receive the pollen, or whether there is a stigmatic surface between them under the disks, or both. But neither of these two species show any evidence of being self-fertilized in the bud. In *G. tridentata*, the species now in hand, the three elongated and somewhat clavate stigmatic bodies or processes, which are nearly alike, ascend, one on the outside of each anther-cell, and one between the two cells, to considerably above the level of the almost horizontal anther; their surface is loosely cellular and slightly viscid, so that the pollen-packets stick to them readily: all three, as already remarked, act functionally as stigmas. But also, underneath the disks and the common origin of the three stigmatic processes, I find a green surface, in position and character just like the stigma in *Orchis* and *Platanthera* except that (so far as I have observed, in unexpanded or freshly expanded flowers) it is only very slightly viscid. On application, few or no pollen-packets are left sticking to it, while they stick in considerable numbers to the upper part of the "processes." From the appearance, thus far, I should suppose that this normal stigmatic surface had become functionless. But, on the other hand, the large disks are in perfect condition; in the expanded flowers they adhere to a bristle or other body, and are thus removed from the shallow cups in which they rest, bringing away the caudicle with the considerable portion of the pollen-packets which still remain attached: the caudicle effects a prompt movement of depression, and now, if the bristle be returned to its position at the entrance of the spur, the pollen-mass will strike this broad ordinary stigmatic surface. The examination of older flowers may be expected to settle the question. But it is certain that the three linear club-shaped bodies act as stigmas.

In a systematic point of view, it is evident that the *Ophrydeæ* with naked disks need to be studied and arranged anew, upon living plants. But the forms cannot be clearly described and correlated until the morphology and terminology of the parts of the column have been reconsidered and elucidated. A. G.

ZOOLOGY.—

7. *Monograph of the Aye-Aye* (*Chiromys Madagascariensis* Cuvier); by RICHARD OWEN, D.C.L., F.R.S., &c.—The curious animal which forms the subject of this monograph, was first noticed in Madagascar by Souverat in 1780, and owes its name to an exclamation of astonishment uttered by the natives of the east coast, to whom, it is said, he exhibited it for the first time. Souverat brought home with him a stuffed skin and a cranium, which have since remained in the museum of the Garden of Plants, the only representatives of the species in European cabinets. Zoologists have been puzzled as to the true affinities of the Aye-Aye, some placing it among the Rodents, and others among the Quadrumana. Buffon assigned it a position in the former group, and in so doing was followed by Cuvier, who at the same time distinctly stated that it "is related to the Quadrumana in more points than one." In view of these differences of opinion, it is easy to see how desirable whole specimens were.

Science is indebted to the Hon. H. Sandwith, M.D., for the specimen, preserved in spirits, which forms the subject of the present investigation. This has enabled Prof. Owen to determine definitely its position among

the Lemuridæ, and at the same time add another to the admirable series of monographs by which the great English anatomist has contributed so largely to the progress of zoology and physiology in our day.

However remarkable the mingling of Rodent and Quadrumanous characters may be in the Aye-Aye, they are surpassed in the correlations of physical structure and strange habits. "The wide openings of the eyelids, the large cornea and expansile iris, the subglobular lens and tapetum, are arrangements for admitting to the retina and absorbing the utmost amount of light which may pervade the forest, at sunset, dawn, or moonlight. Thus the Aye-Aye is able to guide itself among the branches in quest of its hidden food. To detect this, however, another sense had need to be developed to great perfection. The large ears are to catch and concentrate, and the large acoustic nerve and its ministering 'flocculus' seem designed to appreciate any feeble vibration that might reach the tympanum from the recess in the hard timber, through which the wood-boring larva may be tunneling its way by repeated scoopings and scrapings of its hard mandibles." The food of this nocturnal animal, to whose strange physiognomy the eyes and ears add so much, consists mostly, as was ascertained by Souverat, of wood-boring grubs. To extract these, there are, united with the common Lemurine characters, chizel-shaped incisors, resembling those of Rodents, and a most remarkable modification of the middle finger, which is not only used for eliciting by percussion the hollow sound from the bored limb, but as a hook for extracting the grub. All the fingers are of somewhat unusual length, but the middle one "has been ordained to grow in length, but not in thickness with the other digits; it remains slender as a probe, and is provided at the end with a small pad and a hook-like claw." The use made of this part will be best learned from the very interesting letter to Prof. Owen by Dr. Sandwith, in which his own observations on the habits of the Aye-Aye are recorded.

Mauritius, Jan. 27, 1859.

My dear Mr. Owen:

After very great difficulty and much delay, I have at length obtained a fine male healthy adult Aye-Aye, and he is enjoying himself in a large cage which I have had constructed for him. . . . . I observe that he is sensitive of cold, and likes to cover himself up in a piece of flannel, although the thermometer is now often 90° in the shade. . . . . Now as he attacked every night the wood-work of his cage, which I was gradually lining with tin, I bethought myself of tying some sticks over the wood-work so that he might gnaw these instead. I had previously put in some large branches for him to gnaw upon; but the others were straight sticks to cover over the wood-work of his cage, which alone he attacked. It so happened that those I now put into his cage were bored in all directions by a large and destructive grub called the *Montouk*. Just at sunset, the Aye Aye crept from under his blanket, yawned, stretched, and betook himself to his tree, where his movements are lively and graceful, though by no means so quick as those of a squirrel. Presently he came to one of the worm-eaten branches, which he began to examine most attentively; and, bending forward his ears and applying his nose close to the bark, he rapidly tapped the surface with the curious second digit, as a woodpecker taps a tree, though with much less noise, from time to time inserting the end of the slender finger into the worm-holes as a surgeon would a probe. At length he came to a part of a branch which evidently gave out an interesting sound, for he began to tear it with his strong teeth. He rapidly stripped off the bark, cut into the wood, and exposed the nest of a grub, which he daintily picked out of its bed with the slender tapping finger, and conveyed the luscious morsel to his mouth.

I watched these proceedings with intense interest, and was much struck with the marvellous adaptation of the creature to its habits, shown by his acute hearing, which enables him aptly to distinguish the different tones emitted from the wood by his gentle tapping; his evidently acute sense of smell, aiding him in his search; his secure footsteps on the slender branches, to which he firmly clung with his quadrumanous members; his strong rodent teeth, enabling him to tear through the wood; and lastly, by the curious slender finger, unlike that of any other animal, and which he used alternately as a pleximeter (percuteur?), a probe, and a scoop.

But I was yet to learn another peculiarity. I gave him water to drink in a saucer, on which he stretched out a hand, dipped a finger into it, and drew it obliquely through his open mouth; this he repeated so rapidly that the water seemed to flow into his mouth. After a while he lapped like a cat; but his first mode of drinking appeared to me to be his way of reaching water in the deep clefts of the trees.

I am told that the Aye-Aye is an object of veneration at Madagascar, and that if any native touches one he is sure to die within a year, hence the difficulty of obtaining a specimen. I overcame this scruple by a reward of £10. . . . . .

Believe me, yours very faithfully,

H. Sandwith.

The "Conclusion" of the memoir will certainly attract very general attention, since it contains a distinct expression of Prof. Owen's view with regard to the great question of the day, that of "the origin of species." Those who have joined in the issue involved in this question may be arranged in one of two classes: 1st, comprising those who maintain that the present condition of the animal and vegetable kingdom was reached by a series of progressive creations, each species being created and suddenly introduced upon the surface of the earth, and the first formed individuals having the same specific characters as all the successors; 2d, those who deny the preceding view, and assert that all animals and plants are the result of "progressive development," "derivation" or "transmutation" of species, the first created forms being of the simplest kind, or at all events of a simpler kind than those of the present day, and in the course of time transformed into them. How the changes from simple to complex forms were effected, or how specific characters were modified, has been very differently explained. Lamarck says by a "*besoin*," Darwin by "natural selection" and "the struggle for existence," and Owen "by the ordained potentiality of second causes," and by transmutation "under law."

We do not propose, in this bibliographical notice, to enter into a discussion of these different theories, but, before citing Prof. Owen's views, we will merely remark that, if the progressive-creation hypothesis is adopted, we should be glad to see a better answer than has yet been made to the question, how and in what condition did the first forms make their appearance? When a mammal was created, did the oxygen, hydrogen, nitrogen, and carbon of the air, and the lime, soda, phosphorus, potash, water, &c., from the earth, come together and on the instant combine into a completely formed horse, lion, elephant, or other animal? If this question is answered in the affirmative, it will be easily seen that the answer is entirely opposed by the observed analogies of nature. In the practical study of the history of the earth and the changes which it has undergone, of the development of individual animals and plants, the "order of nature" points in one direction, viz: to the process of differentiation. The one-celled plant and the tree, the

polyp and man, and all organic forms intermediate between these extremes pass from the homogeneous to the heterogeneous, from the nucleated cell, or even from what is more simple still, from plasma to the adult individual consisting of organs more or less complex, according to the position in the series. We nowhere see plants or animals reach maturity in any other way than by development or growth.

At the same time, we must not lose sight of the fact that what is true of the successive stages of individual organisms may not necessarily prove true with regard to the history of the races; that while, from the earliest embryonic condition of each individual to the last, there is a connected series of observed changes or differentiations, and no break in the organic continuity, there are no observations whatever to prove a like organic continuity in the races. In the absence of such direct proof, we have no other alternative than to look to the analogies of nature and the geological record. The direction in which the former point is obvious; the testimony of the latter is thus far negative, but is it complete enough to be a safe guide?

In view of the difficulties met with in explaining the first introduction of living forms, Agassiz has put forth the hypothesis of the creation of eggs. "I then would ask, is it probable that the circumstances under which animals and plants originated for the first time can be much simpler or even as simple as the conditions necessary for their reproduction only, after they have been once created? Preliminary then to their first appearance, conditions necessary for their growth must have been provided for; for, if, as I believe, they were created as eggs, the conditions must have been conformable to those in which the living representatives first introduced now reproduce themselves. If it were observed that they originated in a more advanced stage of life, the difficulty would be still greater, as a moment's consideration cannot fail to show, especially if it is remembered how complicated the structure of some of the animals was, who are known to have been among the first inhabitants of our globe."—(*Contrib. Nat. Hist. of U. States*, i, 12.)

This hypothesis would answer very well for spawning fishes and reptiles, whose eggs may be trusted to the effects of physical agents. But does it help us with regard to viviparous fishes, viviparous reptiles, and mammals? To take the case of the mammals, what "conditions conformable to those in which the living representatives first introduced now reproduce themselves" would answer the purpose for the development of the young, except an uterus, or something analogous to an uterus, and for its nourishment after birth, except a mammary gland or something analogous to one? And how could there be an uterus or a mammary gland without organs of nourishment, locomotion, &c.; in other words, before creating the egg, it would be necessary to create some kind of an organism for the egg to live in. If such organism offered the same conditions with those of the individuals now living, why create the egg at all? Rather than this, it would seem to be a simpler matter to create the whole animal capable of producing eggs to begin with. If it be asserted that the conditions were not the same, this assertion would seem to be equivalent to the admission of variation,

inasmuch as the first egg would be capable of being developed under different circumstances from the later ones.

How Prof. Owen meets this difficulty with regard to the first introduction of species may be inferred from the following passages quoted from the monograph on the Aye-Aye.

"But the conception of the origin of species by a continuously operative secondary cause or law is one thing; the knowledge of the nature and mode of operation of that law is another thing. One physiologist may accept, another refute or reject, a transmutational or natural-selective hypothesis, and both may equally hold the idea of the successive coming-in of species by law."

"What I have termed the 'derivative hypothesis' of organisms, for example, holds that there are coming into being, by aggregation of organic atoms, at all times and in all places, under the simplest unicellular condition, with differences of character as many as are the various circumstances, conditions, and combinations of the causes educing them,—one form appearing in mud at the bottom of the ocean, another in the pond or the heath, a third in the sawdust of the cellar, a fourth on the surface of the mountain rock, &c., but all by the combination and arrangement of organic atoms through forces and conditions acting according to predetermined law. The disposition to vary in form and structure, according to the variation of surrounding conditions, is greatest in these first formed beings; and from them, or such as them, are and have been derived all other and higher forms of organisms on this planet. And thus it is that we now find, energizing in fair proportions, every grade of organization from man to the monad." . . . .

"Now the foregoing hypothesis is at present based on so narrow and, as regards the origin of life, so uncertain a foundation of ascertained facts, that it can be regarded only as a kind of vantage-ground artificially raised to expand the view of the outlooker for the road to truth, and perhaps as supporting sign-posts directing where that road may most likely be fallen in with." . . . .

. . . "And herein is one main distinction between it (origin of species by natural selection) and the 'derivative hypothesis,' which maintains that single-celled organisms, so diversified as to be relegated to distinct orders and classes of *Protozoa*, are now, as heretofore, in course of creation or formation, by the ordained potentiality of second causes; with innate capacities of variation and development, giving rise in a long course of generations to such differentiated beings as may be distinguished by the term 'plant' and 'animal;' from which all higher animals and plants have, through like influences, ascended and are being ascensively derived. This, as the naturalist knows, is mere hypothesis, at present destitute of proof. But it is more consistent with the phenomena of life about us, with the ever-recurring appearance of mould and monads, and with the coexistence, at the present time, of all grades of life rising therefrom up to man, than is the notion of the origin of life which is propounded in Mr. Darwin's book, 'On the Origin of Species by Natural Selection.'" . . . . .

"That organic species are the result of still operating powers and influences is probable from the great paleontological fact of the succes-

sion of such so-called species from their first appearance in the oldest fossiliferous strata; it is more probable from the kind and degree of similitude between the species that succeeds and the species that disappears never to return as such; the similitude being, in the main, of a nature expressed by the terms of 'progressive departure from a general to a special type.' Creation by law is suggested by the many instances of retention of structures in Paleozoic species, which are embryonal and transitory in later species of the same order or class; and the suggestion acquires force by considering the analogies which the transitory embryonal stages in the higher species bear to the mature forms of the lower species. Every new instance of structures which does not obviously and without straining receive a teleological explanation, especially the great series of anatomical facts expressed by the 'law of vegetative or irrelative repetition,'—all congenital varieties, deformities, monstrosities—opposes itself to the hypothesis of the origin of species by a primary or immediate and never repeated act of adaptive construction."

If we correctly understand Prof. Owen's views, as expressed in the above paragraphs, he inclines to, in fact adopts, though cautiously, the hypothesis of the origin of species by "transmutation" or "deviation;" these transmutations being in no accordance with a pre-arranged plan, but carried out under the influence of second causes. The first organisms were unicellular, brought into existence by spontaneous generation "under law," and, by a slow and orderly transmutation, ascensively differentiated into the highest vegetable and animal organisms. For the precise mode of bringing about the individual changes, he offers no conjecture, whatever.

We leave it for the advocates of progressive creation to answer these views—and will conclude with expressing the belief, that there is no just ground for taking, and that we arrive at no reasonable theory which takes, a position intermediate between the two extremes. We must either assume, on the one hand, that living organisms commenced their existence fully formed, and by processes not in accordance with the usual order of nature, as it is revealed to human minds, or, on the other hand, that each species become such by progressive development or transmutation; that, as in the individual so in the aggregate of races, the simple forms were not only the precursors, but the progenitors of the complex ones, and that thus the order of nature, as commonly manifest in her works, was maintained. J. W.

8. *On the "Minute Vertebrate Lower Jaw."*—In the *Annals and Magazine of Natural History*, for October, 1862, Dr. Wallich has given a figure and description of a jaw-like object $\frac{1}{100}$ of an inch in length, dredged at St. Helena, which he considers as "evidence of the existence of a vertebrate animal measuring only $\frac{1}{200}$ inch in length!" This has excited much discussion, several papers having since been written upon the subject, and although its vertebrate character has been fully disproved, there is much diversity of opinion in regard to the true character of the object. C. Spence Bate (*Ann. and Mag.*, Dec., 1862) thinks it to be the claw of an Amphipod. It has also been suggested that it may be part of the lingual ribbon of a Gasteropod; or part of the manducatory apparatus of a Rotifer. Mr. Busk, in an illustrated paper