in only two cases, in Virginia and Pennsylvania, have they been examined to the bottom. No agency is at hand to account for their excavation, comparable in potency and efficiency to the floods supposed to have marked the close of the glacial period, and which Prof. Dana ascribes to the Champlain epoch. An extraordinary number of rapidly flowing waters must have operated over a great part of the Southern States, some of them at an elevation of fifteen hundred feet and over (perhaps two thousand) above the present level of the sea. A cave in the Gap Mountain, on the Kanawha river, which I explored for three miles, has at least that elevation.

That a territory experiencing such conditions was suitable for the occupation of such a fauna as the deposits contained in these caves reveal, is not probable. The material in which the bones occur in the south is an impure limestone, being mixed with and colored by the red soil which covers the surface of the ground. It is rather soft but hardens on exposure to the air.

The question then remains so far unanswered as to whether a submergence occurred subsequent to the development of the postpliocene mammalian fauna. That some important change took place is rendered probable by the fact, that nearly all the neotropical types of the animals have been banished from our territory, and the greater part of the species of all types have become extinct. Two facts have come under my observation which indicate a subsequent submergence. A series of caves or portions of a single cave once existing on the southeast side of a range of low hills among the Alleghany mountains in Wythe Co., Virginia, was found to have been removed by denudation, fragments of the bottom deposit only remaining in fissures and concavities, separated by various intervals from each other. These fragments yielded the remains of twenty species of postpliocene mammalia.* This denudation can be ascribed to local causes, following a subsidence of uncertain extent. In a cave examined in Tennessee the ossiferous deposit was in part attached to the *roof* of the chamber. Identical fossils were taken from the floor. This might, however, be accounted for on local grounds. The islands of the eastern part of the West Indies appear to have been separated by submergence of larger areas, at the close of the period during which they

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*See Proceed. Amer. Phil. Soc. 1869, 171.

were inhabited by postpliocene mammalia and shells. The caves of Anguilla include remains of twelve vertebrates,* of which seven are mammalia of extinct species, and several of them are of large size. These are associated with two recent species of molluses *Turbo pica*, and a *Tudora* near *pupæformis*.† As these large animals no doubt required a more extended territory for their support than that represented by the small island Anguilla, there is every probability that the separation of these islands took place at a late period of time and probably subsequent to the spread of the postpliocene fauna over North America."

I think the reader will conclude from the facts Prof. Cope so clearly presents, that the subterranean fauna of this country does not date back of the Quaternary period. These species must have been created and taken up their abode in these caves (Mammoth Cave and those of Montgomery County, Virginia) after the breccia flooring their bottoms and containing the bones of Quaternary animals had been deposited; or else migrated from Tertiary caves farther south, which is not probable, as it has been previously shown that those blind animals inhabiting wells immediately die on being exposed to the light. (British Sessile-eyed Crustacea, i. p. 313.)

The case becomes much simpler when we consider the age of the rocks in which the Adelsberg and other caves mentioned by Schiödte are situated. The Alps were under water in the Middle Eocene; consequently the caves could not have been formed until the close of the Tertiary. Hence the species of the cave fauna were evidently created either at the close of the Tertiary, or more probably the beginning of the Quaternary, as "even in the later part of the Pliocene era there was an elevation of three thousand feet in a part of the Island of Sicily" (Dana). We are therefore led to conclude that the species of the subterranean fauna the world over are recent creations, probably not older than the extinct mammals associated with man.

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*Loc. cit. 1869, 183; 1870, 608. A fourth species of gigantic Chinchillid has been found by Dr. Rijgersma, which may be called *Loxomylus quadrans* Cope. It is represented by portions of jaws and teeth of three individuals. It is one of the largest species, equaling the *L. latidens*, and has several marked characters. Thus the roots of the molars are very short, and the triturating surface oblique to the shaft. The roots of the second and fourth are longer than those of the first and third. The last molar has four dental columns instead of three as in the other *Loxomyli*, and is triangular or quadrant-shaped in section; the third is quadrangular in section, and has three columns. The second is the smallest, being only .6 the length of the subtriangular, first. Length of dental series m. .063 or 2.5 inches. Palate narrow and deeply concave. There is but little or no lateral constriction in the outlines of the teeth; the shanks are entirely straight. In its additional dentinal column, this species approaches the genus *Amblyrhiza*.

The large Chinchillas of Anguilla are as follows, *Loxomylus longidens*, *L. latidens*, *L. quadrans*, and *Amblyrhiza inundata*.

†See Bland, Proceed. Amer. Phil. Soc., 1871, 58.

Assuming on the principles of evolution that the cave animals were derived from other species changed by migration from the outer world to the new and strange regions of total darkness, it seems evident that geologically speaking the species were *suddenly* formed, though the changes may not have been wrought until after several thousand generations. According to the doctrine of natural selection, by which animal species pass from one into another by a great number of minute variations, this time was not sufficient for the production of even a species, to say nothing of a genus. But the comparatively sudden creation of these cave animals affords, it seems to us, a very strong argument for the theory of Cope and Hyatt of creation by acceleration and retardation, which has been fully set forth in this journal. The strongly marked characters which separate these animals from their allies in the sunlight, are just those fitting them for their cave life and those which we would imagine would be the first to be acquired by them on being removed from their normal habitat.

On introducing the wingless locust, *Rhaphidophora maculata*, into a cave, where it must live not under stones, but by clinging to the walls, its legs would tend to grow longer, its antennæ and palpi would elongate and become more delicate organs of hearing as well as touch,* and the body would bleach partially out, as we find to be the case in *R. subterranea* and *stygia*. The Carabid beetle, Anopthalmus, extending farther into the cave, would lose its wings (all cave insects except the Diptera have no wings, elytra excepted) and eyes, but as nearly all the family are retiring in their habits, the species hiding under stones, its form would not undergo farther striking modification. So with the blind Campodea, which does not differ from its blind congeners, which live more or less in the twilight, except in its antennæ becoming longer. The blind Adelops, but with rudiments of eyes, does not greatly depart in habits from Catops, while on the other hand the remarkable Stagobius of the Illyrian caves, which according to

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* After writing this article, and without knowledge of his views, we turned to Darwin's Origin of Species to learn what he had to say on the origin of cave animals. He attributes their loss of sight to disuse, and remarks:—"By the time an animal has reached, after numberless generations, the deepest recesses, disuse will on this view have more or less perfectly obliterated its eyes, and natural selection will often have effected other changes, such as an increase in the length of the antennæ or palpi, as a compensation for blindness." 5th Amer. Edit., p. 143. We are glad to find our views as to the increase in the length of the antennæ and palpi compensating for the loss of eyesight, confirmed by Mr. Darwin.

Schiödte spends its life in crawling ten to twenty feet above the floor over the columns formed by the stalactites, to which unique mode of life it is throughout perfectly adapted, is remarkably different from other Silphids. Its legs are very long and inserted far apart (the prothorax being remarkably long), with surprisingly long claws, while the antennæ, again, are of great length and densely clothed with hairs, making them most delicate sense organs.* So also are the limbs of the false scorpion, and the spider and pill bug (Titanethes) of remarkable length.

But the modifications in the body of the Spirostrephon are such that many might deem its aberrant characters as of generic importance. It loses its eyes, which its nearest allies in other, but smaller, caves possess, and instead gains in the delicate hairs on its back, which evidently form tactile organs of great delicacy; the feet are remarkably long, as also the antennæ. These are not new formations but simply modifications apparently, by use or disuse of organs present in the other species. The aberrant myriopod and Stagobius are paralleled by the blind fish, an animal so difficult to classify, and so evidently adapted for its abode in endless darkness. And as an additional proof of the view here taken that these cave animals are modified from more or less allied species existing outside of the caves, we have the case of the craw fish, whose eyes (like those of the mole), are larger in the young than adult, indicating its descent from a species endowed with the faculty of sight, while in the adult the appendages are modified as tactile organs so as to make up for its loss of eyesight, in order that it may still take its prey.

We thus see that these cave animals are modified in various ways, some being blind, others very hairy, others with long appendages. All are not modified in the same way in homologous organs; another argument in proof of their descent from ancestors

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*Schiödte remarks that "it is difficult to understand the mode of life of *Stagobius troglodytes;* or how this slow and defenceless animal can escape being devoured by the rapid, piratical Arachnidans, or find adequate support on columns, for inhabiting which it is so manifestly constructed. We are led in this respect to consider the antennæ. Whatever significance we attach to those enigmatical organs, we must admit that they are organs of sense, in which view an animal having them so much developed as Stagobius, must possess a great advantage over its enemies, if these be only Arachnidans. Its cautious and slow progress, and its timid reconnoitring demeanor, fully indicate that it is conscious of life being in perpetual danger, and that it endeavors to the utmost to avoid that danger. Darkness, which always favors the pursued more than the pursuer, comes to its aid, especially on the uneven excavated surface of the columns."

whose habits varied as their out-of-door allies do at present. Had they been specially created for subterranean life, we should have expected a much greater uniformity in the organs adapting them to a cave life than we actually find to be the case.

Another fact of interest in this connection is the circumstance that these cave species breed slowly, being remarkably poor in individuals; they are nearly all extremely rare. Did they breed as numerously as their allies in the outer world the whole race would probably starve, as the supply of food even for those which do live is wonderfully limited.

It is now known that animals inhabiting the abysses of the sea are often highly colored: light must penetrate there, for we know that were the darkness total they would be colorless like the cave insects.

In view of the many important questions which arise in relation to cave animals, and which have been too imperfectly discussed here, we trust naturalists the world over will be led to explore caves with new zeal, and record their discoveries with minuteness, and the greatest possible regard to exactness. The caves of the West Indian Islands should first of all be carefully explored. Also those of Brazil, those of the East Indies, and of Africa, while fresh and most extended explorations of our own Mammoth Cave should be made, perhaps by a commission acting under government or State authority, in order that the most ample facilities may be afforded by the parties owning the cave.

A SINGING HESPEROMYS.

BY REV. SAMUEL LOCKWOOD, PH. D.

Some twenty years ago, it was, that the "London Charivari" shot its shafts of ridicule at a singing mouse on exhibition in the metropolis. Thus put upon the scent, the firm of Pooh, Pshaw & Co., whose merciless power is alike feared by philosopher and peasant, "went for" the showman and his "phenomenon."

And so hard was the *punch*-ing,
And such was the fuss,
That it quite put an end
To that musical *mus!*

Albeit the miserable end of poor *Mus musculus*, we are bold to declare our knowledge of the existence of singing mice of the above domestic sort; and farther, our belief that they are not very uncommon. But we now propose to introduce to the readers of the NATURALIST an aristocratic, and entirely new candidate for their consideration—a musical wood-mouse.

Last spring, my friend Philip Ryall, Esq., brought from Florida a mouse which he had captured in his residence there. He says that for a number of nights, a low sound of a more or less musical nature, had been heard proceeding, as was supposed, from the chimney, and which very naturally was attributed to the chimney swallow. One day a small mouse came from under the hearth into the middle of the floor of the sitting-room, sat up, and sang for about a minute, and retired. This explained the mystery. Its nightly music and its daily visit were continued, almost invariably, the visit being limited to the same small area of the floor. It was determined to capture the little stranger; which after many unsuccessful efforts was finally accomplished. Last June the interesting little fellow was very kindly passed into my custody. My first concern was to add to its comfort by enlarging its cage, also to provide for it in every possible way a condition of things suited to its nature. For all this I was amply rewarded in the fine health, and the musical performances that followed.

A little study soon determined that the pretty creature belonged to the vesper mice. It is known by the popular names of jumping mouse, wood mouse, and white-footed mouse. Our specimen is one of the smallest of its own genus, for the precise species is the one known to naturalists as the *Hesperomys cognatus* Leconte. This fact, so novel, once determined, gave additional zest to my purpose to make it the object of especial study. To give it individuality, as it was fast becoming a pet, I named it Hespie; which name, as its object was a female, was certainly appropriate. I thought she soon learned to know me, and certainly I soon came to regard her with attachment. Yet, the truth told, she was a pretty, pert and unamiable little miss, and would permit no familiarity, always biting the finger that attempted to touch her. Her animation, agility and gracefulness of motion were wonderful. Sometimes a fly would enter the cage, when she would spring at, and catch it, sometimes with her mouth, and at others with her hands. This she would eat with great relish. So uniformly quick were her motions, that on

one occasion my little boy said: "Papa, I would like to see mousie *walk* just once." Her taste was quite omnivorous; although unlike the domestic mouse, she did not care much for cheese. But meat, bread, corn, nuts, sugar, and even pudding and fish were all acceptable. A little sod of fresh grass and white clover was occasionally put into the cage. This she enjoyed greatly, eating the greens like a rabbit; only always insisting on sitting up to do it. It was interesting to witness how ready she was for emergencies. Sitting on her hind feet, she would take hold with her hands of a blade of grass, and begin eating at the tip. The spear would rapidly shorten, and seemingly she must now stoop to finish it, or do it in the ordinary quadrupedal style. Now that was just what she did not choose to do. So when the emergency came, she would stoop down, and in a trice cut the blade off close to the sod with just one nip; then up again on her feet in a sitting posture, she would finish it in a comfortable and becoming way. On one occasion a worm crept out of the sod, and Hespie at once fell to it and soon had it tucked away without cooking. As to exercise, she manages to take a great deal. In the day time her exercise is less, as she does a good deal of sleeping then. It is at night that her peculiar talents appear to advantage, beginning at vespers, as her name might imply. Then, as a singer, her genius literally shines. It is with her singing that we are the most concerned; and indeed, at the moment of this writing (for it is night) she is in fine song. Perhaps, however, it will seem more literal and actual if her performances are described in the past tense.

Our little musician had several snatches or bits of melody which were often repeated. But in her *repertoire* were two notable ones, each of which deserves to be dignified as a professional *role*. The one by far the more frequent is notated below; and because it is her favorite, when running in her revolving cage, I have named it *The Wheel Song*.*

The last bar of this would frequently be prolonged to two or three; and she would sometimes change from C sharp and D, to C natural and D, then warble on these two notes awhile, and wind up with a quick chirp on C sharp and D. The distinctness between the semitones was very marked, and easily appreciable to a good ear. I have always enjoyed the mellow little strains of the song sparrow and the house wren. But in either case it was short, and

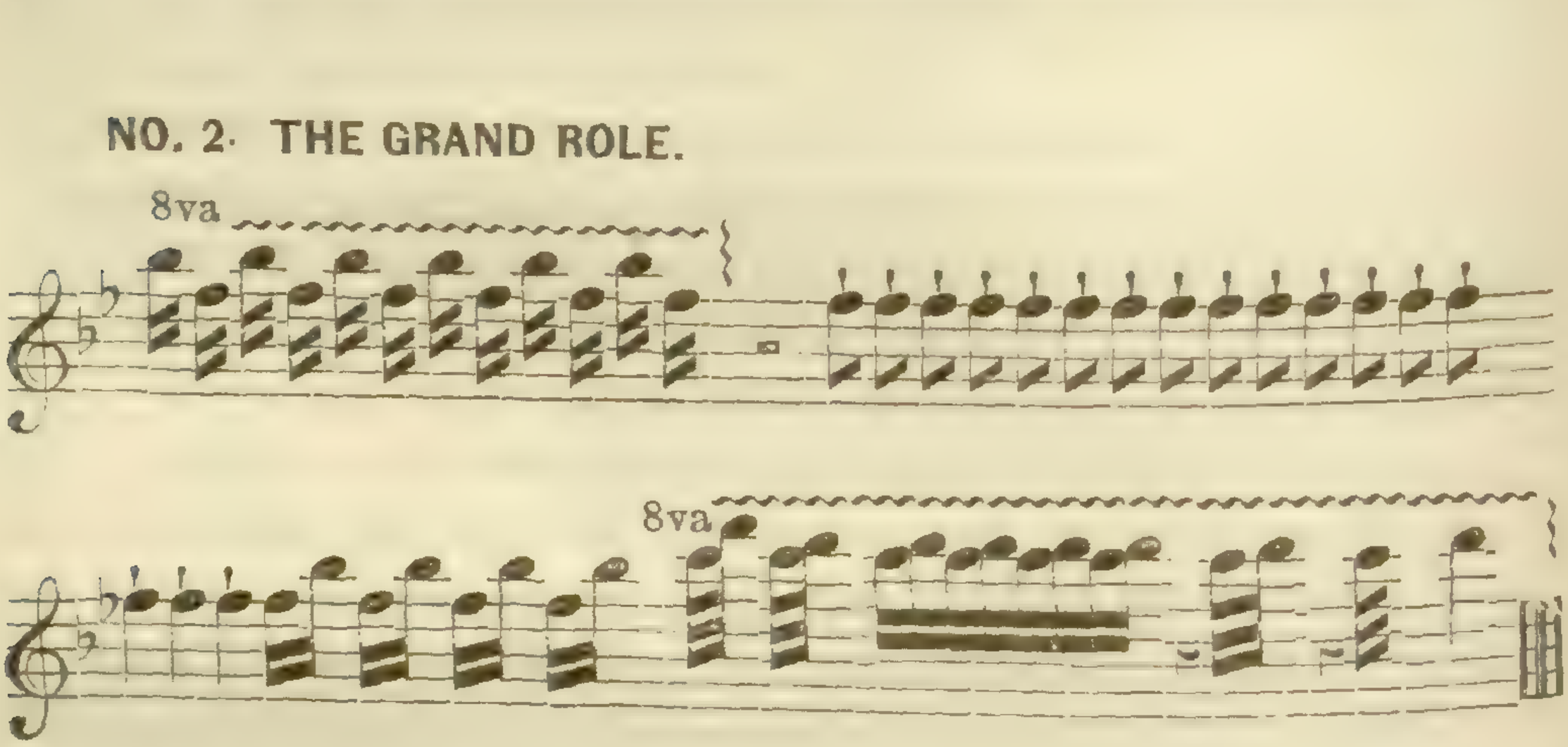
*The musical notation was written by my son, Ferris C. Lockwood.

apt to become monotonous from its admitting almost no variation. Monotony was not chargeable to Hespie's Wheel Song. With unconscious skill she would work out of it a wonderful variety. Instead of the first measure she would sometimes open with the second one, then follow it with the first. Or she might start with the third, following with the second, or the first, just as fancy seemed to dictate. Then she had her own whims as to the amount of repetition of each bar; that is to say, she would double or even

NO. 1. THE WHEEL SONG.



NO. 2. THE GRAND ROLE.



triplicate a measure, when the notion took her. In this regard. time was quite ignored. Indeed, whatever may have been the Hesperomys' canon of musical procedure or propriety, we could not but regard it as arbitrary, or beyond our comprehension. Still it must be admitted, that this little performer possessed precision. delicacy, and scope of execution.

She had one role, which although the notation is simpler than that of the Wheel Song, yet I think to her its execution was more

difficult. It is certain that she was far more chary of its performance; and to me its effect seemed more impressive. I have on account of its less frequency distinguished it as *The Grand Role*.

This was seldom given, yet quite often enough to allow it to be written down. The second measure would be sung quite fast, sounding almost like the pecking of the woodpecker on the tree; and at other times it would be slow like the dropping of water. Although she had no ear for time, yet she would keep to the key of B (two flats), and strictly in a Major key. This fact I considered interesting, as Wood declares his belief "that the untaught cries of all the lower animals, whether quadrupeds or birds, are in the Minor key." Herein theory must yield to observation. If I might venture an opinion, it would be that the music of the really musical wild animals is oftener on a Major key; while the Minor key characterizes savage man. A remarkable fact in the above *role* is the scope of little Hespie's musical powers. Her soft, clear voice falls an octave with all the precision possible; then at the wind-up, it rises again into a very quick trill on C sharp and D.

Though it be at the risk of taxing belief, yet I must in duty record one of Hespie's most remarkable performances. She was gambolling in the large compartment of her cage, in a mood indicating intense animal enjoyment, having woke from a long sleep, and partaken of some favorite food. She burst into a fulness of song very rich in its variety. While running and jumping, she rolled off what I have called her Grand Role, then sitting, she went over it again, ringing out the strangest diversity of changes, by an almost whimsical transposition of the bars; then without for an instant stopping the music, she leapt into the wheel, started it revolving at its highest speed, and went through the Wheel Song in exquisite style, giving several repetitions of it. After this she returned to the large compartment, took up again the Grand Role, and put into it some variations of execution which astonished me. One measure I remember was so silvery and soft, that I said to a lady who was listening, that a canary able to execute that would be worth a hundred dollars. I occasionally detected what I am utterly unable to explain, a literal dual sound, very like a boy whistling as he draws a stick along the pickets of a fence. So the music went on, as I listened, watch in hand, until actually *nine minutes had elapsed*. Now the wonderful fact is that the res between the roles was never much more than for a second of time;

and during all this singing the muscles could be seen in vigorous action through the entire length of the abdomen. This feat would be impossible to a professional singer; and the nearest to it that I have seen was the singing of a wild mocking bird in a grove.

For several days the wheel grated on its axle. This afforded Hespie great delight; and her own little warble was completely lost in the harsher sound. It was pretty much as it is with some of the modern methods of praise; as when the vocal is subordinated to the instrumental, a mere murmur of song, on which the organist comes down as with the sound of many waters. A drop of oil, and the sound of the friction stopped. This quite excited her temper; and she bit the wires of her wheel most viciously. A little device was hit upon which set her in good humor again. A strip of stout writing paper, a half inch wide, was pinned down in such a way that its clean cut upper edge pressed against the wires of the wheel, making with its revolution a pleasant, purring sound. It was on the principle, exactly, of the old-time watchman's rattle, and the old toy known as a cricket. This for a while greatly delighted the capricious creature, and she made the wheel almost fly; at the same time, in unison with the whirr of the wheel, was her own soft, cheery warble. It was very low, yet very distinct. I remember once on a larger scale witnessing an analogous sight, when, unseen, I entered a room in which was a woman spinning wool, and singing at the top of her voice, in keeping with the loud whirring of her spinning wheel. Without her wheel the domestic life of little Hespie would be rather monotonous. Expecting to see some antics in the slipping line, the trick was tried of covering a part of the inside of the wheel with smooth sized paper. Mousie entered and started the wheel, and in the prettiest way jumped the smooth paper floor at every revolution, actually keeping the propulsion up with but a slight diminution of the usual speed. This was certainly a very pretty feat. We next shut her out by corking up the entrance. She worked desperately at the closed aperture; then in despair gave vent to a piercing little cry. It was surprising what a strange pleasure this sound afforded me; it showed so clearly the difference in the timbre or quality of this sound of distress from that which I have called its singing. She was a good deal excited, and ran frantically into and out of her little bed-box, which had a hole at each end. Soon this tiny gust of rage passed over. She

now, although running about her cage, indulging in little gambols, indicating exquisite grace and agility, struck off into a truly beautiful strain of song. It occupied about three minutes, and had in it considerable scope and variety. First there was a clearly enunciated expression like that of the cooing of a turtle dove, a soft note, with a deliberate slowness. This changed into a series of more rapid notes strangely suggesting, though not so weird-like, the conchy clamor of the American cuckoo (*Coccyzus*), then closing with a series of short, rapid sounds, like the tapping of the woodpecker on a tree.

A very noticeable fact was, that a great deal of this little creature's song was poured forth while at play—that is, while in actual activity; and, take the wheel-play, for instance, when really in quite violent exercise. A thing, too, which much surprised me, was, that often when eating she sang and ate at the same time, literally in the same breath. This singular habit, so suggestive of a great physiological difficulty, led to an incident, which caused considerable merriment for those who witnessed it. I had been examining some insect larvæ on a twig of black alder. Without any real motive, a bit of the twig, about an inch long, and an eighth of an inch thick, was offered to Hespie. She was delighted, and at once began in her usual pretty way, sitting up, to eat the bark, although it is very bitter. Thus she sat "bolt upright;" and the manner in which she held this little black stick in both hands up to her mouth, at the precise angle in which a fife is held, although nibbling away, yet singing at the same time, it looked so like a little fifer playing on an ebony fife that laughter was irresistible at the comical sight.

Wishing to see how this Hesperomys would behave in company, I put into her cage a young domestic mouse about one-third grown. She was asleep in her little box. When she woke, it was a pretty sight. What animation! How the black eyes started and sparkled! To me they seemed to snap with fire. The whole frame was in a quiver—first of astonishment, then with rage. It was not a run—but a jump which she made at the little involuntary intruder, who received a nip that made it squeal in terror. We removed the little captive, who was so astonished that it was quite content to lie in our hand. Its terror had won our pity, and we restored to it its liberty. I had a friend who had once a singing domestic mouse, of very moderate musical ability, however. But

one day he captured two specimens of the white-footed mouse (*Hesperomys leucopus*), and supposing it would be good company, he put them into the cage. Great mistake it was. The two white-footed barbarians abused the hospitality, and murdered poor *Mus musculus*.

And now we ask are these phenomena that have been herein described the result of an abnormal condition of things or not? How much truth is there in the theory of some that the singing of these mice is the result of disease, or of some bronchial disturbance? In my opinion the following reasons disprove the truth of any such theory.

1. The exquisite animal enjoyment, and actual physical condition, for it is fat, and perfect in pelage and form, indicating high health. Every form of bronchial disease is in its most ordinary effect depressing to the animal spirits.

2. When engaged in song, the exercise reaches to the very depth of the chest, as is so often seen in the lowing of kine, where the muscles may be observed in action for the whole length of the abdomen. Persons afflicted bronchially avoid deep vocal exercises.

3. The singing is so often performed under those precise circumstances in which bronchially diseased persons are sure to keep still, if possible. For instance, take the Wheel Song. Here, although the exercise was violent, yet the song would be sustained all through with no diminution of vocal strength; and quite frequently was it the case, that when the animal stopped turning the wheel, though it continued the song, the momentum would throw it on its back, when as if in surprise, it would roll off four or five notes on a higher octave, and in a greatly increased loudness of voice.

4. Our vesper mouse delights in a role, the performance of which argues these three facts: — A high organization of the organs of the voice; delicate and skilful adjustment during use; a perfect condition as respects health. She can sing and eat at the same time. When a boy the writer was fond of whistling, usually selecting some ballad tune; and it was with perfect ease that the strain was continued through an entire stanza, without any break for the sake of getting breath; for ere the expiring air had become exhausted, he inverted the process, thus continuing his strain by the inspiring air as it came through the orifice formed by his lips. He also remembers that it was said of Jenny Lind that she could

use the inspiring breath in singing, though he cannot vouch for the fact. Now this fact, in the case of our Hesperomys, that it could eat and sing at the same time, even admitting, what is probably true, that there are intervals of a very short duration (so short as to be almost undiscernible) when the epiglottis closes to allow the food to pass down the gullet, demonstrates, as we think, that the organization of those parts was very delicate, and that the whole organism was in the very highest condition of health. We say nothing about that dual vocalization, other than that we think it looks in the same direction.

Probably it may occur to some that the pathology could be better demonstrated by dissection. To us it hardly seems that such a proof is needed. But I confess to a desire for all possible knowledge from such a source as respects certain physiological questions which I feel impelled to propose. In the human ear is a stringed instrument of amazing delicacy. The physiologist calls it the Fibres of Corti. It is wonderfully suggestive of the strings and keys of a piano; and it is believed that it ministers to the musical function. Query: has our little musician this mysterious organ? If so, in how much is it like that possessed by man? And as Hespie lacked time in her music, and as all animals, other than man, lack harmony, is this delicate organ consonant with that defect? Alas! we may not bring to this matter, though under our hands and our eyes, processes of investigation so delicate as the astronomer applies to matter far distant in space.

We would not run into the vice of generalizing on too scanty a stock of facts. Yet we are disposed to think that as an order the rodents possess a large amount of undeveloped ability for musical utterance. Few of us are aware to what extent among the domestic mice singers abound. Singing rats also have been observed. We have now the Hesperomys, thus affording three well marked genera of the Muridæ. Of the Sciuridæ, or squirrels, I can only speak of three genera with certain knowledge — the gray squirrel, the chipmunk, and the flying squirrel. All these are capable of musical sounds, though not to be called singers. And there is also the whistling of the woodchuck in its burrow. Last summer I caught a young rabbit in a patch of wild lupines, and was struck with the silvery musical ring of its cry, when my hand touched it. It is worth asking how far man's training or culture could develop and improve this potentiality or latent power in the rodents to

sing. My friend, who caught the object of this article, is firm in the belief that on one occasion it made, not without some success, an effort to imitate the canary. If this is a fact, it would of itself prove much in the direction of these remarks.

THE LONG-CRESTED JAY.

BY ELLIOTT COUES.

This bird is the *Cyanura macrolopha* of naturalists, and the genus it belongs to is distinguished among our jays by the ele-

Fig. 134.



The Long-crested Jay.

gant crest that all the species possess, as well as by the rich blue color that shows particularly on the wings and tail, which are also barred with black. This group of birds will be immediately recognized, when we say that the familiar blue jay of the eastern United States is the type of the whole; there are only half a dozen species, among which the common eastern species stands a little apart, being ornamented with richer and more variegated colors, and inhabiting a different zoological province. In the west it is represented by two kinds, Steller's and the Long-crested, so much alike that they might be considered as one species; the last named runs into the *C. coronata* of Mexico, and this into a South American kind called *C. galeata;* while from these last

another Mexican species, *C. diademata*, differs but little. These birds are more sombre in general plumage, than the *C. cristata* of the east, but still they are beautiful: they differ mainly in the varying extent of the sooty blackish and the blue, and in the precise character of the blue or white spots about the head. Our two kinds above named might be described almost in the same terms; they are grayish black with a faint blue shade, passing on the rump and abdomen into bright blue, which becomes even richer on the wings and tail; these last are barred with black. The chin is slightly streaked with whitish; otherwise, the whole head is glossy black, except that the crest is prettily faced in front with blue or bluish-white, and there are frequently whitish spots about the eyelids, as in a robin. It is the character of these head-markings, and the longer and fuller crest, that chiefly distinguishes the Long-crested from Steller's jay. Both are about a foot long, and nearly half as much in spread of wing; the wings and tail are each about half a foot. The sexes can hardly be told apart, though the male is a little the larger; the young rapidly come to resemble the parents; but when they leave the nest they lack the black bars on the wings and tail, and the head markings.

When I was travelling westward in the spring of 1864, I saw some of these jays in the Raton Mountains, in New Mexico, which I believe to be about their eastern limit, at least on that latitude, for they are strongly attached to pine-clad mountains, and, like Clarke's crow (*Picicorvus columbianus*) and the Blue-headed jay (*Gymnokitta cyanocephala*), are found as high up as timber grows. In crossing the Rocky Mountains through Whipple's Pass, I did not happen to meet with any, though others before me had been more fortunate; to the westward still, in the lofty forests of the San Francisco Mountains, they were abundant, and at that time (July), had just reared their families, and were rambling through the tops of the trees together. The old birds were in sorry condition, and had literally a "crest-fallen" air, as if they felt they had lost their chief ornament, and were stuck full of pin-feathers besides. But when I came across them the third time, in the pineries about Fort Whipple, they were in good trim once more, and saucy as ever. They live in the mountainous parts of Arizona all the year, for they are able to endure pretty severe cold, being of hardy nature, and well clothed with very soft, thick plumage, while their food is such as can be procured at any sea-

son. Thus being non-migratory, their permanent habitat may be given with some accuracy; it includes the wooded Rocky Mountain region at large. To the north, and especially about the Columbia River, they become mixed up with Steller's jay, which is the boreal extreme, reaching into Alaska; while in the opposite direction they run into the *Cyanura coronata* on the Table Lands of Mexico.

The imposing crest of this jay merits more than a passing allusion. It does not acquire its full size and beauty, after the July moult, until the approach of cold weather; but late in the fall, and all through the winter, this ornament is as striking as at the breeding season. It grows to be two inches and a half long, and is composed of many slender feathers with loosened barbs. The longest ones grow from the crown, while shorter ones fill in from behind and before, to make an elegant pyramid when standing close together, or a bundle of plumes when shaken apart, as represented in the figure, taken from a perfect spring specimen. This crest is jet black, but it is trimmed in front with a lacing of bluish white, laid on in two rows running a third way up; the colored feathers are of a hard, dense nature, looking something like little bits of metal, and besides these, there are spots of like color about the eyelids, as already mentioned. The crest can be raised or lowered, and opened or shut at pleasure; and its rapid movements, when the bird is excited, are highly expressive. The jay seems to be proud of his top-knot, and generally holds it pretty high, unless he happens to be on a birds'-nesting expedition, which I am sorry to say is not seldom, when he lowers his standard, and makes himself as small as possible, as he skulks silently about, looking, and no doubt feeling, like the thief that he is.

All the jays make their share of noise in the world; they fret and scold about trifles, quarrel over nothing, and keep everything in a ferment when they are about. The particular kind we are now talking about is nowise behind his fellows in these respects: a stranger to modesty, and forbearance, and the many gentle qualities that charm us in some little birds and endear them to us, he is a regular filibuster, ready for any sort of adventure, that promises sport or spoil, even if spiced with danger. Sometimes he prowls about alone, but oftener has a band of choice spirits with him, who keep each other in countenance—for our jay is a coward at heart like other bullies—and share the plunder on the usual

principle in such cases, of each one taking all he can get. Once I had a chance of seeing how a band of these guerillas make their raids, and though they went at it in good style, they came out very badly indeed. A vagabond troop made a descent upon a clump of bushes, where probably they expected to find eggs to suck, or at any rate some chance for mischief and amusement: and to their intense joy, they surprised a little owl, quietly digesting his grasshoppers, with both eyes shut. Here was a lark! and a chance to wipe out a part of the score that the jay family keep against the owl tribe, for injuries received time out of mind. In the tumult that ensued, the little birds scurried off at once, the woodpeckers overhead stopped tapping to listen and look on, and a snake that was basking in a sunny spot thought best to crawl into his hole. The jays lunged furiously at their enemy, who sat helpless, bewildered at the sudden onslaught, trying to look as big as possible, with his wings set for bucklers and his bill snapping, meanwhile twisting his head till I thought he would wring it off, trying to look all ways at once. The impudent jays, emboldened by the feeble resistance, grew more and more insolent, till their victim made a sudden break through their ranks, and flapped into the heart of a juniper tree, hoping to be screened by the tough, thick foliage. The jays went trooping after, of course, and I hardly know how the fight would have ended, but here I thought it time to interfere myself. I got the owl first, as the greater prize, it being the rare and curious Pigmy (*Glaucidium gnoma*) hardly bigger than a blue-bird; and shot four of the jays, before they made up their minds to be off. The collector has no better chance to enrich his cabinet, than when birds are quarrelling with each other; and so it has always been with the third party in a difficulty, ever since the monkey divided cheese for the two cats.

Since I have spoken of the jay's noisiness, I ought to say what his voice sounds like; but that is a hard matter, he is such a garrulous creature, and has such a variety of tones. Ordinarily, he screams out at the top of his voice, and keeps screaming till he is tired, or till something attracts his attention. This note is something like our jay's, but hoarser and heavier, and can be told in a moment, by its base quality, from the harsh outcry of either Woodhouse's or Maximillian's jay, both of which birds run higher up the scale. He has another way of expressing himself, that sounds like the rataplan of our golden-winged woodpecker; and then

again, when greedily regaling upon acorns, or hopping about with no particular object in view, or curiously peering down through the pine fronds to watch an intruder, he talks to himself in a queer way, as if thinking aloud and chuckling over some comical notions of his own; or perhaps simply because he likes to hear himself.

Indeed, this talkativeness gave the name — *Garrulinæ* — to the whole tribe of jays; and versatile as they are in this, they are equally so in the matter of their food, whence they used to be called *Omnivori*. The long-crested jay will eat anything that is eatable. They say jays kill and devour small birds; perhaps they may, but I do not think it is their practice. That they will rob birds' nests, and suck eggs, no one doubts; and if they cannot catch winged insects, fat larvæ and beetles do not come amiss. But after all, they are vegetarians, and live principally upon seeds, berries and other fruit. Out there in the mountains where the Long-crested lives, pine-seeds contribute in large part to his nourishment. I have often watched the bird hammering away at a cone, which sometimes he would wedge in a crotch, and sometimes hold with his feet, like a hawk with a mouse. Though most at home in the depths of the pines where the supply is pretty sure, he often strays into the adjoining patches of scrubby oak and juniper after the acorns and berries, or to pick a quarrel with Woodhouse's jay, and frighten the sparrows. Wherever he goes he has it pretty much his own way, hated and feared by the other birds, whom he silences with his scream, and subdues by a show of authority. But who of his ilk has not enemies to be feared in turn? Cassius' flycatcher, almost as noisy and audacious as himself, has many a set-to with him: and even the nimble little pewees pester him occasionally. The woodpeckers tease him particularly; they can scramble about faster than he can follow, and laugh at him from the other side of a bough, till he quite loses his temper.

But withal our jay has his good points, and I confess to a sneaking sort of regard for him. An elegant dashing fellow, of good presence if not good manners; a tough, wiry, independent creature, with sense enough to take precious good care of himself, as you would discover if you tried to get his skin. As you approach a tall pine where he is rollicking, his restless bright brown eye marks you for a suspicious character who will bear watching. Now thoroughly on the alert, he leaps like a squirrel from bough to bough till he reaches the top; and then, as you advance a step

nearer, he is off with a scream that makes the woods echo his triumphant disdain. It will be of no use to follow him, now that he is alarmed; give up the hope of that particular skin for your cabinet. But perhaps on another occasion he may be inclined to take a better look at you, for his curiosity is great, and so he may expose himself through the rift of the foliage that forms his look-out. That moment is your chance, and with the loud report of the gun comes his shriek of agony, as he falls all bloody from the bough he just mounted in such pride. If he is only wounded, you will find him game to the last, in such desperate strait as this, however he may show the white feather at other times; and you will have hard work to squeeze the last gasp out of him, with your fingers pressed on each side of the thorax, as you well know how. And even though you have a prize, you will think it is a cruel thing to do, as you plug up the shot holes, and thrust him in a stiff paper cone — especially guarding his superb crest — before consigning his warm body to the bag along with other victims.

REVIEWS.

Gray's Hand List of Birds.—With the third Part, which has appeared this year, one of the most remarkable ornithological works ever published is brought to a close. The urgent need of such a work as this has long been felt, while there seemed to be little hope that the want would be supplied, owing to the magnitude and exceptional difficulty of the task. Since Bonaparte's 'Conspectus,' with somewhat similar aim and scope, was abruptly broken off by the author's death, no one has hitherto been found willing, even if able, to bend himself to the undertaking. But Mr. Gray has proved equal to the occasion. To a knowledge of birds possessed by only a few leading ornithologists, he adds an acquaintance with the literature of the subject in which perhaps he stands alone; while the British Museum affords unrivalled facilities for one, who, like Mr. Gray, can use them to greatest advantage. To speak of the work in general terms of praise would be entirely superfluous. Mr. Gray has laid ornithologists under a lasting debt of gratitude.

The three unpretentious volumes simply purport to be a "hand-list of birds, distinguishing those contained in the British Museum;" but this does not say what has been accomplished, nor more than hint at the immense labor involved. This astonishing compilation is really an epitome of ornithological literature. It undertakes to present and identify all the generic and specific names that have been proposed in ornithology from the Linnæan times to to-day. And when we find that some five thousand generic titles, and over thirty thousand specific names, have been collated and identified, either as synonyms or as valid designations, we can appreciate what has been done. The index alone (which, by the way, takes up more than half the last volume) presupposes a familiarity with the literature of the science hardly to be expected in one man, to say nothing of the library work required in looking up authorities, and the mere clerical labor of transcription. But even this seems insignificant, when we recollect that two-thirds of the thirty thousand "species" are synonyms, and that an equal if not greater reduction of the five thousand "genera" was required; that this great mass of bibliographical matter had to be thoroughly digested, the valid species to be sifted out and assigned to other proper sub-genera and genera, and then the load of synonymy to be correctly distributed. Yet this has been approximately accomplished.

It is not within the bounds of possibility that all this should have been faultlessly done. In the first place, ornithological synonymy cannot now be completely disentangled; in every family, and in every extensive genus, there are names that cannot be identified to everybody's satisfaction. Secondly, the number of species cannot be fixed, owing to the well-known and unfortunate lack of agreement as to what shall be held for species and what for geographical or other differentiation. Supposing a man to have arranged before him every name that has been printed in ornithology, and to be personally acquainted with the bird upon which each one of these names was based; yet then he would not be able to pass judgment that would not be contested or reversed by some other equally well informed ornithologist in at least one case out of ten. In such insurmountable difficulty as this, Mr. Gray has adopted the most judicious — in fact the only practicable — course; he gives doubtful species the benefit of the doubt. It was manifestly impossible for him to attempt, in his individ-

nal capacity, critical discrimination in every instance; and the plan carried out is far more satisfactory. Suppressing only unquestionable synonyms, he retains all names not satisfactorily identified, and enumerates separately all geographical and other differentiations, in the cases of widely spread and flexible species, that have been distinguished by name. So in any given group we see at a glance what has been described as distinct, and may so be held with any show of reason whatever. As each name is accompanied by precise indication of locality, we can seize at once upon a probable indication of any specimen we may be looking up; and after determining that it is such a species of such an author, it remains with ourselves to decide whether it is sufficiently distinguished from such another species. Thus any one inclined to be severe in the matter of species can lump to his heart's content; whereas had Mr. Gray heaped up synonyms in a conservative spirit, he would have made it like looking for a needle in a haymow for one of opposite tendencies to pick out the name he wanted. By this method, Mr. Gray makes an approximation towards a perfect mirror of ornithological literature only limited by common human fallibility.

The list of species foots up a total of eleven thousand, one hundred and sixty-two, distributed among two thousand, nine hundred and fifteen genera and sub-genera. Making a reasonable reduction, upon the considerations just presented, the number probably will not exceed ten thousand—a figure that accords with current estimates. But the number of "genera"—one for every four species, and that in a class of animals of the fewest broad types, and an unusual proportion of closely interrelated forms—is a palpable absurdity. Mr. Gray, however, is not guilty of any such thing as this. The full genera he adopts are noticeably few—decidedly fewer than is now customary; at a rough estimate not one-fifth of the two thousand, nine hundred and fifteen names enumerated. For in this matter, he has been guided by the same happy judgment that dictated his disposal of specific names. In reducing the five thousand and odd genera that have been proposed to two thousand, nine hundred and fifteen, he suppresses only those that are positively homonymous—based upon the same type. The rest are given, as subgenera, each over its own type, without raising the question of their taxonomic value; thus among the humming birds, we find only twenty-eight

genera, but no less than one hundred and seventy-eight subgenera! By this means we learn exactly what, if any, names have been based upon a particular species; and so knowing the types. we can combine or keep separate at discretion. If Mr. Gray had brought these various names under the one he adopted for the genus, we should be completely at a loss. One other reason for the prodigious number of generic names indexed, may be found in a peculiarity of Mr. Gray's; he invariably preserves the original spelling of names, whether correct or not, against the custom of the purists who try to amend cacography, false etymologies, and other 'barbarities' of which ornithology is guilty; he will not even correct typographical errors ordinarily; and by citing all the different spellings of the same word as distinct synonyms, his list is considerably swelled, since the same word is sometimes written five or six different ways. For the special purposes of this work, this method is undoubtedly preferable, though obviously it cannot be fully carried out. For instance, in the 12th edition of the *Systema Naturæ*, the genus *Scolopax* stands printed *Scopolax*.

The classification adopted in the hand-list is fairly open to criticism on every score. If there is any point upon which ornithologists are almost unanimous in the midst of the taxonomic enterprises and conflicts of the present day, it is the entire ineligibility of this antiquated classification. Whatever may be said for or against any other system, this one at least will not do.

We hesitate about mentioning the only other feature of the work that does not satisfy us; for it is much like asking the master of a feast why he does not have one more course. But, while a large proportion of the species (the leading ones in particular) are indicated by references to the works where they are described, the greater number of names, including all the synonyms, are merely accompanied by the authors' names, and the locality. This will often leave the student in the lurch, as he may have no idea where to look for the description upon which the name is based. This is complimentary to ornithologists, certainly: but it presupposes a knowledge of the literature of the science that all do not possess. It was not so much matter about the synonyms; but if the line allotted to each species had been filled out with the reference, as it might have been, we should judge that with little additional labor, and without perceptibly enlarging the volumes, the usefulness of the work would have been ma-

terially enhanced. After what has gone before, we hardly need say, that the Hand-list is simply indispensable to the working ornithologist.—E. C.

Origin of Lowest Organisms.*—The author's aim in this and other writings is to prove that while some monads (Bacteria) originate by subdivision of preëxisting individuals (homogenesis), others originate *de novo*, just as crystals originate by certain chemical laws. He thus goes still farther than those advocates of spontaneous generation who believe that Bacteria originate by the transformation of living matter (heterogenesis). For this new mode of spontaneous generation he proposes the term "Archebiosis."

We should premise that Bacteria are monads, the lowest and most minute organized beings, forming mere points of organized matter; they are highly refractive spherical bodies, and move with considerable activity. Torulæ are very similar bodies and are the germs of the yeast fungus. Professor Bastian has observed the ordinary reproduction by fission "most plainly when a few Bacteria have been enclosed in a single drop of fluid, pressed into a very thin stratum, in a 'live box' kept at a temperature of about 90° Fahr. by resting on one of Stricker's warm water chambers placed on the stage of the microscope. Under these conditions, I have seen a Bacterium of moderate size divide into two, and each of these into two others somewhat smaller, in the course of fifteen minutes." These monas-like bodies, as is well known, develop into higher organisms. "It is a fact, however, admitted by many, and which any patient microscopist is capable of verifying for himself, that some Bacteria do develop into Leptothrix filaments, and that these are capable of passing into a dissepimated mycelial structure of larger size and undoubtedly fungus nature —from which, fructification of various kinds may be produced. Some Bacteria may therefore develop into some fungi, just as certainly as Torulæ may develop into some other fungi, or just as surely as some multiplying gonidia may develop into lichens. That some Bacteria are produced from preëxisting Bacteria, just as some Torulæ are derived from preëxisting Torulæ, may, it is

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*The Mode of Origin of Lowest Organisms: including a discussion of the experiments of M. Pasteur, and a reply to some statements by Professors Huxley and Tyndall. By H. Charlton Bastian. London and N. York. Macmillan & Co. 1871. 12mo. pp. 109, with two cuts. $1.25.

true, be considered as settled." "But" he adds "so far as we have yet considered the subject, there may be just as good evidence to show that Bacteria and Torulæ are capable of arising *de novo*, as there is that some of them are capable of developing into fungi."

He next discusses the heterogenetic origin of Bacteria and Torulæ:—

"It has long been known that Bacteria and Torulæ are frequently to be found within vegetable cells, taken even from the central parts of plants whenever these are in a sickly condition or are actually dying. They are apt to exist also within epithelial cells taken from the inside of the mouth; and the frequency and abundance with which such organisms are met with in these cells, is almost in direct proportion to the malnutrition and lack of vital power in the individual who is the subject of observation. Then again, in persons who have died of adynamic diseases, in the course of twenty-four or thirty-six hours (during warm weather), Bacteria may be found in abundance within the blood vessels of the brain and of other parts, although no such Bacteria were recognizable in the blood of the individual during life.

In such cases we must in order to account for the presence of the Bacteria and Torulæ, either suppose that such organisms, in an embryonic state are almost universally disseminated throughout the various textures of higher organisms, both animal and vegetal (though they are only able to develop and manifest themselves when the higher organisms, or the parts of them in which the Bacteria or Torulæ are met with, are on the eve of death), or else we must imagine that when the vital activity of any organism, whether simple or complex, is on the wane, its constituent particles (being still portions of living matter) are capable of individualizing themselves, and of growing into the low organism in question. Just as the life of one of the cells of a higher organism may continue for some time after the death of the organism itself, so, in accordance with this latter view, may one of the particles of such a cell be supposed to continue to live after even cell-life is impossible."

This latter theory (heterogenesis) he favors as in part accounting for the production of Bacteria, as "evidence of a tolerably satisfactory nature, however, is forthcoming which may speak independently in favor of the doctrine of heterogenesis."

"It has been affirmed by Crivelli and Maggi that they have actually seen the particles within granular epithelial cells (taken from the back of the tongue of a patient suffering from diabetes) grow and elongate, so as to give rise to Bacteria, or fuse in longitudinal series so as to form a Vibrio. And, moreover, as I have

myself ascertained, if one takes healthy-looking epithelial scales scraped from the inside of the mouth, which appear to contain nothing but the finest granules, and places them with a little saliva in a 'live box' (and this within a damp chamber kept at a temperature of about 90° Fahr.), in the course of from five to ten hours, the cells may be found to be studded throughout with motionless Bacteria."

The origin, in the third place, of Bacteria and Torulæ by Archebiosis is supported by evidence, in the author's opinion, sharply defined and conclusive.

"Simple experiments can be had recourse to, which are not admissible in the discussion of the question as to the origin of Bacteria and Torulæ by Heterogenesis. Thus, we wish to establish the fact that living matter is capable of undergoing a certain metamorphosis, and consequently, we must deal with living matter. Here, however, with the view of establishing the fact that living matter can arise *de novo*, if we are able, shortly after beginning our experiment, to arrive at a reasonable and well based assurance that no living thing exists in the hermetically sealed experimental vessel — if the measures that we have adopted fully entitle us to believe that all living things which may have preëxisted therein have been killed — we may feel pretty sure that any living organisms which are subsequently found, when the vessel is broken, must have originated from some re-arrangements which had taken place amongst the not-living constituents of the experimental solutions, whereby life-initiating combinations had been formed."

The possibility of this mode of spontaneous generation is "intimately associated with the doctrine as to the cause of fermentation and putrefaction. Bastian espouses Liebig's theory of the cause of fermentation, *i. e.*, by sets of chemical changes, against Pasteur's, who believes that fermentative changes are begun by the influence of living organisms.

He also attacks the theory that the atmosphere is laden with the germs of Bacteria and Torulæ, and thinks that if they do have germs, they must be microscopically invisible to us. He then gives the results of a series of experiments which "seem to show quite conclusively that M. Pasteur's explanations are altogether inadequate to account for the occasional preservation of boiled fluids in bent-neck flasks." They lend no countenance, moreover, to his particular theory, that fermentation cannot be initiated without the agency of living ferments, — they are, on the contrary, wholly opposed to this restriction. In conclusion our author remarks:—

"It would thus appear that specks of living matter may be born in suitable fluids, just as specks of crystalline matter may arise in other fluids. Both processes are really alike inexplicable—both products are similarly the result of the operation of inscrutable natural laws, and what seem to be inherent molecular affinities. The properties of living matter, just as much as the properties of crystalline matter, are dependent upon the number, kind, and mode of collocation of the atoms and molecules entering into its composition. There is no more reason for a belief in the existence of a special "vital force," than there is for a similar belief in the existence of a special "crystalline force." The ultimate elements of living matter are in all probability highly complex, whilst those of crystalline matter are comparatively simple. Living matter develops into Organisms of different kinds, whilst crystalline matter grows into Crystals of diverse shapes. The greater modifiability of living matter, and the reproductive property by which it is essentially distinguished from crystalline matter, seem both alike referable to the great molecular complexity and mobility of the former. Crystals are statical, whilst organisms are dynamical aggregates, though the evolutions of both marked by their peculiar characteristics, may be regarded as visible expressions testifying to the existence of one all-pervading power—

> **"Whose dwelling is the light of setting suns,**
> **And the round ocean, and the living air,**
> **And the blue sky, and in the mind of man:**
> **A motion and a spirit that impels**
> **All thinking things, all objects of all thought,**
> **And rolls through all things."**

NATURAL HISTORY MISCELLANY.

BOTANY.

On the Lever-like Anthers in Salvia.—It must, I think, be evident to many observers that what we are prone to consider beautiful adaptations in the organs of flowers, are, as we should say of many of the operations of men, merely *afterthoughts*; that is to say that often parts would be formed without any idea of the uses which would be subsequently made of them. I have perceived this for some time, but hardly dared express it in the face of the universal belief that everything was designed for some special use and purpose. Last year, however, I submitted in these pages the

idea that if the petaloid lobes of the divided anthers in Salvia. which closed the throat of the corolla in most of the species. were really designed to aid in the diffusion of the pollen by insect agency, the subsequent clasping of the stamens by the upper lip of *Salvia involucrata* and thus preventing the said action, was a queer proceeding.

I hope that this matter will not be lost sight of by those who advocate the universal adaptation theory, and to aid in keeping the subject fresh, I would point out that in *Salvia coccinea* the "lever" arrangement exists as in most other Salvias, but are set back against the upper surface of the corolla, in such a way as to be absolutely useless as an obstruction of the throat, or for any purpose whatever that I can see. It is getting to be the fashion to refer any useless organs or structures to some supposed distant progenitors, from which the modern organism sprung. Our whiskers and so forth for instance, are said really to belong to the monkey from which we are descended, rather than to the modern man to whom they are now attached. It will be a curious study for botanists to trace out the progenitors of these Salvias which may claim the original uses of these petaloid anthers in cases where they are as useless now as the hair on our faces. But if we may be pardoned for deriding easy beliefs, as well as easy labors, we may say of some of these matters, as we say of pollen or of seeds themselves, that nature makes numberless things, for which she has no use whatever. Perhaps it may be, that like the human mind, the mind of nature likes variety and profusion, in the effort for which mere utility is not always consulted.—Thomas Meehan.

[Should Mr. Meehan read E. Müller's Discourse, in the July number of the Naturalist, he will notice that, with the Darwinian school, and in virtue of the very terms of the theory which has imparted so much interest into the subject, "universal adaptation" is regarded as a consequence rather than as a forethought. Thus far he would seem to be in accord with Darwinians. But in nothing could he more widely diverge from their way of thinking than in his suggestions that "Nature makes numberless things for which she has no use whatever," if by his metaphorical expression he means that the "things" are of no use to the beings that produce them. And of this sort, "pollen and seeds" are queer examples. Does he mean that these are useless because superabundant enough to ensure against risk and loss and appropri-

ation by animals, through which fertilization and dispersion are subserved?—Eds.]

Petals in Atragene.—I have just taken a number of specimens of *Clematis* (*Atragene*) *alpina* which have well developed petals. In the subgenus Atragene, as is well known, the outermost of the stamens are usually abortive, as if to represent the true petals, which are wanting. I have in one flower, not less than ten good petals, all of them being as long as the sepals, two-thirds as broad, and quite as deeply colored.

These petals are all entirely destitute of any traces of the anther at their tips; nevertheless, in all the specimens in question, the transition from stamen to petal, is a gradual one, similar to what is seen in the flowers of Nymphœa. The usual four sepals are perfectly normal, and differ from the petals only in being broader.—Edward L. Greene, *Golden City, Col. Territory.*

Transpiration of Leaves.—In the monthly report of the Department of Agriculture for March and April, 1871, page 149, is a short notice on transpiration of leaves. Pettenkofer is named as the observer, but he only made the report of the experiment, which was performed by Prof. Fred Pfaff in Erlangen. Being on a visit to Germany two years ago and standing under the same oak tree, which was the object of the observation, my old friend Mr. Pfaff explained to me his mode of calculations, which may be of interest to some of your readers.

Cutting a small twig with the leaves, he brought it in a wide mouthed glass bottle, corked and weighed it. Then he exposed the leaves to the open air, weighed it again, after three to four minutes and marked the differences, from which he calculated the evaporation of the leaves in a certain time. Then he outlined each of the leaves on fine paper, the weight and measure of which he had ascertained, cut the outlines out and weighed these again; from the difference of weight he calculated the difference of measure, and accordingly the surface of all the leaves. Afterwards he calculated the surface of the foliage of the whole tree in the following manner: the crown of the tree was a regular elipsoid and easily measured; deducting the inner leafless part, he found the bulk of the leafed part. Attaching cubes of different sizes, made of thin sticks representing the edges of the cube, to parts of the

crown of different density of foliage, he counted the leaves falling into the hollow space and calculated by repeated measurements the average number of leaves of the whole tree and the average surface of them.

The loss by evaporation was measured at different hours of each day, from the 18th of May to 24th of October; this reduced the average loss for a square inch surface, and from this was calculated the average loss from all the leaves of the tree during the season.

Many minute precautions were taken, which to mention here is not necessary; but it may be remarked that when exposing the leaves for evaporation he suspended the twigs in the shade, and as the cut twigs during the experiment were deprived of any succor from the tree, the loss is to be considered as a minimum.

The intention was not to find the exact amount of transpiration, but to prove that during the season the tree evaporates considerably more water than it receives by rainfall, and so the method answers the purpose.—Fred. Brendel, *Peoria, Ill., 9th of June*, 1871.

ZOOLOGY.

Spawning of the Goose Fish (*Lophius Americanus*).—During the summer season the fishermen on the New England coast often notice a substance floating in the water, which they term "a purple veil" the precise nature of which has caused much speculation on their part, and which answers singularly well to its designation.

During a late cruise I encountered one of these veils, which presented the appearance of a continuous sheet of a purplish brown color, twenty or thirty feet in length and four or five in width, composed of a mucous substance which was perfectly transparent, to which, as a whole, a purple color was imparted by the presence of specks distributed uniformly throughout the mass to the number of about thirty or more to the square inch. I was unable to ascertain whether this was actually a simple sheet or a collapsed tube, as the material was so extremely slippery that it was impossible to retain it in a position where it could be easily examined. With much effort we succeeded in bringing a portion upon the deck of our boat, when it ran out almost immediately through the scupper holes. To our surprise on closely examining the specks, which gave color to the mass, we found them to consist of embryonic fish, moving vigorously in their envelope but without

any appreciable latitude of motion, or change of relative position to each other.

Portions of this veil, with its contents were brought home, hoping that we might be able to follow the successive transformations of this embryo, and thereby determine the species; but although the water in which they were kept was frequently changed they very soon died.

It was, of course, evident that nothing but a very large fish could lay so heavy a sheet of mucus, covering as it did an area of not less than from sixty to one hundred square feet, and I am informed that they are sometimes found even much larger than this. Allowing one hundred square feet of surface, and an average of thirty feet to the square inch, the sheet in question would contain four hundred and thirty-two thousand eggs, an estimate decidedly within the mark.

When this specimen was first selected, we had overboard at the stern of our boat a trawl net about thirty feet in length, of a tan color trailing behind, and the veil was first seen floating near it, and so entirely similar in general appearance and color, as to remain for some time without attracting special attention, till one end floated off from that of the net, creating the impression that the latter had been torn longitudinally into strips by some unknown accident.

Finding myself unable to ascertain anything about the true character of this spawn I sent specimens of it to Mr. Alexander Agassiz, who informed me that it belonged to the goose fish, and that he had studied out the development of the species from its earliest stage of growth to maturity.—S. F. Baird.

How Living Toads May Occur in Limestones.—It is well known to all naturalists that none of the existing species of animals were in existence during either the paleozoic or mesozoic periods, and hence the reported occurrence of frogs or toads in a torpid but living state, embedded in solid limestone strata, has not been generally credited by scientific men as worthy of serious consideration. Nevertheless it is not uncommon to hear persons assert that such occurrences have taken place within their own personal knowledge, and it seems hardly probable that such reports should arise in various and distant localities, without some apparent foundation in fact.

In the winter of 1853 the writer was informed by a gentleman

of undoubted veracity, that in laying the foundation walls for a warehouse in the town of Naples on the Illinois river, a living toad was found entombed in the limestone, which on coming in contact with the atmosphere soon resumed its wonted activity, though torpid when first discovered.

Having occasion to pass through Naples a few days afterwards, I examined the walls of the buildings to see if I could discover any clue that might serve to explain so improbable an occurrence. I found the walls constructed out of the brown dolomite of the lower St. Louis, or Warsaw limestone, and observed that the rock had been more or less fissured, the fissures cutting the strata at right angles to the lines of bedding, and varying from a mere line to an inch or more in width. Many of these fissures had been filled wholly or partially with a deposit of stalagmite, and in some places the exposed surface of the rock had been coated for an inch or more in thickness with the same material.

These facts seemed to me to afford an easy explanation of the reported phenomena; the toad had sought shelter in one of these crevices as his home for the winter, where he remained in a dormant condition, until the constant dripping of water holding carbonate of lime in solution sealed him in completely. Here he remained until he was released by the hammer of the workman, which broke the crust of his stony mausoleum, and restored him to liberty. Persons who had paid no attention to the manner in which limestones are formed, would make no distinction between the original dolomite which was formed beneath the ocean, eons of ages ago, and the incrusting stalagmite whose formation is still going on, and to them it would be all alike, *solid limestone*. As these comparatively recent calcareous deposits are of very common occurrence, it would not be surprising that living batrachians should be found in them, even more frequently than they are.

It would be a matter of considerable scientific interest, to determine, were it possible, how long animal life could be preserved under such conditions; and if the functions of life are so completely suspended during hibernation, as to cause no waste of tissue, I see no reason why it might not be preserved for an indefinite period, though it is by no means necessary to suppose in the case cited above, that any long period had elapsed after the entombment of the animal.—A. H. Worthen, *Springfield, Ill.*

Young Worms Feeding on Eggs of the Same Brood.—In a recent biography of the celebrated Swiss naturalist Claparède, by M. H. de Saussure, published in the "Bibliotheque Universelle," he is said to have made the strange discovery that among the eggs contained in great numbers in the capsule secreted by the worm (Clitellum) one only transforms into an embryo. This rapidly increases in size, since as soon as its mouth is formed, it devours the surrounding eggs, which thus serve as a reservoir of food. This phenomenon is analogous to that which has been described in certain gastropodous molluscs such as Purpura, etc.

Black Varnished Insect Pins.—M. Peyerimhoff advocates the use of black varnished insect pins instead of silvered brass pins, which corrode in the body of the insects, especially of Micro-Lepidoptera, very soon disfigure them, and eventually utterly destroy them. The editor of "Petites Nouvelles Entomologiques," thinks that varnished brass pins may last somewhat longer, but that these will eventually perish in the same way. "We believe that platinum wire is perfectly indestructible, and open to none of the objections which are made to brass. Certainly nothing but platinum will therefore be used for very rare specimens."

Hymenopterous Parasites in a Beetle.—Wishing to compare certain muscles of locomotion of butterflies with those of some other insect, I selected from a bottle of alcoholic specimens a species of Pimelia which I had collected in Egypt—a large, compact, very hard-shelled beetle, with elytra connate to the last degree. On opening the beetle from above and removing the mass of nearly or quite developed eggs which lay on the upper surface, I noticed some vermiform bodies lying free in the cavity of the abdomen. Examining them carefully, my astonishment was great on discovering that they were hymenopterous larvæ, closely resembling those of certain species of Braconidæ which are so easily reared from some lepidopterous larvæ. I had detected several when I was called away, and was afterwards unable to distinguish from the dried up mass how many larvæ it might have contained. Have hymenopterous larvæ ever before been found parasitic in the abdominal cavity of a perfect hexapod? Least of all should we expect to find them in such hard-shelled Coleoptera? How and

when do they emerge from their host, and do they interfere with its vital functions before the eggs are deposited? The beetle was one of a large colony of lively specimens captured beneath the ruined walls of an Arab hovel at Ismailia on the Suez canal. The specimens have been sent to the editors of the AMERICAN NATURALIST.—SAMUEL H. SCUDDER.

[It is well known in Europe that several species of Conops, a wasp-like dipterous fly, live in the larva state in the abdomens of adult humble bees. We have reared a species also from the abdomen either of *Bombus vagans* or *B. fervidus*.—EDS.]

MADNESS IN A HORSE.—In the "Zeitschrift für Parasitenkunde" published in Berlin, a remarkable instance is recorded of madness in a horse, caused presumably by the bite of a mad dog. The horse was brought to the hospital of the Royal Veterinary School at Berlin, having refused its food for two days, and exhibited extraordinary wildness and propensity to bite, not only other horses and inanimate objects, but also its own body, and had already by this means broken several of its teeth, and inflicted severe injuries on its mouth. When confined in a stall in the hospital, it continued to exhibit this propensity to a terrible extent, but in a fitful manner; in the intervals of the paroxysms it stood in a bewildered state, and would sometimes suddenly fall as if struck by lightning, then give a violent bite to one of its hind feet, then as suddenly spring up, staggering. The loss of blood caused it to become gradually weaker, and in the evening of the day on which it was admitted, it expired without any death-struggle. Except the outward injuries, and some interior swelling and inflammation, the organs were found to be sound after death.—A. W. B.

ANTHROPOLOGY.

WHERE ARE THE BONES OF PREHISTORIC MEN?—In answer to this inquiry, M. W. Pengelly states in the "Quarterly Journal of Science" that their bones may be more subject to decay than the bones of other animals, citing the experiments of Dr. Lindley who "placed in water, in a tank, one hundred and seventy-seven specimens of various plants belonging to all the more remarkable natural orders, including representatives of all those which are constantly present in the coal measures, and also those which are

universally absent. The uncovered vessel was exposed to the air and left untouched further than filling it up as the water evaporated, until April, 1835, or a period of two years. At the end of that time it was found that certain kinds had entirely disappeared, others had left some more or less recognizable traces; whilst others, especially fungi, ferns and coniferous trees were comparatively well preserved. In short, the plants remaining and the plants which had disappeared were respectively of the same groups as those which are not present amongst the coal fossils." He also remarks that it is well known that oyster and limpet shells are more frequently found fossil than cockles, and it was found by Mr. Sorby that the carbonate of lime in the shells of limpets, oysters and other molluses, were turned into calcite, while cockles and their allies were changed into arragonite, the latter being liable to disappear. He also says that after the conversion of the Lake of Haarlem into dry land, when thirty to forty thousand men had been buried in its land, or drowned in its waters, and thousands of miles of trenches and canals were dug through this made land, no human bones had been found, and only a few relics of human art. As direct evidence that the bones of man have been found mingled with those of extinct animals, he cites the following facts:—In 1824 Rev. Dr. Fleming stated that "man was an inhabitant of this country at the time these animals, now extinct, flourished, his bones and his instruments having been found in similar situations with their remains." M. Wrey, F. G. S., in 1831, discovered "an undoubted human skull, very perfect and in good preservation" in the floor of a cave, mingled with the bones of "extinct and recent animals." In 1833–'4, Dr. Schmerling of Liège, in a cave in the valley of the Meuse, discovered certain deposits which "were covered with a floor of unbroken stalagmite, and contained the commingled remains of extinct and recent animals, including man," among which were several skulls, including the celebrated Engis skull. In 1840, Mr. Godwin Austin remarked that the bones of man occurred in Kent's Cavern, Torquay, "under precisely the same conditions as the bones of all the other animals." In 1841 he added, "at Kent's Hole, near Torquay, arrows and knives of flint, with human bones, in the same condition as the elephant and other bones, were found in an undisturbed bed of clay, covered by nine feet of stalagmite."

"The late Col. Hamilton Smith devoted a section of his "Natu-

ral History of the Human Species" (1848), to the question of "Bones of Man among Organic Remains" of which the following is a brief summary:—In a conversation with the author in 1824. Cuvier admitted that the opinions then in vogue on the point would require considerable modification. Donati, Germer, Rasoumouski, and Guetard, maintained that human bones had been found intermixed with those of lost species of mammals in several places; they had been detected in England in caves and fissures; they were found at Meissen in Saxony, and at Darford in France, by M. Firmas. A fossilized skeleton found in the schist at Quebec, and in part preserved at the seminary, excited no attention; and the well known Guadaloupe skeletons had been pronounced recent upon hypothetical reasoning. Those discovered by M. Schmerling in the Liège caverns were similarly disposed of, and Dr. Lund's reports respecting partially petrified human bones, found by him in the interior of Brazil, in the same condition with those of numerous animals, now extinct, which accompanied them, attracted no more than incredulous attention. In the caverns of Bize, in France, human bones and shreds of pottery were found in red clay mixed with the dèbris of extinct mammalia; a similar collocation was soon after detected by M. de Serres, in the caverns of Pondres and Souvignargues; and Dr. Boué found human bones mixed with others of extinct species at Lahr. In 1833, human bones were found together with several species of the well known extinct cave mammals, in caves near Liège, beneath a thick coat of stalagmite; and about the same period, the Rev. Mr. MacEmery collected from the caves of Torquay, human bones and flint knives, amongst a great variety of extinct species, all under a crust of stalagmite upon which the head of a wolf reposed. Amongst the bones of the mammoth and his contemporaries, found at Oreston, near Plymouth, at different times before and after that period, the upper portion of the humerus of a man was detected, and immediately thrown away as valueless on being pointed out to the possessor. About the end of the last century, gypsum quarries were opened in the Vale of Kostniz, in Upper Saxony. The gypsum was intersected in every direction by caves and fissures, which were filled with red clay containing clusters of bones of mammalia, including man, elephant, rhinoceros, horse, ox, elk, deer, reindeer, a great felis, hyæna, hare, and rabbit. A fragment of an arm and a thigh-bone of a man were dug out of the clay at a

depth of eighteen feet; and eight feet below, two phalanges of a rhinoceros."

Other discoveries, made since 1860, and well known to our readers, are alluded to. The writer might have added the case, now apparently well authenticated, of the human skull found by Professor Whitney, under Table Mountain, California, associated with remains of the mastodon.

Fresh Discoveries of Platycnemic Men in Denbighshire.—Mr. W. Boyd Dawkins records in "Nature" the opening of some freshly discovered bone-caves in Denbighshire, Wales, in which were discovered the remains of men with the skulls rather above than below the present ordinary cranial capacity, but with some of the leg-bones remarkable for the peculiar antero-posterior flattening or platycnemism of the shin bones. They are associated with the remains of sheep or goat, pig, fox, badger and stag, and with four flint flakes. The interest of the discovery consists in the fact that the group of caves, which has been used by a race of herdsmen in long-forgotten times as habitations and burial places, must be referred to the Neolithic age. And we can now be certain that those people who have manifested the peculiar flattening forwards of the shin in Denbighshire belong to that age. It is a point also well worthy of note that the cranial capacity of these Neolithic men was not inferior to that of the average civilized man, although the ridges and processes for muscles indicated a greater physical power.—A. W. B.

GEOLOGY.

Geological Expedition to Kansas.—I write to give a brief account of the expedition of seventeen days which I have just made in the valley of the Smoky Hill river in Kansas. Through the courtesy of General John Pope commanding the department of the Missouri, I was furnished with an order on the post commandant at Fort Wallace for a suitable escort. This was furnished by Captain E. Butler (Fifth infantry), who spared no pains to make the expedition a success.

We first camped at a spring eighteen miles south of Fort Wallace, and five miles south of Butte Creek. It had a fine flow of water, and being without a name I called it Fossil Spring. On a bluff on Butte Creek, Lieutenant Whitten discovered the frag-

ments of a monster saurian projecting from the shale, and on following the bones into the hill, exhumed a large part of the skeleton of a *Liodon dyspelor* Cope. This was welcome, as the species had been previously known from vertebræ only. The pelvic arch was found perfectly preserved, and the scapular arch and limbs partially so. The iliac bone is slender and straight, slightly expanded at the acetabulum. The ischium has a some what similar form, but is curved. The axis of the proximal portion is directed upwards, the shaft then turns into a horizontal direction and lies beneath and at one side of the vertebral column without uniting with its fellow. The pubes are elongate, but wider than the other elements and flattened. They are in contact in front medially, and have an angulate axis. A short process projects from near the proximal end, on the exterior margin. The femur is a flat bone slightly constricted medially, and with a decurved and projecting portion of the proximal articular surface on the *inner side* representing a head. The extremities of the dentary bones are each drawn to an acute point differing thus *toto cælo* from those of the *L. proriger*.

On the same bluff another Liodon and a Clidastes were found with five species of fishes.

On examining the neighboring bluff and denuded areas, bones supposed to be those of Pterodactyle, two species of Clidastes, a Dinosaur, a Crocodile, and numerous fishes were brought to light.

In a similar location on Fox creek cañon, one of the escort, Martin V. Hartwell, to whom I am indebted for many fine discoveries, observed the almost entire skeleton of a large fish, furnished with an uncommonly powerful offensive dentition. The jaws were stout, the dentary bone very deep. The teeth in a single row in all the bones, but of irregular sizes. There are two or three very large canines in each maxillary and one in the premaxillary; three or four in the dentary separated by one interval. The lack of the coronoid bone and many other characters, shows that it should be referred to the order Isospondyli, and is probably allied to the herring and the Saurodontidæ. The vertebræ are grooved, and there is a basioccipital tube but little developed. The teeth are simple cylindric conic, with smooth enamel, and project two inches above the alveolar border, and each descends an inch into its alveolus. The species and genus are new to our palæontology, and may be named *Portheus molossus*. It turned out on subsequent explanation to have been quite abundant in the

Cretaceous seas. It was probably the dread of its cotemporaries among the fishes as well as the smaller saurians.

On another occasion we detected unusually attenuated bones projecting from the side of a low bluff of yellow chalk, and some pains were taken to uncover them. They were found to belong to a singular reptile of affinities perhaps to the Testudinata, this point remaining uncertain. Instead of being expanded into a carapace, the ribs are slender and flat. The tubercular portion is expanded into a transverse shield to beyond the capitular articulation, which thus projects as it were in the midst of a flat plate. These plates have radiating lines of growth to the circumference. which is dentate. Above each rib was a large flat ossification of much tenuity, and digitate on the margins, which appear to represent the dermo-ossification of the tortoises. Two of these bones were recovered, each two feet across. The femur resembles in some measure that ascribed by Leidy to *Platecarpus tympaniticus*. while the phalanges are of great size. Those of one series measure eight inches and a half in length, and are very stout, indicating a length of limb of seven feet at least. The whole expanse would thus be beyond twenty feet if estimated on a Chelonian basis. The proper reference of this species cannot now be made. but both it and the genus are clearly new to science, and its affinities not very near to those known. Not the least of its peculiarities is the great tenuity of all the bones. It may be called *Protostega gigas*.

The greater part of a large *Liodon proriger* Cope was found scattered over a denuded surface at one point, his huge, truncate bowsprit-like snout betraying his individuality at once. Portions of other examples of this reptile were afterwards found. Remains of several species of Clidastes occurred at various points in the neighborhood of Fossil spring. One (*C. dux* sp. n.) was found in the side of a bluff fifty feet above the bottom of the cañon; Martin Hartwell exhumed another near the *C. cinerarum* Cope almost complete.

We subsequently left this locality and encamped at Russell springs on the Smoky Hill, twenty-six miles distant. On the way a large Clidastes of some forty or more feet in length was found lying on a knoll of shale, with the head displaying the palatal surface upwards. On the Smoky our explorations were attended with success. When we shifted camp, it was to go to Eagle Tail in Colorado, whence we returned again to Fossil Spring. The

richness of this locality was again apparent, and we added to our collection a number of species, among these may be mentioned *Liodon ictericus* Cope and a new Clidastes.

The writer originally pointed out the existence of representatives of the orders Pythonomorpha and Sauropterygia, in this Cretaceous basin. Prof. Marsh's explorations determined the existence of Ornithosauria and Crocodilia. The present investigation adds Dinosauria and perhaps Testudinata, or the group the new form Protostega Cope, represents.

The preceding account expresses some points of interest observed. These with others now unnoticed will be included in a final report.

The giants of this sea were the *Liodon proriger* Cope, *L. dyspelor* Cope, *Polycotylus latipinnis* Cope, and *Elasmosaurus platyurus* Cope. Of these the first was apparently the most abundant. The second was the most elongate, exceeding in length perhaps any other known reptile. The last named had the most massive body, and exhibited the most extraordinary appearance in consequence of the great length of its neck.

For kind assistance I am much indebted to Captain Edwin Butler post commandant at Fort Wallace; to Dr. W. H. King post surgeon: and to Captain Wyllys Lyman. To Lieutenant James H. Whitten and Sergeant W. Gardiner who accompanied the expedition much of its success is also due. — Edward D. Cope, *Fort Wallace, Kansas, Oct. 9th*, 1871.

MICROSCOPY.

Ahrens' Binocular.— This instrument, the fourth new binocular brought forward within a few months, was submitted to the Royal Microscopical Society, of London, on the eighth of February last. It is applicable mainly to high powers, being manifestly unable to compete with Wenham's arrangement for low powers. It naturally stands in comparison with the contrivances of Mr. Tolles and President Barnard. Like Dr. Barnard's, which was published some months previously, it separates the light above the objective into two pencils by double refraction by means of Iceland spar, cut and cemented in a somewhat complicated and difficult manner. In other respects the two instruments are entirely different. In the new arrangement the pencils of light pass upward from the prism

at an equal angle on each side of the axis of the instrument, are crossed and at the same time rendered achromatic by wedge-shaped prisms of flint glass placed base to base, and proceed to the two eye-pieces through tubes symmetrically situated in reference to the axis of the instrument, as in Mr. Wenham's early proposals for refracting binoculars. Adjustment for distance of eyes is made, as in Wenham's present arrangement, by a draw-tube movement. In stereoscopic effect, as well as in illumination (only one of the two polarized rays being utilized), the new arrangement is no doubt inferior to Tolles' binocular eye-piece, but it possesses the great advantage of enabling the eyes to look at the object, through the convergent tubes, at the natural angle of near vision. It may be made in the form of an eye-piece applicable to any large stand; or, more satisfactorily, as a supplementary compound body capable of being easily fitted to any stand of suitable size, and of being used interchangeably with the regular body belonging to the stand. — **R. H. Ward.**

Nature of Ciliary Movement. — Professor Haeckel has made some highly important observations on the nature of ciliary movement. as we find in the "Quarterly Journal of Microscopical Science." Recent investigations by others had shown that physiologically the ciliary is much more nearly related to the amœboid movement than to the muscular. Haeckel shows that the ciliary is merely a modification of the amœboid movement of protoplasm. "Ciliated cells are of two kinds. In the one kind, *Epithelium flagellatum*, each cell is provided with a single long flagellum or lash. Sponges possess only this kind; in the other, *Epithelium ciliatum*, numerous hair-like appendages take the place of the flagellum. This is the kind found in most of the higher animals. The old notion, that in ciliated cells the cilia are attached to the outside of the cell membrane, must now be considered as entirely set aside. Many, probably most, ciliated cells are destitute of a membrane, and the appendages, whether flagella or cilia, are direct processes of the protoplasm of the cell." Prof. Haeckel's observations on lower organisms during the last year have led him to the conclusion that ciliated cells arise directly by the transmutation of amœboid cells.

Combination of the Spectroscope and Polariscope. — Mr. Francis Deas has introduced to the Royal Society of Edinburgh

a very curious department of microscopical study, the details of which are published in the "Monthly Microscopical Journal." He combines the spectroscope with the polarizing microscope, in order to analyze the colors given by double refracting crystals when viewed by polarized light. In his arrangement, the light from the mirror passes first through an adjustable slit below the substage, then through a Nicol's prism and the achromatic condenser, and forms an image of the slit on the double refracting crystal on the stage. The dispersion prisms are placed above the objective, and the spectrum is viewed with the eye-piece and analyzing prism. Those who prefer to use the spectroscopic eye-piece, as most do in this country, would dispense with the slit below the substage, and place the analyzing prism over the objective.

A High One-fifth. — Assist. Surg. J. J. Woodward, U. S. A., resolves *Amphipleura pellucida* with a Tolles' immersion one-fifth. This is a high one-fifth, but much less than a one-sixth in power. Angular aperture 110° to 170° according to adjustment. As these lines count ninety-six thousand to the inch, Dr. Woodward expected that it might resolve the sixteenth band of Nobert's plate. He only succeeded, however, in getting through the fifteenth band. This result corresponds with his judgment, based upon other observations, that Nobert's lines are more difficult of resolution than lines of equal fineness on the natural objects usually studied in comparison with them.

Fresh-water Algæ. — Dr. T. C. Hilgard's paper on this subject, read before the Microscopical Section of the American Association at the Indianapolis meeting, was inadvertently omitted from the list of papers published in the Association Number of the Naturalist.

Photographing Histological Preparations. — Dr. Woodward describes in the "American Journal of Science and Arts" for October certain improved methods of using the light of the sun for photographing the soft tissues.

Nobert's Lines. — President Barnard judges that it is not necessary to count the whole of one of Nobert's bands in order to resolve it unmistakably, but only to count a measured portion of a band.

Stanistreet's Lines. — John F. Stanistreet, Esq., of Liverpool. has ruled some stars on glass and steel, the rays of which, some fifty in number, consist of bands of parallel lines two thousand to the inch. The intersection of these different lines gives very curious and beautiful optical effects under the microscope.

Microscopy in Paris. — We learn from the "Quarterly Journal of Microscopical Science" that Hartnack is back at Paris, just as he was before the war. He is about to establish works at Potsdam.

NOTES.

"A very large audience, consisting of the teachers in Boston. assembled early in November, in the new hall of the Massachusetts Institute of Technology to attend the opening of a series of lectures upon Methods of Instruction in Natural History.

As it was the first time this hall had been publicly used, Professor Runkle, President of the Massachusetts Institute of Technology, opened the proceedings and introduced, in a few appropriate words of welcome, Mr. Thomas T. Bouvé, President of the Boston Society of Natural History.

Mr. Bouvé stated that the society which he represented had for many years by its publications and meetings, but more especially by the display of natural objects in its Museum, appealed to the public mind and endeavored to cultivate a taste for science in the community. The Teachers' School of Science was a very appropriate supplement to the other operations of the society and had been in contemplation by several officers of the society for some time past. The present active beginning, however, was due to the generosity of one of these gentlemen who had furnished the pecuniary means for making the necessary collections and paying the lecturers. The enterprise, however, was considered as an experiment to be worked out rather than talked about, and he would therefore without further delay introduce Prof. W. H. Niles, who would deliver the first course on 'Physical Geography.'

Prof. Niles made a few preliminary remarks upon the necessity of teaching science in the schools in a practical manner, and showed that the projectors of the enterprise had no intention of forcing theories upon the minds of the teachers. They simply wished to help, to join with them in their efforts to educate the young, and to place before them such information as their special acquirements in different branches of knowledge would justify.

He then proposed an elementary exercise which should embrace the definition and general relations of natural objects, proposing to teach it as if the audience were a class and he the teacher.

This was unanimously assented to, and he led them, by a series of carefully worded questions, from the definition of what a material body is to the classification of objects into artificial and natural, inorganic and organic, and the subdivision of these into mineral, vegetable and animal.

In a few concluding remarks the lecturer spoke of the general incompleteness of definitions, but also showed that they were essential to the analytical method of teaching, and, when used with the careful exclusion of all doubtful facts, of great use in classifying natural objects.

This principle was amply illustrated by the objects on the table. It was really surprising to witness how much might be done with such simple things as a piece of marble, an apple, a plant, a squirrel, a flask of water, etc., in giving a child the fundamental ideas that govern the distribution and classification of the three great kingdoms of nature. The spirit manifested by the teachers present was evidently very gratifying to the lecturer, and he referred to it twice. If it had not been for their willingness to enter into and help work out the questions, the lecturer would not have succeeded. As it was, so large an audience, about five hundred teachers, was probably never before successfully handled by one man in object teaching. All who are engaged in this experiment, as it was called by the President of the society, have reason to congratulate themselves upon so auspicious a beginning." — *Boston Transcript.*

We learn from one of the committee that they have long recognized the hopelessness of attempting to work upon the public at large by means of the usual lecture system. However effectual this may be as a means of cultivating a taste for natural science, it certainly does not produce any very definite or encouraging results. Collateral study and practical work with specimens are essentials without which mere lectures are very barren to the majority of minds. They have therefore concluded that their efforts should be concentrated upon the public system of education, and here they have been nobly seconded by the teachers, who have come forward to the number of seven hundred and fifty, while an average of nearly six hundred have actually been in attendance at the lectures, which have been given by Prof. W. H. Niles upon physical geography. On this subject the whole class of teachers can be instructed at once, but in subsequent courses upon mineralogy, zoology and botany, it is proposed to divide them into

smaller classes, so that each teacher will be able to use specimens and carry out completely the system of object teaching. The committee hope by so doing, and furnishing the schools, wherever practicable, with type specimens, to meet the immediate wants of teachers, and by introducing them to practical laboratory work, to induce them to pursue for themselves some special branch of natural science. The committee have been greatly assisted in their efforts by the masters of the public schools, especially the chairman of the masters' committee, Mr. Paige, and also by the superintendent of public instruction, Mr. John D. Philbrick. The experiment owes its support at present entirely to the generosity of one of the committee, Mr. John Cummings.

The aims of the committee (consisting of John Cummings, Esq., and Professors A. Hyatt and W. H. Niles) who have projected the entire movement, are wholly practical and will be to a large extent governed by experience. They intend if possible to meet the daily wants of the teachers now, and in the coming winters of 1872 and '73 to develop such a plan as will insure the permanent introduction of the teaching of natural science in the public schools of Boston at least.

We congratulate the Boston Society on so successful an inauguration of science teaching, and believe that it has assumed the most practical form by which teachers can be fitted to teach the rudiments of science. We look forward to similar courses in other cities in connection with the local scientific societies, and thus a defect in our system of education will gradually be remedied.

We may divide the German Museums into — (1) Those founded with the intention of exhibiting objects of Natural History to the general public; and (2) those established for educational purposes. There are not many of the former class. To it belong the Museums of the formerly independent "Reichsstädte," Hamburg, Bremen, and Frankfort-on-the-Main, one of the Vienna Museums, and the collections in Stuttgart and Darmstadt. There are others like that in Mayence, but they have more the character of well-arranged local country museums. Although originally founded for the purpose of exhibiting curiosities, they soon took another position by receiving objects in which the general public takes a very limited interest (as, for instance, botanical, geological, or mineralogical specimens), and by systematically collecting materials for the

purposes of purely scientific research. In several instances the scientific results were sufficiently important and extensive to form not only a nucleus but the sole subject-matter of distinct periodical works, such as the "Annalen des Wiener Museums," the "Museum Senckenbergianum," the "Abhandlungen des Hamburger Museums." The Frankfort Museum became the head-quarters for the Zoology of North-eastern Africa; Bremen possesses a unique collection of African birds, celebrated not only for the great number of standard specimens, but also for their beautiful state of preservation. In the Vienna Museum particular attention was paid to European fresh-water fishes; and travellers like Natterer, Russeger, Kotschy, enriched it with collections so numerous that the Austrian naturalists have been engaged in their examination till within a very recent period. The Stuttgart and Darmstadt Museums are now celebrated for their valuable collections of South-German fossils, worked out by G. von Jäger, Kaup, and others.

In the museums of this class great attention is paid to the local flora and fauna, recent and extinct. Thus the Stuttgart collection may be mentioned as a model of what a museum ought to be; besides a most complete series of the plants and fossils, it contains a collection of the animals of Suabia in all stages of growth and development and of variation, in a perfect state of preservation and particularly attractive from the life-like manner in which the specimens are mounted.— *Nature*.

The Middletown Scientific Association, accompanied by the members and friends of the Springfield Association made an Excursion to Rice's Cut, Reed's Gap and Hamilton Mountain, on Saturday, October 28th. On this excursion, the party numbering about one hundred had an opportunity to observe some of the most remarkable phenomena connected with the trap rocks of the Connecticut Valley, and enjoyed one of the finest views in the vicinity.

The Secretary of the Boston Society of Natural History, Rev. J. A. Swan, died late in October. He was much beloved as a man, and his scholarly attainments and zeal for natural history, made him an efficient officer. His successor has not yet been appointed.

It is stated that Prof. Raphael Pumpelly has been appointed State Geologist of Missouri. Another report states that Prof. Swallow received the appointment. Which is correct?

Prof. E. Claparède, the eminent zoologist of Geneva, died on the 2d of June, at Sienne, Tuscany. He had not yet reached his fortieth year. By his anatomical and systematic works on the lower animals, especially the worms, and illustrated with his facile pencil, he had attained the front rank as an investigator, and his death is a serious loss to science. His principal works were on the Evolution of Spiders, Studies on the Infusoria and Rhizopods, the Formation of the Egg in Nematode Worms, Studies on Acarina, and his splendidly illustrated works on the anatomy of the Worms. He was a pupil of Johannes Müller, and besides a high order of talent, must have been endowed with great powers of application to have produced so much.

We are glad to announce that the Chicago Academy of Science have resumed their meetings and that the members are resolved to go on with their good work at once. At the meeting on Nov. 14, Col. Foster read a paper on the "Colorado Mountains" which will be printed in our January number. Mr. Walker in behalf of the Trustees of the Academy made an informal announcement to the meeting that the Academy would have left from the fire about sixty thousand dollars with which to rebuild, and trusted that a lot would be secured near the lake shore.

BOOKS RECEIVED.

Das Innere von Grœnland. Von Dr. Robert Brown. 4to. 1871.

Beretninger om Norges Deeltagelse i den almindelige Industri—Udstilling og Kunst—Udstillingen i Stockholm 1866, *og Paris* 1867. 8vo. Christiania, 1869.

Carcinologiske Bidrag til Norges Fauna. Af G. O. Sars I. Monographi. Mysider. 4to. 5 plates. Christiania, 1870.

Om Skuringsmærker Glacialformationen og Terrasser samt om grundfjeldets Overfladeforholdets mægtighed i Norge. I. Grundfjeldt. Af Prof. Theodor Kjerulf. 4to. Kristiania. 1871.

Kart over Christiania Omegn med Randtegninger. 1871.

Le Nevé de Justedal et ses Glaciers par C. de Seue [with map and photographic plate of glaciers]. 4to. Christiania, 1870.

Bidrag til Lymphekjertlernes normale og pathologiske Anatomi. Af A. Hansen. 4to. 5 plates. Christiania, 1871.

Meteorologiske Iagttagelser det Sydlige Norge, 1863-6. Folio. Christiania, 1867.

Meteorologiske Iagttagelser paa fem telegraftstationer ved Norges kyst. Folio. Christiania, 1866.

On a Method of Registering Natural History Observations. By Alfred Newton. 8vo. pp. 11, with sample sheet. Norfolk, 1870.

Catalogue of New Species of Birds collected by Dr. Habel in the Galapagos Islands. By P. L. Sclater and Osbert Salvin. 8vo. pp. 8. Cuts. London, 1870.

American Journal of Conchology. Vol. 7. No. 2. Philadelphia. [Nov. 24, 1871.]

Fossil Plants of the Devonian and Upper Silurian Formations of Canada. By J. W. Dawson. 8vo. pp. 100. 20 plates. Geological Survey of Canada. Montreal, 1871.

Bulletin Mensuel de la Société d'Acclimatation. 2e. Tom. 8. Nos. 9, 10. Oct., Nov., 1871. Paris.

On the Connecticut Valley Glacier, and other Examples of Glacier Movement along the Valleys of New England. By James D. Dana. 8vo. pp. 12. New Haven, 1871.

Plantas Toxicus do Brasil. These de Concurso. Do Dr. J. M. Camiuhoa. 8vo. pp. 186. Rio de Janeiro, 1871.

Quarterly Journal of Microscopical Science. No. 45. Oct., 1871, London.
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Journal of the Franklin Institute. Nov.
Amer. Journal of Science and Arts. Dec.
Land and Water. Nos. for Oct.
The Academy. Nos. for Nov.
La France Scientifique. Nos. for Nov.
Bowdoin Scientific Review. Nov.
Le Naturaliste Canadien. Nov.
Nature. Nos. for Nov.
The Field. Nos. for Nov.
Science Gossip. Nov.
Newman's Entomologist. No. 97, Nov.

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