caused fractures in many of them. Sections still further south illustrate the greater pressure and consequent larger irregularities in position with similar overturns. Prof. Hitchcock thought this theory of origin and method of disturbance, though involving numerous fractures, would enable geologists to understand perfectly the structure of the whole ground covered in the Taconic controversy.

In conclusion, the speaker remarked that these views would confirm the sections he had drawn across the Green Mountains, giving to that range an anticlinal form, whether exhibited naturally or inverted.

The Vice President announced that Prof. James Orton proposed to make a third South American exploration, and had selected the Rio Beni, as promising results of the greatest importance. It was voted that the chair appoint a committee of three to prepare a proper expression of the Society's interest in the proposed survey; and Messrs. Niles, Kneeland and Burgess were accordingly appointed.

November 17, 1875.

The President, Mr. T. T. Bouvé, in the chair. Fifty-nine persons present.

The following paper was read: —

Embryology of Salpa. By W. K. Brooks, Ph.D.

Students of the embryology of the various forms of Tunicata are so numerous and active at present, that the naturalist who refrains from publishing any new facts which he may acquire until the figures necessary for their illustration can be prepared, is very apt to find that they are no longer new. The following brief abstract of the more important points in the history of the development of Salpa has therefore been drawn up and presented to the Society, as the precursor of a more extended description which is now in preparation.

At the time when the Salpa-chain escapes from the body of the solitary form, each individual of the chain contains one ovum, which is inclosed within a capsule of epithelial cells, and is suspended in the sinus system of the "zoöid" on the neural side, between the stomach and the atrial orifice, by means of a gubernaculum, by which it is attached to the wall of the branchial sac. (See Figure I.)

The ovum shows no trace of a vitelline membrane; the yolk is composed of transparent protoplasm without granules, and the germinal vesicle contains no dot, but seems to be homogeneous.

Impregnation takes place through the action of the spermatic filaments which are discharged into the water by the "zoöids" of other fullgrown chains, are drawn into the branchial sacs of the immature "zoöids" which contain the eggs, and penetrate into the interior of the gubernaculum.

Upon impregnation the germinative vesicle disappears; the gubernaculum becomes irregularly swollen and shortened, thus drawing the egg down into the brood-sac, which is formed by an involution of the branchical sac of the nurse (Figure II). The egg, nourished by the blood which bathes it, rapidly increases in size, and undergoes a process of *total* segmentation, as the result of which two portions are formed; a finely segmented "germ yolk," and a less completely segmented "food yolk." (Figure V.)

The latter becomes enveloped by the former through a process of invagination, forming a true "gastrula" or "invaginate planula," the opening of which, the "orifice of Rusconi," persists and forms the orifice of the placenta. (Figures VI, VII, VIII, *f*.)

The embryo, still growing rapidly, becomes divided into two portions by a constriction (Figure VII) ; the portion nearest the point of attachment to the brood sac forms the embryo proper, and the remaining portion that part of the placenta which is to be in communication with the sinus system of the fœtus. (Figure VII.)

Within this portion there is a cup-shaped cavity, part of the original "cavity of Rusconi," which is in direct communication with the sinus system of the nurse, and thus forms the second or inner chamber of the placenta. This soon becomes divided up into a great number of irregular intercommunicating lacunæ, which are produced by the growth of a structure resembling a stump with its roots, and which seems to be formed directly from the blood of the nurse, by the aggregation and fusion of the blood corpuscles.

The subsequent development of the fœtus, which is the young of the solitary salpa, is substantially as it has been described by Sars, Krohn, Vogt, Huxley, Leuckart and others, and I have been able to add little to what is known upon the subject.

The atrium of Salpa has been supposed to lack those lateral portions which, in most Tunicates, lie upon the sides of the branchial sac and are called the lateral atria; but at an early stage these seem to be present, as well as the mid-atrium, but the cavities of the lateral atria never become connected with that of the branchial sac by the formation of branchial slits; and at a very early period of development the walls of each lateral atrium unite, thus obliterating the cavity, and giving rise to a broad layer of tissue upon each side of the body, between the branchial sac and the so-called "muscular tunic," the "outer tunic" of Huxley.[1] Rows of transverse splits soon appear in these layers, which thus become divided to form the muscular bands, which latter subsequently become united to the inner surface of the outer tunic. (Fig. VIII, *m.*)

The sides of the mid-atrium become united at two points, one on each side, with the posterior surface of the branchial sac, and as the atrial and branchial tunics are free from each other between these regions of union, a median longitudinal sinus is thus formed which is the "gill" or "hypopharyngeal band." The central portions of the two regions where the tunics are united, are soon absorbed, and a single branchial slit is thus formed on each side of the "gill."

The earliest stages in the formation of the atrial chamber were not observed, but nothing was seen which seemed to indicate that it is formed, as in most Tunicates, by tubular invaginations of the outer wall of the embryo.

The cavity of the œsophagus is a prolongation of that of the branchial sac, and was in direct communication with this at the mouth when first observed. The stomach is formed as a diverticulum from the side of the œsophagus, and the cavities of the two were connected at all the periods observed, but the cavity of the intestine originates independently, and at first is closed at both ends; the partition between it and the stomach disappears first; that at the anal or atrial end persists some time longer.

The few facts which I have been able to add to what is known of the development of the salpa chain relate, for the most part, to the earliest stages in the development of this, which has always been considered the sexual generation; and seem to prove that the solitary

[1] This "outer tunic" must not be confounded with the "cellulose test" o Huxley, which covers it.

salpa is the female, and the chain salpa simply the male, which does not reproduce, but simply serves to fertilize and nourish the egg, so that we have, not an alternation of generations, but a very remarkable difference in the form and mode of origin of the two sexes.

The tube or stolon which is to form the chain first appears as a protrusion or diverticulum from the outer or muscular tunic of the solitary salpa, directly opposite the heart; this protrusion rapidly increases in length, and soon presents the form of a long tube closed at its distal end, projecting into the test, and with its cavity in direct connection with the cavity of the sinus system (the body cavity) of the solitary salpa, so that the blood of the latter enters and circulates freely within it. (Figure X.)

A second tube with very thick walls and a very narrow cavity now grows out from the pericardium, crosses the sinus and penetrates the cavity of the outer tube almost to its tip or blind end, and soon becomes flattened and its edges unite with the walls of the outer tube, which thus becomes divided into two chambers, which are entirely separate from each other except at the tip. The blood now passes into one of these chambers at its base, and is driven up to the blind end where it passes around the partition, back through the other chamber to the sinus of the parent. It is of course unnecessary to state that when the circulation of the parent is reversed that of the stolon changes also.

By the formation of the partition above described the tube is divided longitudinally into halves, and each half is destined to be converted into the series of " zooids" on one side of the chain. The outer wall of the tube, which has been shown to be part of the muscular tunic of the parent, becomes the muscular tunics of the "zooids"; the chambers, which are continuous with the sinus system of the parent, form the body cavities or sinus systems of the "zooids," and the central tube, which is a prolongation of the pericardium of the parent, forms the nervous, digestive and branchial organs of the " zooids " of the chain. It is probable that the cavity of this inner tube gives rise to lateral diverticula, which form the cavities of the digestive organs and branchial sac of the young, but this point could not be determined with certainty, nor could any connection between the cavity of this inner tube and any of the cavities of the parent be discovered.

Before the tube becomes differentiated into the organs of the " zooids," in fact, before there are any indications that the tube is to give rise to the chain, two new organs are formed, one in each of the sinus chambers of the stolon. These new organs are long club-shaped masses of protoplasm, which are not at first attached to the tube, but are free within the chambers, and do not seem to be derived from any of the pre-existing parts of the solitary salpa, but are formed directly from the blood. As the tube grows these organs lengthen as well, and soon a row of germinative vesicles is seen extending along each of them; they are the ovaries. (Figure X, *x*.) At the time that the constrictions, which are the first indications of the "zooids," make their appearance on the outer wall of the tube, each ovary is seen to be made up of a single row of eggs, equal in number to the constrictions which indicate the number of the future "zooids," and as these latter are developed, and their sinus systems become separated from the common cavity of the tube, the chain of ova divides, so that a single egg passes into the sinus system of each "zooid," and becomes suspended there by a gubernaculum, by means of which it is attached to the wall of the branchial sac, as already described.

Since the chain salpa at birth always contains an unimpregnated ovum, organically connected with its body, and since this egg and the resulting embryo are nourished by the blood of the chain salpa by means of a placenta, and since no reproductive organs have ever been observed within the body of the solitary salpa, it seems most reasonable to accept the belief that the solitary salpa is the asexual, and the chain salpa the hermaphrodite sexual generation, and that the developmental history of the genus presents a true example of "alternation of generations." When, however, we have traced backward the history of one of the "zooids" which compose a chain, and find that the egg is present at all stages of growth, and is of exactly the same size and appearance as at the time of its impregnation; when we find one organ after another disappearing, until at last we have nothing but a faint trace of a constriction indicating upon the wall of the stolon the position of the future "zooid," the conclusion seems to be irresistible that the animal, which has as yet no existence, cannot be the parent of the egg which is already fully formed.

The life history of Salpa may then be stated in outline as follows: The solitary salpa is the female, and produces a chain of males by budding, and discharges an egg into the body of each of these before birth. These eggs are impregnated while the "zooids" of the chain are very small and sexually immature, and develop into females which give rise to other males in the same way.

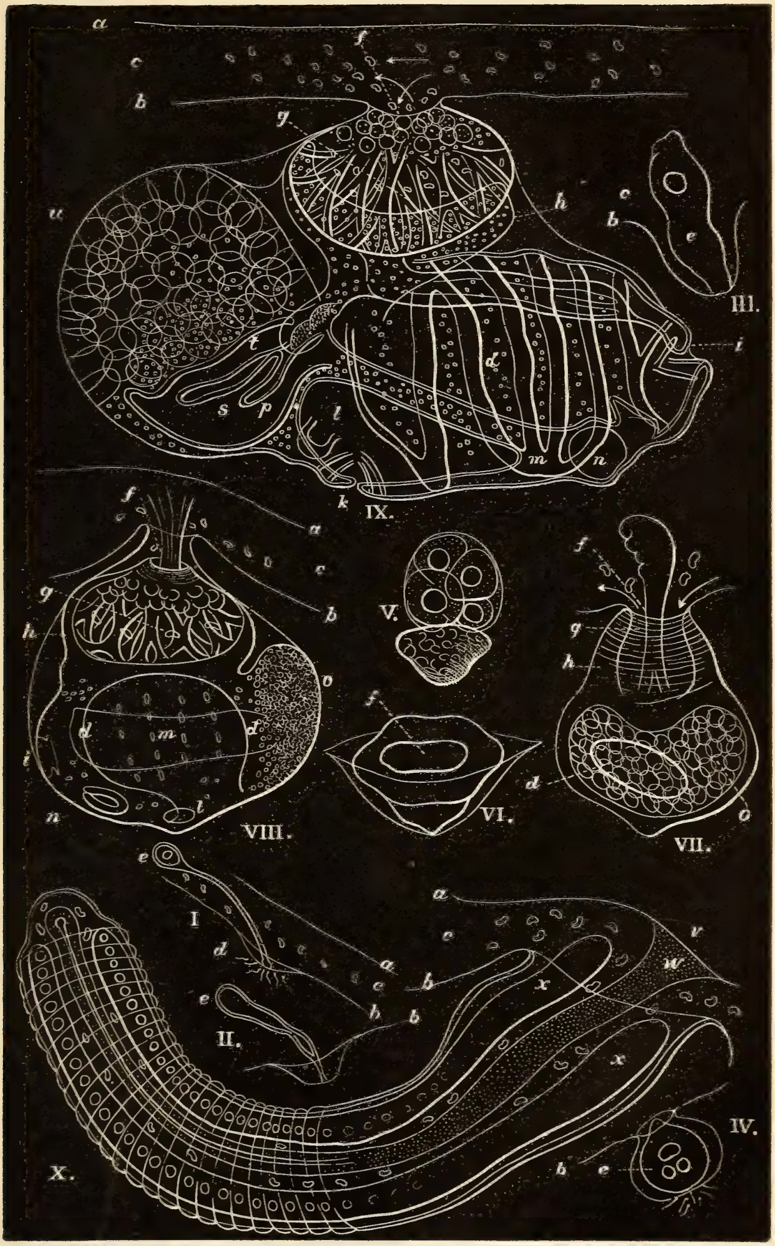
After the fœtus has been discharged from the body of the male the latter attains its full size, becomes sexually mature, and discharges its spermatic fluid into the water to gain access to the eggs carried by other immature chains.

The fact that impregnation takes place, not, as we might expect, within the body of the solitary, but within that of the chain salpa, is no objection to this view, for the number of animals whose eggs are fertilized within the body of the female is quite small, and in at least one genus, Hippocampus, the eggs are received into a specialized brood sack in the male, and are there impregnated.

We can also find analogy for the singular fact that the eggs always develop females, while the males are formed by budding. The fertilized eggs of the bee always give rise to females, while the males are developed by the virgin bee, through what seems, as pointed out by Prof. McCrady, to be most properly regarded as a process of internal gemmation; and we cannot fail to mark the very striking parallelism between the process of reproduction as manifested in Salpa and the bee.

The fertilization of the eggs within the bodies of "zooids" produced by budding from the body of that whose ovary gave rise to the eggs is not unusual among the Tunicata. The "zooids" of most of the Tunicata are hermaphrodite, and develop eggs of their own, but, at least in the case of Pyrosoma, Perophora, Didemnium and Amauricium, the egg which undergoes impregnation and development within the body of the "zooid" is derived, not from its own ovary, but from that of the generation before, and the eggs produced in the body of the second generation must pass into the bodies of the "zooids" of the third generation before they can be fertilized. The essential difference between this process and that presented by Salpa, is that in Salpa the sexes are distinct, and as the chain salpa has no ovary the process of budding stops with the second generation; while as the "zooids" of the other Tunicata are hermaphrodite the process may go on indefinitely.

The history of Salpa is of especial interest, as it throws a great deal of light upon the manner in which separation of the sexes may be brought about in forms which were originally hermaphrodite, and it is also interesting to note that the elæoblast, the history of the development of which shows it to be the homologue in the female of the testicle of the male, is concerned in reproduction, although it has lost all the characterstics of a sexual organ, and is simply a supply of food.



W. K. BROOKS. EMBRYOLOGY OF SALPA.

We cannot fail to notice the connection between the manner in which the male salpa is produced, and the numerous cases, through the various groups of the animal kingdom, in which the male is, to some extent, parasitic upon, or supplemental to, the female.

The Cirrhipeds, Arachnids and the Argonaut, will at once suggest themselves, as familiar instances of the occurrence of such a relation between the sexes.

These interesting theoretical points are simply mentioned here, as a more exhaustive discussion of them is reserved for another place.

EXPLANATION OF PLATE I.

The small letters have the same signification throughout.

a. Wall of branchial sac.
b. Wall of outer tunic.
c. Sinus cavity.
d. Branchial cavity.
e. Egg.
f. Opening of inner chamber of placenta.
g. Cavity of inner chamber of placenta.
h. Cavity of outer chamber of placenta.
i. Branchial aperture.
k. Atrial aperture.
l. Cavity of atrial chamber.
m. Muscles.
n. Ganglion.
o. Nucleus.
p. Œsophagus.
s. Stomach.
t. Intestine.
u. Elæoblast.
v. Pericardium.
w. Inner tube of stolon.
x. Ovary.

Figure I. Egg within the sinus system, and attached by a gubernaculum to wall of branchial sac, within the cavity of which a few spermatic filaments are seen.

Figures II, III, IV and V. Successive stages of segmentation.

Figure VI. Gastrula within the brood-sac.

Figure VII. Embryo, soon after the primitive digestive cavity has become divided into the branchial and placental chambers.

Figure VIII. Embryo considerably advanced, showing the mid-atrium, *l*, and one of the lateral atria, *m*, which has already begun to split and form the muscles.

Figure IX. Embryo at about the time that the stolon appears.

Figure X. Stolon, at a very early stage, showing the ovaries, *x*, *x*; [in this figure the letters *a* and *b* were accidentally transposed, so that *b* represents the outer tunic, and *a*, the branchial sac].

The President, with a few warm words of welcome, then introduced Professor James D. Dana, who, after some general remarks on the subject, read a paper on the relations of Pseudomorphism to Metamorphism, in reply to Prof. T. Sterry Hunt's criticisms published in the Proceedings of the Society for June 2, 1875.

Professor Dana stated his objections to various statements in Professor Hunt's article, gave his reasons for denying that he held, or had held, the views which Professor Hunt had attributed to him, and stated that if Mr. Hunt had admitted in 1871 that Prof. Dana's Manual of Geology contained a fair exposition of its author's views on Metamorphism, the controversy would never have had a beginning.

Dr. Sterry Hunt responded that, as Prof. Dana had declared that his earlier expressions as to the relations of Pseudomorphism to Metamorphism had been misinterpreted, and that he had never, to his knowledge, held the views attributed to him, although he did not complain that under the circumstances a misapprehension had in the first place occurred, he (Dr. Hunt) was free to say that he regretted the misapprehension on his part, and that it is now evident that Prof. Dana's Manual of Geology of 1863 correctly expresses the author's views.

The Secretary presented by title, "A Prodrome of the Tabanidæ of the United States," Part II, by C. R. Osten Sacken, which will appear in the Society's Memoirs.

The Custodian announced the gift, by Capt. Charles Bryant, of a fine skeleton and a skull of the Sea-lion, and skeletons of two Fur-seals, for which the thanks of the Society were voted.

Section of Entomology. November 24, 1875.

Mr. George Dimmock in the chair. Nine persons present.

Mr. B. P. Mann exhibited male and female specimens of *Anisopteryx vernata*, one of the males having undeveloped wings, and male and female specimens of *A. pometaria*, including three males with undeveloped wings and one female with wings partially developed.

The latter specimen is a much more striking example of the possession of wings by a female than the one described in these Proceedings, xvi, 163–165. The right hind wing is nearly as much developed as the corresponding wing in the normal males, the other wings are more developed than in the specimen formerly described; the antennæ are pectinated, but the female showed no signs of hermaphroditism.

In connection with the exhibition of these specimens, Mr. Mann called attention to an article just published by Mr. Riley in the Trans. St. Louis Acad. Sci., in which Mr. Riley gives in detail the characters drawn from every stage of life of these two species, showing that the differences in character of each stage would be of specific value, independently of the characters in the other stages, if no intermediate forms were found, which thus far has been the case

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December 1, 1875.

Vice President, Mr. S. H. Scudder, in the chair. Twelve persons present.

Mr. Scudder gave a short account of the geographical distribution of *Vanessa cardui* and *V. atalanta*, the two most widely ranging species among the butterflies. The former had been hitherto supposed by entomologists to be of European origin, but the speaker showed that the group of Vanessa to which it belonged was confined to the American continent, where he believed therefore that *V. cardui* was really indigenous.

Dr. Chas. Pickering observed that *V. cardui* was not found in the Hawaiian Islands at the time of his visit in 1840, and probably not in Tahiti.

Dr. J. B. S. Jackson exhibited, and presented, a portion of a tree trunk from the submarine forest at Provincetown.

The following paper was read:—

Notes on some Fishes and Reptiles from the Western Coast of South America. By S. W. Garman.

The specimens from which the following notes are taken were collected at different points along the coast from Peru to New Grenada. The collection was made for Mr. Alex. Agassiz, and by him given to the Museum of Comparative Zoology. It is especially interesting on account of the representatives of recently described and new species it contains.

Fishes.

Gobius transandeanus Günther.

Eighteen specimens were obtained at San Jose, one of the Pearl Islands. They were found to be numerous in the pools left by the tide on the shores.

Batrachus pacifici Günther.

One specimen from the island San Miguel. When removed from its hiding-place, under a rock on the beach some distance above low tide, the animal grunted so lustily as to be heard at a distance of a couple of rods.

Thalassophryne reticulatus Günther.

From the Bay of Panama. Presented by the well known naturalist, Capt. J. M. Dow.

Atherinichthys microlepidota Günther.

Coast of Peru.

Mugil Rammelsbergii Tschudi.

The two preceding are very common species on the Peruvian coast. They were the most abundant fishes in the market during the months of December and January.

Sicyases Petersii sp. nov.

Dorsal fin with six rays; anal six. Incisors tricuspid, eight nearly vertical upper, six oblique lower; at each end of the series, above and below, are two curved canines, of which the posterior is the longer. Head as broad as long, prominent in front of the eyes. Subopercular spine medium. Body wedge-shaped. Skin tough, naked. One third of the base of the dorsal anterior to that of the anal. Color olivaceous brown, with a series of six or seven dark brown spots on the back, and twice as many triangular ones on the lower half of the sides. From the eye there are three white bands, two over the opercle, and one, to the end of the muzzle, on the lip. Belly whitish, uniform. A band of brown crosses the caudal fin. In some specimens the markings are very obscure. Length 1.3 inches (33 mm.).

Sixteen specimens, from San Jose, San Miguel and Saboga. These fishes were numerous in the little pools among the rocks on the shores of these islands. On being hard pressed by attempts at capture they would run to the water's edge, and by jumps of considerable length, throw themselves into the water again at some distance from the point of attack. A wet surface on which there was no appreciable depth of water connected two small basins which were about two feet apart; this was traversed several times by some of the fishes before they could be taken. After the water had all escaped from the pool they were to be found hidden under the coarse sand in the bottom.

This species is brought into notice in the name of the very eminent zoologist, Dr. Wilhelm Peters of Berlin.

The known species of the genus are

S. sanguineus Müll. u. Trosch. Chili.
S. chilensis (Barnev.) Günth. Chili.
S. fasciatus Peters. Caribbean Sea.
S. Petersii sp. nov. Bay of Panama.

Sternopygus carapus Günth.

The scales on these fishes are invisible until the mucus which covers them is removed. They were very abundant in the Guayaquil River. Great numbers were taken by the natives with large dip-nets, at the mouths of little creeks and inlets as they came in with the tide.

Muræna melanotis Günth.

Numerous amongst the Pearl Islands.

Batrachians.

Bufo agua Latr.

Specimens which were rough with small spines, and others quite smooth, were taken from a pond on the island Saboga.

Reptiles.

Phyllodactylus tuberculosus Wiegmann.

Fourteen rows of tubercles. A band of brown from behind the eye over the ear, and traces of six transverse bands on the back between the occiput and hips; these are probably more distinct in the young. Two specimens from the Daule River, Ecuador.

Anolis sp.

Small, form slender. Head narrow; muzzle long. Tail very slender, more than twice as long as the head and body, with larger scales on its upper surface. Scales keeled on body, head and tail; those of the abdomen larger, of the sides granular. On the back the hexangular scales of the median series are larger than those of the sides. Goitre small. Back and nape simple. Posterior limb and foot as long as the head and body; anterior as long as the body from shoulder to hip. Expansions on the toes very slight. Supra-orbital series of eight scales, separated from each other by two series, and from the small oval occipital by four. Upper labials eleven. Colors reddish brown and green, bronzed; with a series of elongate, more or less confluent brown spots on each side of the dorsum from the ear to the tail. Indistinct bands of brown on legs and tail. Head darker than body; ventral surface lighter. Total length, 5.5 inches. Body, 1.7 inches. From Saboga, two specimens.

Microlophus peruvianus Gray.

Dark colors in transverse bands. Just above and in front of the thigh there is a brick-red band reaching forward to the middle of the flank. The large occipital is surrounded by a series of medium sized plates; a diminishing series of four or more extends laterally from its sides. A young specimen and an adult with eggs were obtained at Lima, Peru.

Liophis bicinctus Dum. et Bibr. Var.?

Body stout. Head little larger than the neck. Tail short, strong. Cephalic plates normal; rostral medium, wider than high; frontals and prefrontals wider than long; vertical hexangular, broad; loral small, quadrangular; one preocular; two postoculars; temporals one and two; upper labials eight, fourth and fifth in contact with the eye; lower nine, fifth pair largest; anterior pair of inframaxillaries twice the size of the posterior. Eye moderate, lateral; pupil round. Posterior maxillary teeth larger, smooth, separated from the others by an interspace. Dorsal scales nearly as wide as long, smooth, in twenty three rows. Abdominal scutellæ two hundred and eight. Anal entire. Subcaudals thirty-nine pairs.

Colors red, black and white, in transverse rings. Body encircled by sixteen rings of red, from six to fifteen scales in width, separated by fifteen pairs of black rings, from two to three scales wide, each pair enclosing a single white ring from three to five scales in width. Each scale in the white has an oval spot of black in its centre. These rings extend quite around the body; the black grow narrower on the abdomen. All the shields of the head are marked with black; the rostral has a spot in its centre; a large spot covers the junction of the first pair of lower labials with the inframaxillaries, and a wide band passes over vertical and supraorbitals through the eye on the fourth and fifth labials. A narrow band of black, two scales wide, passes around the head behind the occipitals, and in front of the first band of red fifteen scales in width. Total length, 30.5 inches; tail, 3.4 inches.

From the Daule River, Ecuador, one specimen.

Brachyryton clœlia Dum. et Bibr.

Daule River, Ecuador.

Leptognathus nebulatus Günth.

In both specimens the dark bands are margined with white; one has a rudimentary anteorbital below the loral on each side. Length of one example, 16.5 inches; tail, 4 in. This specimen has one hundred and ninety-three abdominals and eight pairs of subcaudals. Daule River, Ecuador.

Eteirodipsas annulata Jan.

One of these specimens is quite young, and has the brown of the back and sides in continuous longitudinal bands; excepting slight sinuations in the anterior portion of the dorsal band, there is no indication of the spots. Daule River, Ecuador. Seven specimens.

Elaps Dumerili Jan.

Its common name, "Culebra coral," or Coral snake, is applied to all red banded snakes, of whatever genus or family. No band of lighter color on the head in front of the eyes. The black of the head extends upon the lower labials.

Bothrops pictus Jan.

One specimen from Lima, Peru.

Section of Microscopy. December 8, 1875.

Mr. E. Bicknell in the chair.

The following paper was read: —

A Contribution to Microgeology. By Charles Stodder.

The "infusorial deposit" of Richmond and other Virginian localities was discovered by Prof. W. B. Rogers about 1842 (Am. Journ Sci., vol. xliii).

Prof. J. W. Bailey gave (in Am. Journ. Sci., 1844, 5) descriptions and lists of various organic forms found by himself and by Ehrenberg in this deposit. Ehrenberg also published from time to time, and especially in his great work, Microgeologie 1852, accounts of his discoveries. Since then the Richmond earth has been a subject of interest to geologists and micographers throughout the scientific world. At various times eminent microscopists both in Europe and America have discovered, and added to the lists, a new species that had escaped the searching of Bailey and Ehrenberg. But from all that has been published by either of those renowned micographers and all their successors, there has been an important omission. The stratum containing the fossils in Richmond is stated generally to be twenty feet thick. In all the published accounts that I have seen there has been no mention of the depth in the stratum from which the specimens were taken. A deposit of microscopic vegetable and animal remains of twenty feet in thickness, from twenty to eighty per cent. only being mineral, would require a long period of time — ages probably — for its accumulation. During all that time were the conditions of life such as to maintain the existence of the same species and genera? or were there changes of climate or physical conditions sufficient to induce changes in the species and genera? Nothing that I have been able to find in the literature of the subject throws any light on the question.

For some years I have been endeavoring to obtain authentic specimens of the deposit that might give some information on the question, but without success until the last year, 1874, when Mr. R. B. Tolles visited Richmond, and with considerable trouble and annoyance procured from Shockoe Hill (one of the well known localities) seven specimens from as many different layers of the deposit.

The locality is a ravine on the westerly side of the hill. The specimens were taken from the southerly side of the ravine at five feet, seven feet, seven and one-half feet, ten feet, eleven feet and fourteen feet below the top of the bank; besides one from the north side forty feet below the top, from a bed apparently the continuation of the fourteen feet bed on the opposite side, the hill being higher on the north side. The first specimen, at five feet depth, was surrounded by the roots of a large tree standing on the summit of the bank, and contains numerous vegetable fibres.

All the specimens are similar in appearance (except that from fourteen feet in depth, which is much darker) of a light drab color very like clay, very low specific gravity, a little heavier than water, and more or less stained, apparently by iron, which seems to act as a cement. Now they are dry they are hard, but not so hard that they cannot be crushed in the fingers. The forty feet specimen from the northerly side has the darker color of the fourteen feet sample.

I have cleaned and prepared for microscopic study portions of the five feet, eleven feet, fourteen feet and forty feet samples. Some are more difficult to clean than others, the iron cement adhering very tenaciously, and being very difficult to remove.

The upper layers present, as might be anticipated, more differences from the others than they do from each other, viz., there is a smaller proportion of organism, and larger of mineral, I estimate about twenty per cent. organic and eighty per cent. sand, with many vegetable fibres and roots. The diatoms are in a more perfect condition, a larger proportion being whole and uninjured, while in the deeper layers they are more broken, the fine fragments of the siliceous valves exceeding in bulk the entire or whole frustules. The lower layers contain from fifty per cent. to eighty per cent. of organic forms of which the Diatomaceæ constitute by far the greatest part.

The deeper we go, the larger is the proportion of debris or broken frustules. There was so little variation in the contents of the specimens examined that I have not undertaken the great labor of cleaning the other specimens.

I annex in a tabular form a list of the species identified in the different layers. From this it will be seen that there is no essential change of forms from the lowest until we come to the upper or five feet layer, indicating that during all the time required for the gathering of this great accumulation of these minute remains there were no great changes of physical conditions to influence the life and growth of these forms. The five feet layer then gives indications that some changes were taking place, by the disappearance of genera or species that flourished in earlier periods.

Miocene Richmond Infusorial Deposit.

DIATOMACEÆ.	5 ft.	11 ft.	14 ft.	40 ft.
Actinoptychus senarius		o		o
" biternarius	o	o		
Omphalopelta punctatus	o	o		
" versicolor		o		
Actinocyclus Ehrenbergii			o	
Coscinodiscus radiolatus		o		
" punctatus, oval and spherical varieties.	o	o	o	o
" lineatus		o	o	
" velatus	o	o		
" marginatus	o	o		
" radiatus		o	o	
" gigas	o	o	o	o
" oculis-iridis	o	o	o	
" perforatus	o			
" centralis			o	
" subtilis		o		
Systephania corona		o	o	o
Aulacodiscus crux	o			
Craspedodiscus coscinodiscus	o	o	o	o
Asterolampra Brebissonii Greg.		o	o	
Eupodiscus Rogersii	o			
Endictya oceanica				o
Pyxidicula aculeata		o		
Stephanopyxis diadema		o		o
" apendiculata		o	o	
Xanthiopyxis globosa		o		o
" hirsuta		o		
" oblonga				
Rizosolenia americana	o	o	o	o
Goniothecum odontidium	o	o	o	o
" Rogersii	o	o	o	o
Dicladia capreolus			o	
Chætoceros sp.		o		o
Biddulphia Toumeyii	o	o	o	o
Triceratium reticulum		o		
" undulatum		o		
" condeconum		o		o
" obtusum	o		o	o
" marylandicum		o	o	o
Mastogonia actinoptychus	o			
Rhaphoneis amphicerus		o		
Grammatophora marina		o		
" africana		o		
Navicula (Pinnularia) perigrina		o	o	
" viridis		o	o	o
" viridula				o
Pleurosigma = Nav. sigma Eh.—very like P. angulatum.		o	o	o
Stephanogonia polygonia.		o		o
Orthosira marina W. S. = Galionella sulcata Eh. .	o	o		
Fragilaria pinnata		o		
RHIZOPODS.				
Actinisceæ — Actiniscus pentasterias	o	o		
Dictyocha crux	o			
" fibula	o			
Mesocenia diodon	o			
Polycistinæ, various	o			o
Phytolitharia Eh.—Spongolithis accicularis, S. caputserpentis; spines of Polycistinæ, Acanthometra and others	o	o	o	o

It has not been thought advisable to attempt to identify all of Ehrenberg's species, as his plan was to found a species upon any variation in the number of rays in the circular forms of the Diatomaceæ, a principle now generally rejected.

One striking fact is the great abundance in all the layers of *Galionella sulcata* Eh. = *Orthosira marina* W. Smith, which is more numerous in some slides than all the other forms together.

December 15, 1875.

The President, Mr. T. T. Bouvé, in the chair. Sixteen persons present.

The following papers were read: —

Ancient Hearths and Modern Indian Remains in the Missouri Valley. By W. J. Hoffman, M. D.

ANCIENT HEARTHS.

The Military Station at Grand River, D. T., is situated upon the western bank of the Missouri River about midway between Fort Sully and Fort Rice: approximate location, long. 100° 12′ W., lat. 45° 31′ N. About three hundred yards from the river the bottom-land is walled in by a range of bluffs, about one hundred and twenty feet in height, the upper surface of which corresponds to the level of the surrounding prairie. Three quarters of a mile below the station, Oak Creek empties into the Missouri River, thus forming a low head-land or spur, the ridge of which still bears evidence of aboriginal occupancy. Grand River empties into the Missouri from the west also, three miles below the station, where the Mound Builders once threw up earthworks, traces of which are still visible.

During the spring flood of 1873 about twelve feet of the embankment at the station was washed away, exposing to view two distinct river beds. The height of the embankment is twenty-two feet. The upper stratum, which was composed chiefly of sand and gravel, was ten feet thick, resting upon the fine sand of the upper surface of the second stratum. Throughout the bottom of the upper stratum was deposited an indiscriminate mixture of branches, trunks and stumps of trees, consisting chiefly of cottonwood, oak and cedar. The second stratum was six feet thick, also consisting of coarse sand and gravel,