NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

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No 47. Vol. VIII. JANUARY, 1896.

NOTES AND COMMENTS.

Our Bengawan Fossil Ancestor.

At a recent meeting of the Anthropological Institute, Dr. Dubois showed to the leading anatomists of England the far-famed remains he discovered in Java. The remains consist of the roof of a skull which belongs to no known human or anthropoid type, and which is yet both human and anthropoid in appearance; a second and third molar, from opposite sides of the upper jaw, which are more human than ape-like; and a femur, in almost every respect distinctively human. Dr. Dubois, who sat beside the President and showed no trace of the malarious climate of Java, is completing a tour round the leading scientific centres of Europe. In France, he found that there was practically a consensus in favour of regarding the remains as indications of an animal that was human-like but not human: in Germany, they were thought to be ape-like and belonging to an ape. Now, in Britain, most have thought them human-like and of a man. These differences of opinion are themselves evidence that the anatomical gulf between man and apes has been exaggerated.

The Neanderthal skull was formerly the subject of an equally great conflict of opinion. Some anatomists declared that it belonged to an ape: some that it belonged to an abnormal man: some accepted it as evidence for the existence of a Quaternary type of man: others cautiously declared the evidence insufficient for any conclusion. At the meeting of the Anthropological Institute the same four groups of opinions were shown. Even to-day anthropology hesitates to speak with a certain voice upon the chief point of its own subject-matter.

As the normal human skull, the Neanderthal skull, and this Bengawan skull lay on the table together, it seemed clear enough that the three formed a series of grading forms. The differences between the normal and the Neanderthal skulls were much the same in kind and in amount as the differences between the Neanderthal and Bengawan skulls.

Dr. Dubois set at rest all doubts as to the geological antiquity of these remains. He showed photographs of the bank of the Bengawan stream, from which they were taken; of the geological formation of the bank—a thick stratum of sandstone with a stratum of gravel-conglomerate under it, from which the fossils were obtained; of skulls, teeth, and other bones belonging to species and genera of mammals now extinct, taken from the same stratum as the human remains. Dr. Dubois thought the skull, the teeth, and the femur belonged to the same individual; this may be doubtful, but there can be no doubt that they all belong to individuals of the same race.

An interesting, but to our thinking, a crude, attempt was made by Dr. Dubois to represent in a genealogical tree—rising and branching through the various Tertiary strata—the positions occupied by this animal he calls *Pithecanthropus erectus*, and by men and monkeys. He considers *P. erectus* as representing the human race in late Tertiary times. We think he has done perfectly right in placing this animal as the direct precursor of the human race—but why give it such a name? If it is a grandparent of the human race, why not call it human? It is quite evident that the anthropologists of Europe have a difficulty in drawing a line of separation between it and present man. The difficulty has only just appeared, but further geological research will bring it more into prominence. At what point in the ancestry of man are we going to draw the line, and say, on this side of that line it is man, on the other side, ape? Dr. Dubois has drawn that line; he has drawn it separating Quaternary from Tertiary man. Tertiary man he calls *Pithecanthropus erectus*. The rest of Dr. Dubois' genealogical tree—showing the relationship in descent of apes to each other and to man—we do not think will be endorsed by any who have a knowledge of the anatomical structure of these animals.

The chief result of Dr. Dubois' discovery is this: Man in late Tertiary times had already completely attained the habit of erect posture, and locomotion had already set his hands free as the servants of his brain; but his brain and skull had not nearly attained the rounded completion of to-day.

Mr. Bland Sutton made one of the most interesting contributions to the debate. He pointed out that the Bengawan individual had suffered from Myositis ossificans—a disease peculiar to man, and coming on late in life. Evidently, also, man has carried the burden of his disease through a very long series of ages.

At a recent meeting of the Royal Dublin Society, Dr. Dubois showed his specimens to Irish naturalists. Professors Cunningham and Haddon agreed that *Pithecanthropus erectus*, Dubois, was a progenitor of the human race, but held that the Anthropoids branched from the line at a point lower down.

The Sanctity of Life in Africa.

The Congo Free State having paid the German Government £4,000 as compensation for loss, owing to the death of the latter's agent, Stokes, and having agreed to the trial of Major Lothaire in Brussels, this unfortunate business has been simplified. With the political aspect of the case we have nothing to do, but attempts have been made to prejudice the Congo Free State officers, by declarations that no European's life would be safe in Africa in the future; and that is a question which concerns naturalists. There never has been any doubt that Major Lothaire acted illegally in the execution of Stokes; and now, there is no doubt that his conduct was also recklessly injudicious. The technical illegality does not count for much no explorer can do anything in Africa without breaking many of the silly regulations of the Brussels and Berlin conventions, and disregarding ordinances issued by well-meaning officials. But when such illegalities affect the lives of Europeans they become more serious. The discussion this summer of the Bembiré incident has reminded us that acts take place in Africa which would never for a moment be tolerated in Europe. If a courageous official, in order to suppress piratical proceedings, were to punish the offenders, it would be the duty of those who have the interest of Africa at heart to see that he was given fair play, and not tripped up by mere technical illegalities. But no official ought to inflict a death penalty on a European, especially on a native of another country, without recognising that he is incurring a great and risky responsibility. Illegal executions can only be tolerated under circumstances of great urgency or of extreme provocation, and then carried out with dignity and judicial care. It is because Major Lothaire's action lacked these characteristics that it has been unanimously condemned. But random statements that his action has for ever broken European prestige on the Upper Congo may be dismissed as worthless; for so many Europeans have met their deaths in that region at the hands of rebellious natives and slave-trading Arabs, that our prestige has long been dependent on character and conduct, instead of on colour.

Dr. Donaldson Smith's Journey.

Dr. Donaldson Smith is heartily to be congratulated on the successful termination of the difficult journey from the Somali coast, across the countries of the Somali, the Galla, the Reschiat, and the Pokomo, to the coast at Lamu. This long journey has been frequently projected, but the fickleness of the Somali, the hostility of the Wa-suk, and the great tracts of barren, waterless wastes in the Lake Rudolf region, have prevented its achievement. The only previous European visitors to Lake Rudolf were Count Teleki and Lieutenant von Höhnel, who reached it from the south. Dr. Smith is the first to gain it from the north, and thus his work helps to bridge the gap between the expeditions from Mombasa and Zanzibar and those from the north through Abyssinia. We are glad to hear, moreover, that Dr. Smith has made extensive scientific collections, especially of birds, the skins of which have been prepared by his assistant, Mr. Dodson. The expedition crossed the country of the Doko, a tribe of dwarfs, which were first reported by Harris, in 1844, and first seen and described by Borelli in 1890.

THE SPECIESMONGER IN HIGH PLACES.

WE are somewhat astonished at the temerity of Professor William Bullock Clark, of Johns Hopkins University, in sending to us, presumably for review, number 121 of the *University Circulars*, which is devoted to "Notes from the Geological Laboratory." We have often had the pleasure of praising the energy and work of Professor Clark, and he may possibly suppose that we shall look upon the stuff he now sends with lenient eyes. Mr. Clark must learn that we endeavour, to the best of our ability, to speak of everything submitted to us on its own merits, and we regret that we have to speak of his present performance in terms of severe condemnation.

The chief cause of our complaint is a paper entitled "Contributions to the Eocene Fauna of the Middle Atlantic Slope." This contains, within the limits of three pages, a so-called description of no less than thirty-two alleged new species. This is the kind of thing that is served up to us:

"*Trionyx virginiana*, n.sp.
Fragments of costals with characteristic tuberculated surface; pits broad; ridges far apart and irregular.
Loc. Aquia Creek, Va."

and

"*Teredo virginiana*, n.sp.
Tube cylindrical, long, irregularly curved; surface smooth; prominent, transverse partition near posterior extremity.
Loc. Many places in Maryland and Virginia."

Does Mr. Clark seriously suppose that his fellow-workers, the specialists on Reptilia or on Mollusca, can recognise these forms from such undiagnostic diagnoses? As for the so-called description of the shell for which the name *Pecten rogersi* is proposed, all we can gather from it is that the form in question is certainly not a *Pecten*, though it may be a *Chlamys*. We do not congratulate Mr. Rogers, whoever he may be, on being the recipient of this dishonour. It is, perhaps, unnecessary to add that none of these species are figured, neither are the numerous alleged new species of corals, which are proposed in this same circular by H. S. Gane, nor the alleged new species of Foraminifera introduced by R. M. Bagg. It is true that some plates are promised to posterity; but we know from sad experience how long it is before such promises are fulfilled, and such promise is at best an admission that the work as now published is incomplete. Grateful, meanwhile, for small mercies, we acknowledge that some poor zincotypes illustrate two new species of *Cistella*, and a few other miscellaneous fossils. It is useless for us to hope that Professor Clark and his assistant, Dr. R. M. Bagg, teach their students how to produce in a proper manner the best kind of scientific work, for however eloquent their precepts may be, they in this case certainly do not better them by their example.

We are ready to praise those who are breaking new ground in American palæontology, and we are willing to admit that the active geologists of Johns Hopkins University are not the only hawkers of *nomina nuda et synonyma*; but it is time that this particular method of retarding the progress of science was put a stop to, and if that task is not undertaken by the enlightened universities of Europe and of America, we fail to see what hope is left for the overwhelmed systematist. It seems to us, after many years' experience of systematic work both good and bad, that the great desideratum at the present time is, not the multiplication of species whether good or bad, but the re-description, in the light of modern science, of the species that have already been named (we will not say diagnosed), and the arrangement of all species under their proper and finally determined names in the genera to which they are thus shown to belong.

We cannot sufficiently commend such work as is being done by Hall and Clarke in their revision of the Brachiopoda, by Hyatt, Beecher, and Jackson in studying the development of various fossils, by Wachsmuth and Springer in their monograph of palæozoic crinoids, and by Whitfield in figuring species described long ago but never yet figured. Men like this are bridge-builders and road-makers for science, the others only raise obstacles in her path.

On Nomenclature: A True Word in Jest.

Under the title of "Hérésies Taxinomistes," Professor A. L. Herrera has sent us an amusing pamphlet, published in *Memorias de la Sociedad "Alzate" de Mexico*, vol. ix. Professor Herrera begins by a series of quotations, of which the following are the best :—

"La Botanique est l'art de dessécher des plantes dans des feuilles de papier brouillard et de les injurier en grec et en latin.—Karr."

"Les auteurs, une fois plongés dans les études speciales, ont la rage des noms nouveaux et pompeux pour désigner des choses de minime importance scientifique.—Kennel."

He would show that nomenclature, as it exists, is a nuisance, unsatisfactory, and often absurd, and urges on authors the advisability of imposing on newly-discovered forms names descriptive rather of their peculiarities than of the persons to whom the author is indebted. To emphasise this matter, he writes as follows: "In order that we may see the superiority of the common names bestowed on humming-birds, we give a synoptical table. In the first column are the names given by the collectors of birds, who are, for the most part, natives little favoured intellectually, and generally with disease of the liver, drunkards, or illiterates; the second column contains the names evolved by scientific men of an ordinary intelligence, who do not often suffer from cirrhosis, who do not get intoxicated, and who possess great erudition.

"Oiseau—mouche à gorge bleue.	Caligène de Clémence.
————— à poitrine couleur de vin.	Lamprolème de Rham.
————— à queue de poisson. . .	Chlorostilbon de Canivet.
————— violet grand.	Trochile d'Alexandre.
————— bleue à queue d'hirondelle.	Tilmature de Dupont."

Professor Herrera thinks that if the Latin name were invariably compounded to have a meaning, such as the blue-throated humming-bird, it would be much more intelligible and instructive than if it were called after "Mademoiselle Clémence" or "Monsieur Dupont."

He also calls the attention of systematists to the inconvenience caused by not retaining one termination for certain groups; for instance, he quotes Malherbe's nomenclature of the Picidæ, in which the termination of every generic name ends in *picos* or *picus*, whereas in that of Swainson each genus is a distinct and unconnected word. He further emphasises his remark by asking how many scientific men outside the systematists of the group understand what is meant by *Spinolis zena*? Is it a mushroom, an ant, a rose, a spider, or a monkey?

We quite agree with Professor Herrera that the procedure of naming forms might be thus simplified, could we begin over again; naturally Professor Herrera shrinks from such a drastic remedy, since, as we already have a nomenclature extending over some 140 years, we must accept it, and, to our way of thinking, the only method of clearing the ground is to adopt strict priority in every instance. This, if persisted in conscientiously, must eliminate the endless synonyms now existing. But the obstacles in the way of even this rational method are very great; specialists cannot agree among themselves as to whether a form belongs to this genus or to that, and this point is well brought out in Herrera's own paper. He quotes ninety-five authors who have written on *Alauda cristata*, and shows that this bird has been put alternately into *Alauda* and into *Galerita* by almost each successive writer. Now, if diagnoses of genera are any good at all, it is either an *Alauda* or a *Galerita*; there should be no dispute, and all we can gather from Herrera's table is that generic descriptions are so vague that no one can decide to which genus the bird belongs.

There are many other points in this amusing paper which we should like to quote had we the space, but we must content ourselves with noting one crowning absurdity quoted by Herrera—that of *Enema gonzalezi*, on which he remarks, "Quelle politesse dans le langage de la science! Quels termes bien appropriés et distingués!"

As evidence of the lamentable work done in the past in overloading science with useless names, Herrera gives a table of names accepted, names rejected, and total used in three volumes of the British Museum Catalogue of Birds, in which the synonymy has been worked out in so able a manner by the authors:—

Psittacidæ,	accepted	499,	rejected	2,794
Sturniformes	,,	601	,,	2,038
Picidæ	,,	385	,,	2,010,

and he points out that to designate 1,485 distinct birds, not less than 8,327 names have been used, of which 6,842 are considered as meaningless terms by the compilers of the catalogue. As Herrera truly says, "this is hideous." But as so many names are proposed by persons who, because they live at a distance from great libraries, are ignorant of previous writings on their subjects, we fear this "hideousness" will last to the end of time.

Erratics.

"Who drives fat oxen must himself be fat," and who studies erratic blocks must himself be erratic. At least, this is the only conclusion we can draw from the remarkable eccentricity of the *Glacialists' Magazine*, a so-called "Monthly Magazine of Glacial Geology," edited by Percy F. Kendall, secretary of the British Association Committee on Erratic Blocks, and published by F. H. Butler, London. The heat of the summer melts the ice and checks the advance of the *Glacialists' Magazine*; with returning winter its activity is renewed. Thus we explain the fact that the February and March numbers are published at the end of November, and come loaded with morainic *débris* that has fallen on them during the intervening months. Now, this is exceedingly interesting; but as a scientific observation its value would be increased if the erratic editor would only put the true date of publication on the wrapper. Why does Mr. Kendall take no notice of our previous warning (vol. vi., p. 231)? We have heard of only one reason for issuing periodicals with a false date, and that is the desire to gain an unjust priority for a published statement. This cannot be Mr. Kendall's reason, for he knows that, ethically considered, such action is on a par with the publication of a fraudulent balance-sheet. We cannot put such offenders in prison, but we shall continue to put them in the pillory.

Glacial Geology in the North of England.

We do not wish our remarks in the previous paragraph to disparage the splendid work now being done in the north of England by the members of the Glacialists' Association, who are bringing this branch of geology in England into line with that of the American school. We have received from Mr. T. Mellard Reade three papers, which are a further illustration of the energy with which glacial geology is being studied in the north of England. One contains a description of some tarns in the Brecknockshire Beacons, which are supported by moraines attributed to small "nestling" glaciers. There is no previous satisfactory evidence of glacial action in this district, but these moraines certainly point to the former presence of permanent snow on the Beacons. A second paper, written in conjunction with Mr. T. D. Davies, describes some new sections on the Wirral Railway, at Seacombe, near Birkenhead. The Boulder Clay contains the usual assortment of the rocks of the north of England, and in the sands are marine shells, mostly in fragments, and some peculiar balls of clay. The authors contend that both of these are indicative of marine origin, though they admit that this view, as well as that which assigns the deposits to land ice, is full of difficulties. Our hope of overcoming these difficulties is largely based on the accumulation of carefully observed facts now being made by Mr. Kendal and his colleagues.

A Fresh-Water Station in Norfolk.

Our readers may remember that in Natural Science some time ago (vol. v., p. 370), we gave an account, with illustrations, of the portable fresh-water biological station established by Dr. Fritsch in Bohemia. We are glad to record that there is a probability of the example to which we called attention being followed in England. Mr. W. A. Nicholson, the honorary secretary of the Norfolk and Norwich Naturalists' Society, writes to us to direct our attention to a proposal brought forward in the recently issued *Transactions* of his society (vol. vi., part i.). "The systematic study of fresh-water biology," he says, "seems to be rather neglected in England. Many of your readers will recollect the description in your review a few months ago of the station in the lake district of Bohemia. Interesting particulars are there given as to apparatus, etc., required.

"Norfolk, with its Broads, hundreds of acres in extent, and its slow-running rivers and streams, is, I should think, the most suitable county in England for the study of the fauna and flora of fresh waters. The establishment of a biological station would, however, necessitate much more than merely local support.

"It is with a view to obtaining an expression of opinion on this subject, that I venture to bring forward the matter before you."

We have the fullest sympathy with Mr. Nicholson's object, and we hope that his scheme will be carried out. In the note in the society's *Transactions*, he points out that in the large and exposed lakes of Bohemia a portable house was necessary, as microscopical work could not be conducted on floating craft. He proceeds to write:—

"In the sheltered Broads and waterways of Norfolk, however, such difficulties do not exist. A wherry, fitted up for the purpose of investigation, would answer admirably. That there is important work to be done, of great benefit to science, in the zoology and botany of the Broad district, will be generally acknowledged. The discovery of

Cordylophora in Heigham Sounds, a few years ago, by Mr. Bidgood, was, I believe, an event hitherto unrecorded for that district. This organism is interesting, as *Cordylophora* is the only member [of its family known to inhabit fresh water]. Mr. Geldart gave us an account of its life-history at the time. I mention this as an instance that the district is not by any means thoroughly explored. In botany, Hickling Broad is the only known habitat in England of *Naias marina*, according to Bentham and Hooker. I have searched for it myself, but have not been successful in finding it. Again, *Tolypellopsis stelligera*, found in the Hickling district, is specially interesting, as, according to Mr. Bennett (*Transactions*, vol. iii., p. 382), up to 1882, it had been found nowhere else in Britain. There are several points in its life-history yet to be explained. For the study of the group of *Characeæ*, Norfolk waters offer great inducements, as they contain many species, several of which have not yet been recorded for the county. For the whole of the aquatic flora, Norfolk seems to offer special facilities for clearing up obscure points. To mention only one of these obscure points, the economy of *Stratiotes aloides* (Water Soldier) requires investigation, as, in spring, the plants rise to the surface for flowering, and in autumn sink down into the mud again for the winter, it is supposed for the purpose of ripening its seeds. The cause of the rising and sinking of this plant has yet to be discovered, though a theory to account for it has been propounded by M. Forel, of which mention is made in the "Bulletin of the Society for the Protection of Alpine Plants" (Geneva, 1895). It is a matter of doubt whether *Stratiotes* ever does ripen its seeds. Its reproduction may be entirely vegetative."

Biology in the Channel Islands.

In the October number of his interesting *Journal of Marine Zoology and Microscopy*, just received, James Hornell gives an account of the work done at the Jersey Biological Station during 1895. No less than fifteen workers have occupied tables at this station during the summer, most of them for a month or more, while many others have visited it for a shorter time. We note that the list given includes zoologists from France, Germany, Switzerland, England, Scotland, and Ireland. To afford working-place for all of these, an additional laboratory-table, with gas and water supply, has been erected in the room used as a museum. H. C. E. Zacharias, from Berlin University, intends to occupy a table permanently in the future, and will assist the Director of the Station in his morphological researches upon some of the rarer representatives of the fauna. An account has already been published in Natural Science (vol. vii., p. 416), of the experiments on formalin as a preservative medium. Mr. Hornell has also pursued investigations upon the difficult bait-problem, for which, in the absence of any subsidy, he deserves great credit. Under the care of the former co-director, Mr. Sinel, the Oyster-parks recently constructed at Green Island are now in a flourishing condition, and the shores of Jersey have been proved so suitable for oyster-culture that other parks are being formed.

In the present number of the journal, Mr. Hornell continues his

"Microscopical Studies of Marine Zoology" with the Corynidæ, *Sertularia pumila*, and the Cirripedia, all of which are illustrated in the plates. There is also a somewhat belated and rather curious article on *Spirula peronii* by E. H. L. Schwarz.

We wish the Jersey Biological Station and its interesting journal the success that they deserve.

Zoology in Japan.

English naturalists do not appear to be aware of the existence of a scientific journal published at Tokyo by the Keigyosha, and entitled *The Zoological Magazine*. This is not to be wondered at, for till recently the greater part of this journal was in the Japanese language. We have, however, received three interesting papers reprinted from it, all written in English. The first, by Professor K. Mitsukuri and S. Ikeda, March, 1895, figures and describes a gigantic Cephalopod which was caught in a net by some fishermen in the Bay of Tateyama not far from Tokyo, having been driven inshore by a violent storm. It appears to be of the genus *Architeuthis*, which numbers so many monsters, but the authors are unable to identify it with any known species. They do not, however, give to it any name, since they think it may possibly be identical with the gigantic Cephalopod which Hilgendorf saw in Tokyo and named *Megateuthis martensii* in the *Sitzungsberichte der Gesellschaft der Naturforschende Freunde*, 1880, a paper which the Japanese writers have been unable to see. The length of the body on the dorsal median line is 72 cm., the length of the longest sessile arm, namely, the left of the ventral pair, is 122 cm., the length of the tentacular arms is 291 cm. Although large, still these measurements are small compared with other species of the genus; and this fact, taken together with the unripe condition of the reproductive glands, suggests that "the animal was still immature—in fact, the baby of a giant." The second paper, by Professor Mitsukuri (June, 1895), announces the occurrence in Japanese waters of a species of *Hariotta*. This genus of Chimæroid fish was not long ago described by Messrs. Brown Goode and Bean from specimens collected off the coasts of Virginia, Maryland, and Delaware. The occurrence of so rare a genus in both the Pacific and Atlantic Oceans is, as Professor Mitsukuri remarks, "an interesting fact, well worthy of being placed on record as speedily as possible." The third paper, by Jiuta Hara (October, 1895), is a "Description of a new species of Comatula, *Antedon macrodiscus*," of common occurrence near Misaki, and belonging to the *Milberti* group. The author compares his species with *A. milberti*, *A. carinata*, and *A. rosacea*, but curiously makes no mention of Hartlaub's *Antedon japonica* from the same locality, which, though different, is quite as close an ally. This paper compares unfavourably with the other two in the absence of an illustration.

We may add here some personal information kindly supplied by

Professor Mitsukuri. Our readers are well acquainted with the Chinese habit of eating Holothurians. Certain species only are suitable for food, since many are rendered rather too indigestible by the size and number of their calcareous stipules. The Bêche-de-mer or Trepang Fishery, as it is called, is largely carried on about the Great Barrier Reef of Australia and in the China Sea (*see* NATURAL SCIENCE, vol. ii., p. 457). The particular species *Stichopus japonicus* also forms an important article both of food in Japan and of export thence to China, the value of the trade being estimated at £100,000 a year. At the instance of the Japanese Fisheries Commission, Professor Mitsukuri has been investigating the life-history of this species, in order to find some means of preserving, and, if possible, of propagating, the animal. He has already devised a plan and is having it tried on a small scale.

We are glad to learn from Professor Mitsukuri that the recent war is likely to stimulate scientific activity in Japan. "The victory is," he says, "in a certain sense the victory of science."

THE CELL-THEORY.

IN the *Quarterly Journal of Microscopical Science* (Nov., 1895), Mr. Adam Sedgwick, in the course of reply to Mr. Bourne's criticisms, makes some further remarks on the Cell-Theory which should be read by all biologists. He distinguishes between the statement of fact that "structures most conveniently called cells undoubtedly exist, as the ovum, spermatozoon, lymph-cells, etc.," and the theory that "organisms of Metazoa are aggregations or colonies of individuals called cells, and derived from a single primitive individual—the ovum—by successive cell-divisions; that the meaning of this mode of origin is given by the evolution theory, which allows us to suppose that the ancestor of all Metazoa was a unicellular Protozoon, and that the development of the higher animals is a recapitulation of the development of the race." So far as the statement of fact goes, Mr. Sedgwick thinks that the "phenomena called cell-formation" are not of primary significance. He gave special instances of the absence of this: in the mesoderm and in the formation of nerves; and he declared that the theoretical part of the cell-doctrine had led investigators to misinterpret facts. Against the theoretical part of the doctrine he continues to wage wholesale war, and most readers will agree that he has made a reply to Mr. Bourne the occasion of urging very weighty considerations against the older views. Incidentally, he makes a novel suggestion as to the nature of the conjugating cells of Metazoa. In the "Protozoa in which the amount of formed tissue is generally slight, and the structure of the body simple, conjugation can and does often take place between the ordinary forms of the species." But in the Metazoa "conjugation is impossible between adult or ordinary individuals of a species, from mechanical causes." Conjugation is, however, a necessary part of their life-cycle, and, special individuals, of extremely simple structure—a structure so simple that conjugation between them is possible—are formed. These individuals are the ovum and spermatozoon. A diœcious metazoon is a "tetramorphic species, consisting of male, female, ovum, and spermatozoon."

New Memoirs on Cells.

The whole issue of the *Quarterly Journal of Microscopical Science*, in which occurs Mr. Sedgwick's paper referred to in our last paragraph, consists of memoirs upon cells and nuclei. Mr. J. E. S. Moore writes an extremely interesting memoir upon Elasmobranch spermatogenesis. He divides the spermatogenesis into two periods. The first lasts from the first appearance of the genital cells in the embryo until the actual production of spermatozoa begins. The nuclear divisions in this period are similar to the divisions occurring in the tissues of the body generally. In *Scyllium canicula*, the common dog-fish, when the nucleus is preparing for division, twenty-four chromosomes appear; in the division each chromosome splits longitudinally into two. At the end of the first period the cells are lying in the genital ampullæ in layers seven or eight cells thick. Avoiding technical details, it is enough to say that marked changes in the structure of the nucleus and the various parts of the cell mark the advent of the second period. When the chromosomes appear for the divisions of the second period, only half the number of those present in the first is found. In the case of the common dog-fish, twenty-four chromosomes appeared in the divisions of the first period; twelve chromosomes appear in the divisions of the second period. These, at first thick loops, become ring-like structures. The actual splitting of the chromosomes takes place across the long axis of the rings, which become pulled out into loops. A second set of divisions, in which also twelve chromosomes appear and divide transversely, gives rise to the actual spermatozoa. Apart from the exact details, the processes described by Mr. Moore have a theoretical interest. As he points out, Weismann laid great stress on the occurrence of a reducing division in the formation of germ-cells, that is to say, of a division in which the chromosomes did not divide, but one-half passed out to each daughter nucleus. Mr. Moore shows that such a reducing division does not occur in the spermatogenesis of the dog-fish: many botanists have shown that there is no evidence for it among plants.

To the same number Mr. M. D. Hill contributes a valuable memoir upon Fecundation, Maturation, and Fertilisation in *Sphærechinus* and in *Phallusia mammillata*, and Mr. A. B. Macallum contributes a most important memoir upon iron compounds in animal and vegetable cells.

Professor Ray Lankester.

We go to press early this month, so that what is new now may be a matter of common knowledge when this number is published. But we have the greatest pleasure in giving additional publicity to the appointment of Mr. Edwin Ray Lankester as a vice-president of the Royal Society. When Professor Lankester was a boy at school he became interested in fossil fish, and Huxley, who was a family friend, encouraged him in his pursuit, and was the external cause of his first important scientific publication, a monograph of the Fossil Fishes of the Old Red Sandstone. At Oxford he was a pupil of Rolleston's and a contemporary and friend of Moseley. His subsequent career as Jodrell Professor at University College, and as the present holder of the Linacre Chair at Oxford, is known to everyone. Were Francis Balfour alive, Lankester and Balfour would be the two great representative names of the latter part of the century among English morphologists. As it is, the older school has disappeared, and Professor Lankester alone occupies a great gap between Huxley and a host of younger men, many of whom are eminent, but none of whom is yet conspicuously in front of his fellows.

Professor Karl Pearson's Reply to Mr. Balfour.

We did not notice Mr. Balfour's "Foundations of Belief" in the part of our columns devoted to new books, for two reasons. The part of his interesting argument dealing with religion necessarily is outside the scope of Natural Science. The part which dealt with the foundations of science we were unable to recognise as having anything to do with any modern branch of scientific thought. The majority of scientific men pursue their studies and investigations without troubling about the metaphysical difficulties that lie behind, not only scientific thought, but all thought. Mr. Balfour seemed to us to imagine that science necessarily identified itself with the old, crude materialism of the Hall of Science School. It is quite true that Moleschott and Buechner many years ago identified scientific concepts with "things-in-themselves," but the few modern scientific men—such as Huxley, Clifford, and Karl Pearson—who have touched upon metaphysics, took the greatest pains to make clear that they were not "materialists."

As we did not review Mr. Balfour's book, we cannot find space for Professor Karl Pearson's criticism. But those who are interested in such ultimate problems should make haste to send to Mr. William Reeves, 185 Fleet Street, the publisher of "Reaction!" by Karl Pearson, price fourpence. We can assure them that they will find the pamphlet exceedingly interesting, and even though they may not agree with Professor Pearson, he will satisfy them that Mr. Balfour's treatment of science was a mere burlesque.

DIPTEROCARPS.

DIPTEROCARPS, or rather some species of the family, are to the tropical forests of Eastern Asia what the pine, the spruce, and the beech are to Europe. That is to say, they are gregarious, forming nearly pure forests of large extent in which one species has got the upper hand, to the exclusion of almost all others. This is the more remarkable since one of the chief characteristics of tropical forests is the great variety of kinds and the isolation of individual species. Thus one member of the family *Shorea robusta*, the Sāl tree, forms pure or nearly pure forests of vast extent at the foot of the Himalaya, from Assam to the Punjab, and in the hills of Eastern Central India. The chief factors which enable this tree to maintain its ascendancy are briefly these. The seed ripens at the right season of the year, at the beginning of the rains, after the forest fires of the hot season; it is produced in great abundance almost every year and germinates readily. The leaves of the seedlings are very large, and will thus choke other trees and shrubs which have sprung up with them. Last year's seedlings are, moreover, generally strong enough to send up fresh shoots when the rains set in, although they may have been burnt down to the ground by the jungle fires. Finally, the Sāl can endure a good deal of shade when young, remaining alive for many years under dense cover of grass, bushes, or trees. Sir Dietrich Brandis has had the advantage of working on the spot, and hence his remarks in the revision of the Order which has just appeared in the Linnean Society's *Journal* (vol. xxxi.) carry weight. An observation on those species which, though common, do not grow gregariously, but as isolated individuals, often far apart, is of much interest. They are by far the larger number, and many flower and seed abundantly. In three cases, however, in which a great number of seeds were examined, very few were perfect, many were worm-eaten, while in others the place of the embryo was filled up by dry, cork-like tissue. The author records a similar peculiarity in another family, Combretaceæ, which produce seed abundantly, but only occur singly in mixed forests. Among large quantities of seed examined only a few contained a perfect embryo. The circumstances which enable certain species to form pure forests certainly promise much interest as a subject of biological research.

Though Dipterocarps as a rule flower and seed annually, this is not always the case. Mr. Ridley states that in the Malay Peninsula every sixth year is unusually dry, and is characterised by the large number of species which only then produce flower and seed.

"MISCELLANEOUS INFORMATION."

FEW works justify their title more thoroughly than the *Bulletin of Miscellaneous Information*, issued at irregular intervals in connection with the Royal Gardens, Kew. Primarily intended to be "economical and not scientific," its contents have recently consisted, for the most part, of diagnoses of plants possessing no economic value and of purely botanical interest. Some two years since, when the *Bulletin*—which, it must be remembered, is issued by the Stationery Office—was threatened with extinction, *The Times* stated that its publication was "one of the most useful functions discharged by the Royal Gardens." We should ourselves be sorry to estimate Kew at so low a value as is implied by this statement, but there can be no doubt that since the *Bulletin* has taken to publishing diagnoses of new species, it has become of greater interest to the systematic botanist.

We are, however, at a loss to understand for whose benefit the last number of the *Bulletin* has been issued. It is certain that science cannot be the gainer by the bringing together of such names as "Odontoglossum Impératrice de Russie," "Masdevallia Mary Ames," "Lælio-Cattleya Hon. Mrs. Astor," and "Cypripedium Madame Jules Hye"—to select only one or two examples of names which may be counted by dozens. The introductory note tells us that these lists are "indispensable to the maintenance of a correct nomenclature" and to "smaller botanical establishments"; yet the enumeration, which might easily have been completed by the first week of January, and issued as soon as finished, is not sent out until November. Nor is this all: the contents are as useless from a horticultural as they are from a botanical standpoint. What, for instance, does the student gain by the knowledge that *Tylophoropsis* is "a new genus of no horticultural interest?" If the Stationery Office chooses to compete with the scientific journals which are carried on at private expense, or with the various learned societies which devote themselves to the publication of scientific papers, it is of course at liberty to do so. But the public has a right to demand that its publications should be at least up to the level of usefulness secured by works that are not subsidised by Government.

European Elephants.

An important and interesting find of remains of *Elephas* has been made at Tilloux, near the station of Gensac-la-Pallue, France. The remains consist chiefly of tusks and teeth of animals of great size—the largest tusk recovered measuring 2 metres 85 centimetres in length, and being almost straight. The teeth are identified as those of *E. meridionalis*, *E. antiquus*, and *E. primigenius*, and figures of all are given in *L'Anthropologie* (vol. vi., no. 5) for October. Associated with the remains were those of *Rhinoceros*, *Hippopotamus*, *Cervus*, and *Bison priscus*, and numerous flint implements belonging to Mortillet's "Chelléen" and "Moustérien" ages. One of these implements, a "striker," was found underneath a tusk, to which it adhered. Three of the implements are apparently made from the same flint, and are identically similar in every character but form. There is, therefore, no reasonable doubt as to the contemporaneity of the remains and the tools.

Bibliography of Zoology.

In our November number (p. 359) we announced the arrangements for the publication of an international *Bibliographia Zoologica*. The committee appointed by the American Society of Naturalists in Dec., 1894, has reported upon the plans of Dr. H. H. Field, in *Science* for November 15, 1895; they conclude their report as follows:—

"Your committee, having examined the matter in detail, would, therefore, report that they regard the plan as one worthy the fullest support of the American scientific world. They recommend it as worthy of financial support and would urge all publishers and publishing institutions to send all periodicals and other works (or in the case of books at least the correct title and a summary of contents prepared by the author) promptly to the central bureau. They would finally recommend the appointment of a permanent committee of ten to co-operate with similar committees in other countries in forwarding the movement.

"(*Signed*) Samuel H. Scudder, Henry F. Osborn, J. S. Kingsley,
H. P. Bowditch, E. A. Andrews, *Committee*."

We do not know of any higher authority on the bibliography of zoology than S. H. Scudder, and it is small wonder that American zoologists generally have welcomed the above report in a practical manner. All the money that was asked for has been subscribed, namely, $250 from the Elizabeth Thompson fund, $250 from the American Association for the Advancement of Science, and $50 from the American Society of Microscopists.

The scheme has been strengthened by affiliation to the Institut International de Bibliographie at Brussels, to which Lord Kelvin alluded in his recent address to the Royal Society. It is proposed to include animal physiology, and ultimately botany, in the plan, without altering present arrangements. All working zoologists who desire to keep pace with their subject should send their subscription of fifteen shillings to the publisher, W. Engelmann, Leipzig.

Bibliographic Innovations.

With this number we adopt two suggestions which were made at the International Congress of Bibliographers, held last September, in Brussels, and which have since been emphasised by the above-mentioned Bibliographic Department of the Belgian Government, and by other foreign bibliographers. The first is the printing at the head of each article the index-number under which the subject of the article is placed in Melvill Dewey's system of decimal classification, a system that was adopted in its entirety by the Congress of Bibliographers. The second is the underscoring of certain words in the title of each article, the most important word or words having a full underscore, and words of less importance having shorter underscores. These are changes that appeal to the professed bibliographer rather than to the ordinary man of science. They may or may not be found valuable enough to gain universal adoption. But, in any case, we are yielding to a strongly expressed demand, and by familiarising English readers with the system, we do what little we can to prepare the way for that bibliographic reform which all admit to be an urgent need.

GENERAL VIEW OF THE VALLEY AT SPITALMATTE.

The arrows show the direction of the avalanche, and the dotted line marks the tract covered by it.

Rocks carried to a distance of 300 metres by the wind of the avalanche.

551.31

I.

The Great Avalanche on the Gemmi Pass.

THE following is the substance of a report made by Professors Heim, Forel, and Chodat (of Zurich, Lausanne, and Geneva Universities respectively) on the subject of the great avalanche from the Altels Glacier, as the result of a personal and detailed study of the scene of the catastrophe.

On the snowy brow of the Altels (see the map, Fig. 1) is now seen a broad semicircular scar representing an ice-cliff of about 150 feet in height, and marking the point where the central glacier parted in twain. The two lateral glaciers ordinarily descend to a much lower level than the central one, which comes direct from the summit of the mountain. These have stood firm, though it is not easy to understand how that on the south side has been able to resist the shock caused by the loosening and headlong descent of the mass of ice abutting on its upper portion. In point of fact, an enormous lateral crevasse, which is visible above the line of separation, gives rise to fears lest the phenomenon should repeat itself. However, the Bernese engineers consider the shock to have been such as must have carried away everything that could possibly be detached.

According to the professors' observations, two transverse crevasses on opposite sides of the central glacier had lengthened until they at last coalesced. The continuous heat of the summer considerably enlarged the fissure. Thus the glacier became divided into a lower and an upper portion, the latter of which is still in place. On the night of the catastrophe there had been a violent *föhn* wind constantly blowing. The remaining points of detachment may thus have been loosened, while the water pouring into the crevasse and continuing its course below the glacier carried on the work of disintegration. It must be remembered that the phenomenon was facilitated by the fact that the strata on which the glacier rests have a remarkably even slope of 45°. The separation of the two parts of the glacier was thus bound to result in the precipitation of the lower portion down the mountain side. It is in the upper part that the slope of the rock-bed is most regular; lower down there are some slight undulations, while 200 metres above the Spitalmatte, which lies at the foot of the mountain, there is a projecting terrace almost vertically dominating it. It is over the edge of this terrace that the mass of ice was hurled in its bound on to the pasturage, clearing in part the ground just at the foot of the rock.

Here and there we found the grass at this part still green and free from blocks of ice or stone. In its frightful glissade from an altitude of 3,300 metres into the valley, which is 1,900 metres above sea-level (*i.e.*, a drop of 1,400 metres), the glacier, with its burden of moraine, must have acquired an enormous velocity. The Spitalmatte, together with the adjoining Winteregg alp, was a lovely glen, a true oasis in the midst of the rugged scenery (Pl. I.). It was intersected by hillocks, and on the west side, *i.e.*, that opposite the Altels, ran up to the foot of a rocky ridge (the Weissfluhgrat), which has an average height from crest to base of 300 metres, and stretches from the Weissfluh on the south to the Gellihorn on the north. At the southern extremity were four châlets not far from the frontier of Canton Valais. Forests of mountain pines cover the slopes towards the north and south. Last year 227 head of cattle, chiefly heifers, had been grazing there through the summer months. On September 13 they were to have been brought down to the lower valleys. Only three of them escaped destruction by the catastrophe, which took place on September 11, at 5.10 a.m. The three animals which were saved had doubtless strayed in the evening in a southerly direction, where they were found on the morning of the 11th, wandering in the forest.

On reaching the foot of the Altels, the avalanche, which up to this point must have consisted of one vast moving block of ice, measuring one-and-a-quarter millions of cubic metres, was reduced to fragments, at the same time that the heat generated by the shock converted these into a semi-fluid condition. Among the *débris* were to be seen some blocks of considerable size, but only a few exceeded two metres in diameter. With the velocity acquired in its descent, this river rushed across the pasturage and up the western slope of the valley to a height of 1,300 feet along the rocky wall of the Weissfluhgrat. Not being completely able to surmount this barrier, the main mass came surging back—like a vast sea wave recoiling from the cliffs—with such force that some of it returned to a height of one hundred feet up the eastern side. Isolated blocks, however, were hurled clear over the ridge into the adjoining valley, the Uschinenthal.

The avalanche was preceded by a terrific blast of wind which swept away châlets, trees, men, and cattle as though they had been feathers. This is proved by the fact that, far above the limit reached by the avalanche, hundreds of trees have been uprooted, and lie in regular rows indicating with mathematical exactitude the direction of the ærial current. These trees are for the most part of great size, several, indeed, having trunks one metre in diameter. Such as were protected by a large rock or a reverse dip on the hill-side have been spared. Others, standing with only half their height above such hollows, have had the exposed part blown off, while the subsequent on-coming of the avalanche has not succeeded in tearing up what was left of them, even when it has enveloped their base. This wind produced a veritable bombardment of ice-dust mixed with stones, which has stripped the roots and branches of the trees laid low by the wind itself, and which must have killed man and beast before ever the real avalanche overwhelmed them. Further away the trees have only been denuded of their upper portion, the

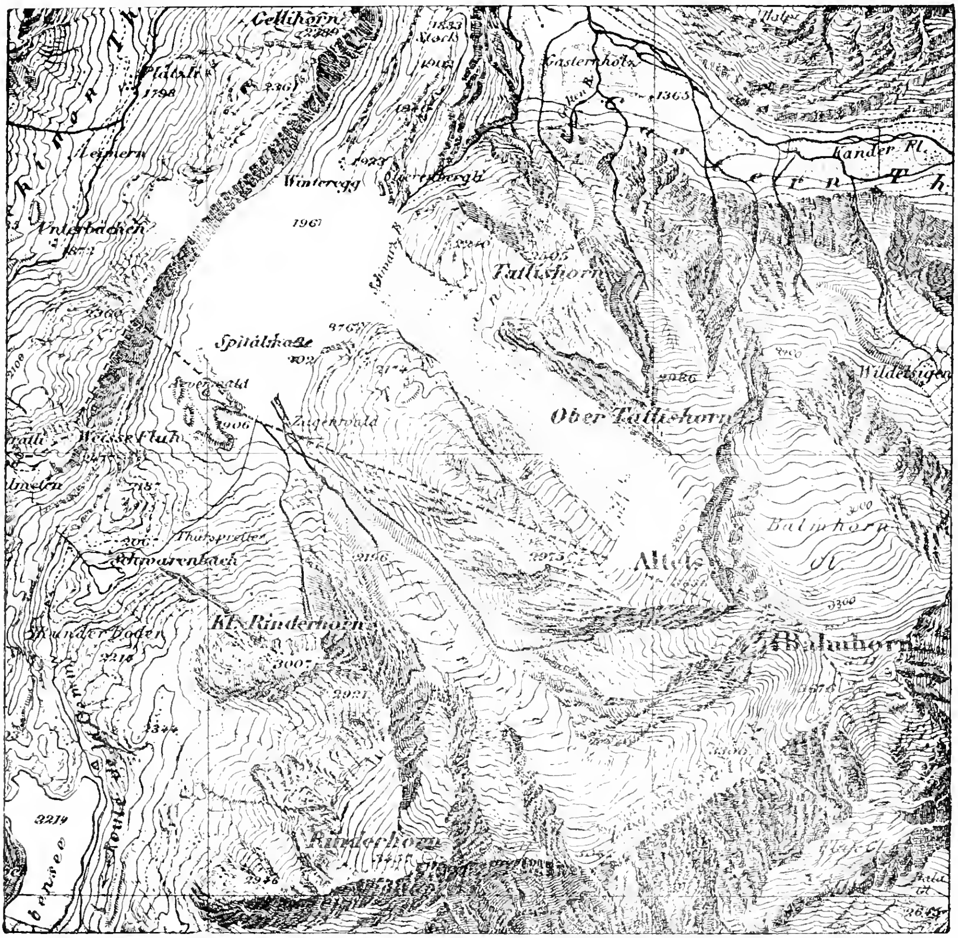

Fig. 1.—Neighbourhood of the Altels Glacier: from the Carte de l'État-Major.

The part of the glacier that was precipitated, almost up to the summit of the Altels, on the 3,300 metre contour line, is left white, as also is the ground covered by the avalanche. The course of the blocks of ice and snow is indicated by a dotted line between the Altels and the Schwarzbach.

(From *Le Journal de Genève*, Sept. 21, 1895, by kind permission of the Editor.)

branches composing which were transported to a great distance, and now form a compact line of *débris* among the far-off scattered trees, like the bank of sea-wrack left on open coasts after a fierce storm. Ice-bombs, too, round like cannon-balls, but with an average diameter of one foot, which lay all about in the neighbourhood of the fallen mass, bore eloquent testimony to the extreme violence of the wind. On the way from the Hotel Schwarenbach, before coming to the Bernese frontier, the green pasture was strewn with these balls like a battle-field in old muzzle-loading times. The true avalanche, in its recoil from the rock-wall, has formed an immense rampart, separated from the rock by a deep trench. On the sides, under the stress of the enormous power of the wind, which, like the avalanche itself, was deflected by the Weissfluhgrat, blocks of considerable size were driven around as in a whirlpool, so as, at least on the northern edge, to have been forced back up the slopes of the Altels towards the entrance of the gorge leading to Kandersteg (Pl. II.). These different atmospheric movements were well marked owing to the disposition of the materials which came under their influence. Near the Winteregg, the trees, shrubs, and grasses were all bent towards the north, forming an exterior zone, which was more and more thickly covered with the dust, etc., raised by the catastrophe as the central mass was approached. A second zone, within the first, was found to consist of the loose rocks, etc., thrust aside by the head of the ice-mass as it dashed up the west slope; the inner edge of this zone was itself covered by a layer of ice and snow, representing the matter that kept pouring off from the sides of the central body in its upward progress, and also the results of the reflux which took place when its further advance was barred. Some of the ice and stones hurled against the Weissfluhgrat had adhered to it, being plastered, as it were, into the fissures and gullies. These masses were being constantly detached from their precarious position, and kept descending in roaring avalanches. On the two sides of the projecting terrace near the foot of the Altels, over which, as has been mentioned, the glacier leapt on to the pasturage, are two immense cones of detritus, composed chiefly of the stones which were drawn down in the wake of the true avalanche, and which have followed the course of two gullies, one on the north, the other on the south.

At Leuk the people say that it was on August 17, 1782, that the Winteregg alp was overwhelmed in a similar manner. The corpses of two of the men who lost their lives in that catastrophe were not recovered from their icy tomb till June in the following year.

Howard V. Knox.

Baden, Switzerland.

II.

The Endeavour after Well-being.

WITHIN recent years not a few writers, who may be credited with average intelligence and acquaintance with the subject, have protested that the familiar phrase "*The Struggle for Existence*" is inadequate to express the general dynamic aspects of animate nature, or to serve as the sole formula for the method of organic progress. Since the views of these writers have been variously regarded,—as imposture and truism, as illusory and absurd, as important and 'scientific,' it may be useful to attempt a brief summary of the question from the point of view of one who believes in 'Natural Selection' and 'The Struggle for Existence,' but in more besides. Little can be argued out in a mere summary, hence references to literature are here and there interpolated.

1. The idea of a struggle for existence, in the course of which the relatively unfit to given conditions are more or less rapidly eliminated, is probably as old as clear thinking. We find it expressed by Empedocles, Aristotle, and Lucretius, and, apart from those ancients, by several pre-Darwinian naturalists. (See, in illustration, Osborn's admirable history "From the Greeks to Darwin," and other historical works.)

2. But the idea remained on the level of a general impression until Darwin and Wallace gave it credence as an induction, and showed, moreover, in some detail *how the struggle operated as a factor in evolution.* Darwin was, he tells us, stimulated by the essay of Malthus, who had illustrated the struggle for existence among men; and it has been said that Mr. Wallace acknowledges a like indebtedness. (See Darwin's "Life and Letters.")

3. As a matter of historical interpretation, it may be noted that many theories, *e.g.*, in economics, appear to have arisen as afterthoughts justifying or expressing current social experience. For verification of this scientific anthropomorphism, in some measure probably unavoidable, see, for instance, Ingram's "History of Political Economy." On the same line, it has been suggested that the Darwinian Theory unconsciously projected upon nature *a generalisation derived from the keen competitive conditions of the industrial age.* (See Geddes' article, "Evolution," in Chambers's Encyclopædia.)

4. The colour of Darwin's picture of nature certainly suggests a very keen and continuous struggle for existence. He speaks of 'the battle for life' and 'the severe often recurrent struggle,' and he expresses recoil from a world which is so full of misery. "In a state of nature, animals and plants have to struggle from the hour of their birth to that of their death for existence." Mr. Wallace uses similar expressions. (See "Origin of Species" and "Darwinism.")

5. But it must be observed that Darwin used *many saving clauses*, of which one of the most important is:—"I should premise that I use this term [struggle for existence] in a large and metaphorical sense including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny." ("Origin of Species," p. 50.) Similarly, Mr. Wallace says: "the struggle for existence, under which all animals and plants have been developed, is intermittent and exceedingly irregular in its incidence and severity." ("Darwinism," p. 139.)

6. Since we wish to know, not so much what even the masters have said, but what is actually the case, it would not be of special importance to consider individual statements, were it not that the opinions of the experts are presumably summations of cumulative evidence, wider than their works supply. Thus the generalisation that the struggle is most severe between closely-allied forms can hardly be supposed to rest on Darwin's half-dozen examples, not all of which are correct. In fact, having relatively few actual statistics of elimination except in cases, such as bison and beaver, where man has been the discreditable chief agent, we must still depend largely on the impressions of those who have had wide experience. Nor can it be denied that the conception of the struggle for existence has derived its force, not wholly from actual observation of what occurs, but very largely from inference as to what, it is believed, must occur. The necessity for its occurrence depends upon (a) the tendency of organisms to rapid increase, (b) the variability of the physical environment, to which organisms are at best only relatively well adapted, and (c) the secondary consequences of these primary facts.

7. Indecision of statement in regard to the stringency of the struggle is inevitable, being due in part to the complexity of nature, in part to the (alleged) fact that 'egoism' is continually moderated by 'altruism,' in part to the fact that the conception is based partly on observation and partly on inference. It is plain that the nature of the struggle must vary with the nature of the organism, thus that of the beech tree must be very different from that of the squirrel. It is plain that the phrase includes three forms of struggle—with related fellows, with foes, and with physical nature; therefore, the reality must be very diverse. The objects of competition include (1) continued individual existence and enjoyment, and (2) the continuance of family and race, both objects of manifold complexity. Finally, the struggle varies with the rate of reproduction and the variability of the environment. In

short, *it is a function of numerous—partly dependent, partly independent—variables.*

8. This conclusion—a familiar one, of course—that the struggle for existence is a function of numerous variables, leads one to agree very emphatically with Darwin that the phrase, to be true, must be used '*in a large and metaphorical sense.*'

9. But just as a reproduction almost inevitably falls short of the original, so many post-Darwinian pictures of the struggle for existence have tended to exaggerate the intensity of the struggle, and to ignore Darwin's saving clauses. Thus, generalising from the rivalry of the brown and black rat, a case for internecine competition by no means so clear as is often supposed, many have presented us —or at least 'the man in the street'—with what may be called '*the rat theory of life.*' This may be quite indifferent to the pure biologist, pre-occupied within his preserves, but it is practically important, since the moralists, economists, and theologians, who use or abuse biological conceptions, tend to derive their impressions rather from the epigoni than from the masters. And apart from less expert popularisers, who 'put a sword in the hand of a child,' as Bateson complains, has not Huxley said, "From the point of view of the moralist, the animal world is on about the same level as a gladiatorial show," and again, "He must shut his eyes if he would not see that more or less enduring suffering is the meed of both vanquished and victor." (See "The Struggle for Existence—A Programme," *Nineteenth Century*, February, 1888.)

10. Among the many cautions of which the biologist is or should be aware in appreciating the process of natural selection in the struggle for existence, the following may be noted :—(A.) *A secondary factor cannot claim rank as a primary one.* As Giard pointed out some years ago, and as we are all well aware, the primary, originative, or productive factors in evolution are the more or less unknown causes of variation ; while the secondary, directive, or determining factors in evolution are the processes of elimination, selection, and isolation, and perhaps others. This is very obvious, yet even expert Darwinians, *e.g.*, Romanes, have described natural selection as 'creating' (a *lapsus pennæ*, of course), while an independent thinker, such as Hutcheson Stirling, who puts his finger, somewhat irritatingly perhaps, on this weak point and others, has his book described as worthless and contemptible. (B.) A negative factor should not be spoken of as a positive one. See Lloyd Morgan's proposal to substitute the phrase 'natural elimination,' except in those cases where there is really (intelligent) selection (*Proc. Bristol Soc. Nat.*, v., 1887–8). Wallace also said, "Nature does not so much select special varieties as exterminate the most unfavourable," and Darwin allowed the force of the criticism. (See Darwin's "Life and Letters.") (C.) The need for, and the efficiency of, natural elimination must vary (1) in relation to the number, nature, and amount of the variations

(see Bateson), (2) in relation to the occurrence of isolation (see Romanes), and (3) in relation to the intensity of the struggle. (D.) The struggle for existence, in the course of which elimination occurs, is complex, variable, etc., and not to be simply postulated as a force of nature. How vague we are as to what constitutes an 'elimination-determinant'; how silent we are as to the moderating factor due to the 'altruism' of animals!

11. Not only does 'the struggle for existence' appear somewhat too strong a phrase to use in describing the pursuit of such luxuries as a seventh wife, or that continuous endeavour after well-being which secures a few years longer life to the stronger constitution, or the intra-germinal combat of Weismann, but there are numerous facts of life which seem hardly inclusible within its elastic scope. Among these facts, which form *the other side of the struggle for existence*, are attraction between mates, reproductive sacrifice, parental and filial affection, the kindliness of kindred, gregariousness and sociality, co-operation and mutual aid, and altruism generally. Moreover, there are numerous cases, from, to cite extremes, the manifold variety of humming-birds to the specialisation of many pelagic animals, in regard to whose struggle for existence we can venture to say very little.

12. Observation shows us what we call physical attraction between cells which are at the same time entire organisms. Through some types of simple Metazoa the attraction remains cellular, *i.e.*, between the germ-cells. Gradually there appears a sexual attraction of entire bodies. With the development of a centralised nervous system, it becomes possible to speak of two organisms being aware of one another. The awareness is by and by accompanied by a reflex of emotion, the creatures seem to be fond of each other. Various æsthetic attractions are added to the primary ones, and, on an inclined plane, 'love' emerges. At the same time, however, there has evolved a parento-filial affection, and it is easy to understand how 'love,' broadened in the family, returns enhanced to the pair. Mixed up with this there is also the evolution of a sense of kinship, which is expressed in mutual aid.

13. "*Giebt mir Materie*," Kant said, "*und ich will daraus eine Welt schaffen*," and it is not difficult to imagine—impossible as it may be to prove—that from a protoplast with its ordinary functions, with its chemotaxis, thermotaxis, cytotropism, and more besides, there may have evolved sexual attraction, a feeling of kinship, and love. But what is difficult to understand is that a cultured science should scoff at those who point to the open secret that sexual attraction, kinship, altruism, and love are factors in life, moderating and transforming the struggle for existence. (See Spencer, Darwin, Fiske, Geddes, "Evolution of Sex," Kropotkine, Drummond, Coe, etc., etc.

14. Just as Empedocles recognised two ultimate forces—love and hate—so Spencer has insisted on recognising altruism as well as

egoism in Nature. "If we define altruism as being all action which, in the normal course of things, benefits others instead of benefiting self, then from the dawn of life, altruism has been no less essential than egoism. Though primarily it is dependent on egoism, yet secondarily egoism is dependent on it." "*Self-sacrifice is no less primordial than self-preservation.*" (See "Principles of Ethics" and "Principles of Psychology.")

15. As to the propriety of using the word altruism in the wide Spencerian sense, there may be difference of opinion (see "Data of Ethics"); and truly it is 'mere poetry' to have no scruple in reading the man into the beast or even into the plant and the cell. But so long as we do not attach unwarranted ethical content to altruistic action, there seems no confusion in asserting that motives comparable to 'altruism' and 'love' have their place beside 'egoism' and 'hunger' in the process of evolution.

16. As to the origin of egoism and altruism, we are equally in the dark in regard to both. We *suppose* that both are primary qualities, springing from the very heart of things; we only *know* that they rise from grade to grade with complex interactions (see diagram in "Evolution of Sex"). In the development of both there has probably been much elimination, some lines of which Spencer has suggested; both the ultra-egoistic and the ultra-altruistic are doomed. But elimination is directive, not originative. In regard to origin, Darwin suggested that the social sensations "were first developed in order that those animals which would profit by living in society should be induced to live together, in the same manner as the sense of hunger and the pleasure of eating were no doubt first acquired in order to induce animals to eat"; or was the master ironical in this return to *die alte Teleologie*?

17. Evolutionists who insist that the ordinary formula—the natural selection of variations in the struggle for existence—is adequate to express nature's method, or is, as our foremost zoologist says, "the one medium whereby all the phenomena of life, whether of form or function, are rendered capable of explanation by the laws of physics and chemistry," may be reminded (1) that their theory has not as yet been eminently successful in explaining many of the 'big lifts' in evolution, such as the acquisition of a body, the evolution of sex, the origin of mammals, the origin of the family, the ascent of man, and a score of others; (2) that the often-repeated psychological attempt to explain the higher aspects of human nature on this basis has hitherto failed, while even the Nestor of modern ætiology falls back on "spiritual influxes"; (3) that a denial of the importance of altruism among the beasts leaves the evolutionist who will account for the gentleman in the position of him who sawed at his own supporting branch, and leads to Huxley's strangely paradoxical conclusion, with which the moralists have sufficiently dealt, that ethical progress depends on combating the cosmic process—a con-

clusion that stands in interesting antithesis to Geddes' description of evolution as "a materialised ethical process."

18. And if it be said that attempts made to explain the 'body,' the colony, the pair, the mammal, the family, the gentleman, by recognising 'altruism' and 'love,' kinship and sociality, etc., as facts of life—not less inventive than 'egoism' and 'hunger,' competition and struggle—are mere interpretations, one is driven to ask if more can be said of the elimination theory. Has not Weismann admitted that the operation of natural selection is in no case rigidly demonstrable? Not that one would disbelieve in it on that account!

19. But if it should be said that all this is a tilt against a windmill, and that all are agreed that progress depends on much more than a squabble around the platter; that the struggle for existence is far more than an internecine struggle at the margin of subsistence; that it includes all the multitudinous efforts for self and others between the poles of love and hunger; that it comprises all the endeavours of mate for mate, of parent for offspring, of kin for kin; that love and life are factors in progress as well as pain and death; that existence for many an animal means the well-being of a socially-bound or kin-bound organism in a social *milieu*; that egoism is not satisfied until it becomes altruistic—then we *are* all agreed, but the colour of the picture has changed.

J. Arthur Thomson.

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III.

The Constantinople Earthquake of July 10, 1894.

FROM time to time, but fortunately at long intervals, the country round Constantinople has been shaken by disastrous earthquakes. During the Christian era, the present city or its predecessor has been seriously damaged not less than thirteen times. The last occasion was on July 10, 1894, and the havoc then wrought must be fresh in the memories of all who read this paper.

H.I.M. the Sultan showed much interest in the investigation of this earthquake, which was undertaken by Mr. D. Eginitis, the Director of the Observatory of Athens. Official despatches were forwarded to the latter, and a Government steamer placed at his disposal, enabling him to visit rapidly the chief scenes of disaster. Another important result of the Imperial interest is the recent formation of a geodynamic section of the Meteorological Observatory at Constantinople. This has been placed under the charge of Dr. G. Agamennone, who for several years previously held a similar office at Rome. Delicate instruments have been, or will shortly be, erected at Constantinople with the object of founding there what is called in Italy a geodynamic observatory of the first order. Dr. Agamennone is also collecting statistics of the earthquakes felt in the islands and bordering countries of the eastern Mediterranean, and the Bulletins (2) which he issues every month are full of valuable records, many of which might otherwise have been lost.

Isoseismal Lines.—The central area disturbed by the last great earthquake is shown on the accompanying map (Fig. 1), which is reduced from that prepared by Mr. Eginitis (7). Of the three isoseismals (or lines of equal earthquake intensity) marked on it, the first surrounds the area of greatest destruction, in which well-built houses were thrown down. The second includes all places where badly-built houses were overthrown or strongly-made walls were fissured; the third those in which buildings were in no way damaged, but loose objects were displaced or overturned. These three isoseismals correspond approximately to intensities 9, 8, and 7 of the Rossi-Forel scale. The fourth, which is not shown on the map, bounds the area over which the shock was perceptible to ordinary observers. It extends as far as Janina, Bucharest, Crete, Greece, Konya, and over a great part of Asia Minor. Outside this line, Mr. Eginitis distinguishes a fifth zone, in which the shock was sensible only to delicate seismographs and magnetic instruments. This zone is of immense extent: it includes practically all Europe and large areas in Asia and Africa. There is no reason, however, for placing any terrestrial limit to its expansion; for a good horizontal pendulum erected at almost any spot on the earth's surface would have registered the passage of the earthquake-pulsations. The time will soon come, we may well hope, when a system of these wonderfully sensitive instruments may be established at certain selected stations all over the world, and we may then be able to trace the pulsations of a great earthquake as they travel round the globe, perhaps more than once, after the manner of the air-waves from Krakatoa in 1883.

The chief feature of the first three isoseismals is one that characterises those of nearly all severe earthquakes in countries

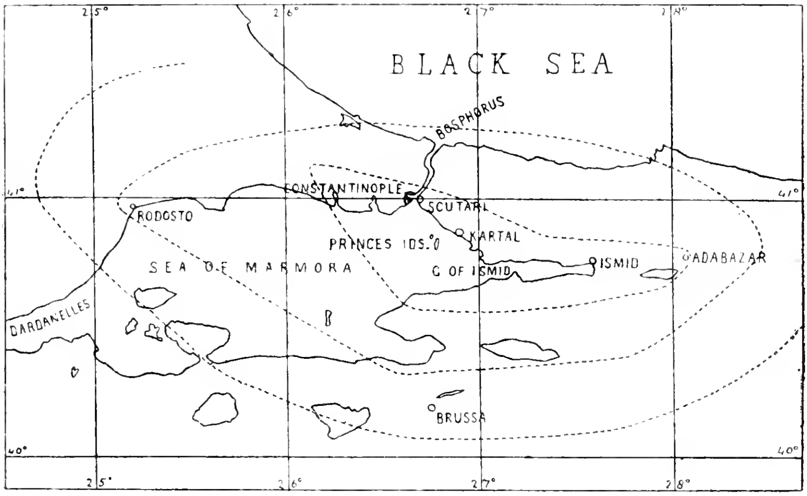

FIG. 1.—MAP OF THE CONSTANTINOPLE EARTHQUAKE.

where they are frequent and violent—that is, in which the rate of tectonic development is now rapid. This is their extreme narrowness compared with their length. The first isoseismal, for instance, is 175 kilometres long and only 39 broad, the second 248 by 74, and the third 354 by 175 kilometres. The natural inference is that the seismic focus is not a point, but of great length and parallel to the axes of the isoseismal lines.

Nature of the Earthquake and other Phenomena.—At Constantinople the earthquake was felt shortly after noon. Mr. Coumbary, the Director of the Meteorological Observatory, gives the time as 0.24 p.m. (mean local time). Three shocks were felt in rapid succession, there being hardly any interval between them. The first was the weakest. It was preceded for a second or two by a loud noise, like the rolling of many carriages on a paved road. It was horizontal, lasted four or five seconds, and continually increased in intensity, but was at no time strong enough to overturn or displace loose objects. A slight pause, and then came the second and most powerful shock, vertical and rotatory in direction, and accompanied as before by a deep rumbling noise. It grew gradually stronger, and it was during the eight or nine seconds of its duration that nearly all the loss of life and damage to property occurred. After a similar pause followed the third shock, lasting five seconds, with the same underground noise, undulatory, and towards the end horizontal in direction. The total duration of the earthquake was thus about seventeen or eighteen seconds.

At many places within the first isoseismal the direction of the shock was determined, and this was always found to be nearly parallel to the shorter axis of the isoseismal. At others the shock was vertical or rotatory, and, apparently, this was only the case in the immediate neighbourhood of the epicentre. The reason of this appears to be that the first vibrations come from the nearest parts of the focus, and, therefore, in most neighbouring places, in a direction roughly at right angles to it, while the later vibrations come from the more distant parts and in a different direction; so that it is only near the focus that the rotatory motion should be distinctly observed. In Prinkipos, the largest of the Princes Islands, a chimney was split horizontally into three pieces, which were all twisted from the north towards the east.

Most of the secondary phenomena which generally accompany a great earthquake were present in a more or less marked degree. Some springs ceased to flow for a few hours, and afterwards returned to their original condition. Others increased in volume, or the water was disturbed. In several, though not many, places the ground was fissured. The most important crevice observed was three kilometres long, and 8 cm. in maximum width. This was in alluvial ground, at Hambarly, to the west of Constantinople, and 300 metres from the sea. It was, as usual, parallel to the coast, and was, no doubt, caused by the sliding of the unsupported mass. About three miles from Kartal, that is, close to the longer axis of the first isoseismal, the Kartal-Dardanelles cable, belonging to the Eastern Telegraph Company, was broken in several places. The fractures were quite clean, as if the cable had been cut with a knife, showing, as Mr. Eginitis remarks, that they were not the result of a great tension. He suggests that they were probably caused by the fall of rocks, but bearing in mind the position of the fractures, is it not more likely that they were due to a sudden displacement of the ocean-bed—to the formation, perhaps, of a fault-scarp which was but the superficial continuation of a slip that may have caused the shock? If this were the case, there would be some change in the depth of that part of the Sea of Marmora, though it might be too slight to be perceptible. Soundings were, indeed, made in this district, and they differed from those given by the English Admiralty Chart, but unfortunately, it is not quite certain that they referred to the same spots.

Other evidence pointing to a sudden movement of the ocean-bed is furnished by the seismic sea-waves. Wherever it was observed, the sea first retired several metres—at San Stefano as much as 200 metres—and then, after some oscillations, returned to its original level. On the opposite side of the Sea of Marmora and outside the first isoseismal, however, no observations were made, and it is therefore uncertain whether the first retreat of the sea was universal.

Earthquake-Pulsations.—The island of Crete appears to be the most outlying district where the earthquake was actually felt, and this is about 450 miles from Constantinople. But to a distance far beyond this the pulsations spread outwards, and, as they passed each spot, the ground there rocked slowly and gently to and fro through an angle of, perhaps, not more than a fraction of a second. At Nicolaiew, in the south of Russia, a horizontal pendulum was so strongly disturbed that it was thrown out of position. At numerous stations in Italy, long and heavy pendulums recorded the passage of the pulsations. They were registered by magnetographs at Pola, Potsdam, Wilhelmshaven, St. Petersburg, Utrecht, Paris, and even at Kew, which is more than 1,560 miles from the seat of disturbance.

In Fig. 2 is reproduced the record of the pulsations at Siena, obtained with the aid of the Vicentini microseismograph. This instrument consists of a heavy pendulum, from the base of which a lever projects vertically downwards. The lower end of the lever is connected with the short arms of two very light horizontal levers at right angles to one another, and the longer arms of the latter end in fine points which leave their traces on a strip of smoked paper driven just underneath them by clockwork. Each of the divisions on the intermediate straight line corresponds to an interval of one minute. The record begins on the left side of the diagram, and for several minutes the movement was so great that Professor Vicentini, who happened to be watching the instrument, found it necessary to displace the paper sideways to prevent one of the pens from leaving the smoked surface. It will be seen from the figure that the movement of the ground lasted for more than three-quarters of an hour; and this was not due to the free swinging of the pendulum, for the period of the pulsations near the close was several times greater than the period of oscillation of the pendulum (9).

At many places it is possible to ascertain the moments when the first small movement became perceptible, and also when the larger pulsations began and ended. If the time at which the earthquake was felt at Constantinople were known with equal precision, we should be able to obtain a good estimate of the velocity of the pulsations. Unfortunately, this important element of the calculation is not free from doubt. Mr. Coumbary gives the time at the Meteorological Observatory as 0·24 p.m. (Constantinople mean time). At first sight, one feels disposed to accept such a statement without question. The Observatory clock is not, however, regulated by transit, but by sextant, observations, and the latter are not nearly as exact as the former. Moreover, there is a considerable difference between Mr. Coumbary's estimate and those which Mr. W. H. Wrench, the British Consul-General at Constantinople, kindly obtained for me (5). He ascertained that the regulating clocks of two prominent watchmakers in the city were stopped, one at 0.20½ and the other at 0.21¾, the owner of each clock being confident that his time was correct. But Mr. Wrench informs me that there is no standard clock in Constantinople capable of giving correct time, so that the

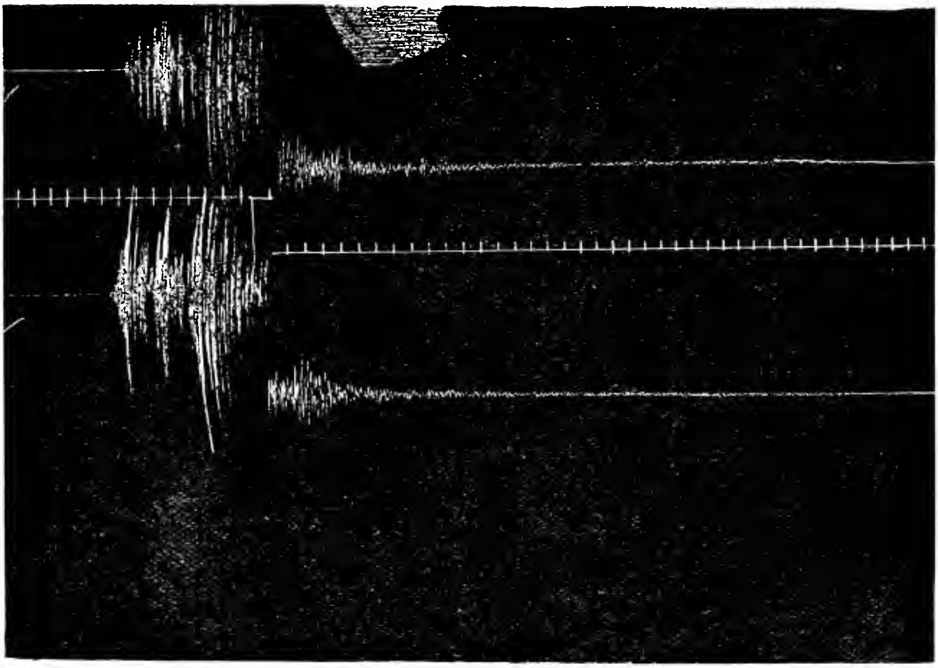

FIG. 2.—CONSTANTINOPLE EARTHQUAKE-PULSATIONS AS RECORDED BY THE VICENTINI MICRO-SEISMOGRAPH AT SIENA.

close agreement between these two estimates may be only accidental. On the whole, therefore, while recognising that a doubt exists on the point, I think that Mr. Coumbary's time is likely to be nearer the truth than the others. If it may be regarded as correct, then the larger pulsations must have travelled outwards with an average velocity of two miles a second; but if one of the other times be adopted, as Dr. Cancani thinks desirable (4), then the average velocity would be either 1·4 or 1·6 miles per second. The correct value thus probably lies between 1½ and 2 miles per second.

Depth of the Seismic Focus.—To ascertain the depth of the seismic focus, Mr. Eginitis has employed the well-known method used by Messrs. Dutton and Hayden for the Charleston earthquake of 1886. The evidence on which his calculations are based is not described, but the result obtained for the depth is 34 kilometres or about 21 miles. Another estimate has been made by Mr. Lacoine (7). This is founded on the times of occurrence of the earthquake at different places, and the result arrived at is the same. The coincidence is striking, but it should not, I think, be inferred that the result is trustworthy, for both methods of calculation are liable to the same source of error, namely, the varying refractive powers of the different rocks traversed by the earthquake waves in their passage from the focus to the surface. The method of Dutton and Hayden is, moreover, open to a serious objection. If it were correct, it would follow that, for all earthquakes originating at the same depth, the distance from the epicentre of the line on the surface (the "index-circle") at which the intensity declines most rapidly would be the same. But it is conceivable that many earthquakes with the given depth of focus may not be perceptible so far as the index-circle, perhaps not even at the surface at all. Since it fails, then, in these cases, the method can hardly be expected to give correct results in others. Indeed, the problem of finding the depth of a seismic focus is one that at present lies beyond our range. The only guide our knowledge gives us is to look with suspicion on any estimate so great as twenty miles.

After-shocks.—The principal earthquake was succeeded, as usual, by many after-shocks, though these were less numerous than is often the case.[1] One reason for this may have been that a large part of the epicentral tract was submarine, and thus the district where they are most frequent lay beyond the reach of observation. At Constantinople four slight shocks were felt on July 10, the day of the earthquake, three on the next day, and ten more before the end of the month. After this they became still less frequent, though several months elapsed before the district returned to its usual condition (1, 2).

Origin of the Earthquake.—Mr. Eginitis points out that the axis of the first isoseismal coincides with the line of depression which begins at Ada-Bazar, and is marked by the Lake of Sabandja and the Gulf of Ismid. He suggests that the earthquake was tectonic—in other words, connected with the moulding of the earth's surface features. This he infers from the absence of volcanoes in the district affected, the great calculated depth of the focus, the elongated form of the isoseismal lines, the intensity of the shock, and the immense area over which it was observed. With this conclusion, probably, all geologists will agree, though not unnaturally they may desire more detailed information as to the way in which the moulding was effected. The evidence is too scanty to provide this with any certainty, but what there is seems to me to support the view that the earthquake was caused by a great fault-slip, the effect of which has been to deepen the Gulf of Ismid.

[1] See NATURAL SCIENCE, vol. vi., pp. 391–397, June, 1895.

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IV.

Recent Work on Seaweeds.

STUDENTS of algæ will welcome Messrs. Macmillan's new volume of Science Manuals, namely, that on the Study of Seaweeds, by Mr. G. Murray (1). The author meets a pressing need in providing a handy and trustworthy text-book. The study of algæ is continually advancing, and an immense amount of work has been done in recent years, so that the aspect of the whole subject has been changed by the progress of research. The results arrived at by the workers are scattered in many papers, both English and foreign, or are embodied in lengthy monographs which are not easily accessible. A wide-spread interest in seaweeds, or any exact knowledge of the subject, has been difficult, as there has been no book other than systematic works to guide the student. Phycologists like Mr. Bornet and others, who were able to undertake such a task, have been content to publish at intervals the results of their own observations on morphology and development; they have stopped short of arranging the results in text-book form. This is the more remarkable when we consider the splendid treatises on Fungi by Berkley and De Bary.

Mr. Murray's "Introduction to the Study of Seaweeds" is critical throughout, and the facts have been selected from abundant material with great care. The introduction deals with the biological conditions of marine plants, their economic uses, and their distribution in space and in time. The record of fossil algæ is, however, very small, that branch of phycology being somewhat starved for lack of material. A large field of investigation has been opened up in the study of plankton plants—the floating algæ of the open sea, the extent of which has been proved to be so much greater than that of the coast marine flora. "A recent estimate of the bulk of this flora," writes Mr. Murray (Introduction, p. 19), "compares the inconspicuous marine organisms of the Sargasso Sea with the bulk of the floating banks of gulf-weed that give this great tract of ocean its name, with the result that the microscopic forms enormously exceed the gulf-weed in aggregate mass." Mr. Murray lays special stress on the economic importance of these microscopic plants, which form the primary food of marine animals, and merit more attention than they have yet received from authorities on fishery matters.

In the main part of the work the author begins with the brown seaweeds, as being the more familiar forms; he discusses each Order, with the life-histories of certain typical forms, indicating any divergence that occurs in other members of the group, and giving in each case the geographical distribution of the genera. He then takes up the Chlorophyceæ, in which plankton forms are numerous and include the plants that cause the brilliant luminosity of tropical and other seas. The Diatomaceæ are treated as a separate sub-class by Mr. Murray, for, though they are nearly related to Orders under the Chlorophyceæ, they are separated off from these by their brown colour. Dr. Schmitz's sketch of the classification of the Florideæ forms the basis of arrangement for the Rhodophyceæ. They are divided into four orders, viz., the Nemalionaceæ, the Gigartinaceæ, the Rhodymeniaceæ, and the Cryptonemiaceæ. The grouping is made to depend entirely on the development and structure of the carpogonium, while the vegetative characters show considerable diversity even in genera placed side by side, as, for instance, *Delesseria* and *Claudea*, which are both placed in the family of the Delesserieæ. The Cyanophyceæ have been described last of all: they do not form a large group, many of them being fresh-water forms. The book is very fully illustrated with drawings that, with one or two exceptions, have not appeared in any text-book of general botany, many of them having been prepared for this volume. The coloured plates give illustrations of the typical British forms of the principal Orders.

The new forms recently described are very important, and include plants from North and South America, the East Coast of Africa, and the Cape of Good Hope, as well as from European shores. Mr. E. A. Batters (2) publishes those found lately in Britain; he adds two new genera, *Tellamia* (green) and *Hymenoclonium* (red), and five species, four of which are described for the first time. He has founded a new natural Order, Buffhamiaceæ, on the genus *Buffhamia*, one of the Phæosporeæ, on account of its peculiar vegetative character, a mode of classification also followed by Kjellman in his Phæophyceæ. Mr. Murray, in his "Study of Seaweeds" (1, p. 87), writes regarding the multiplying of Orders: "Considering how much remains to be discovered in the neighbouring groups, it appears to be scarcely justifiable to add, on grounds mainly of vegetative development, to the already excessive number of orders in the Phæophyceæ." Mr. Murray has carried out his own theory in this matter by sinking the Myriotrichaceæ into the Order Elachistaceæ, while he has placed *Stilophora* and *Spermatochnus*, which had each a natural Order allotted to it by Kjellman, provisionally under Sporochnaceæ.

Miss Barton (3) has made the Cape marine flora her own, and her "Notes on *Bryopsis*" have reference to Cape specimens; she figures and describes, for the first time, the haptera of *Bryopsis cupressina*, Lam., by which the younger plants attach themselves to the parent stem, and thus grow into colonies of bushy tufts; she adds one new species to the genus, *B. Flannagani*, named after Mr. Flannagan, by whom it was collected.

Several lists of algæ have been contributed by Mr. Paul Hariot to the *Journal de Botanique*. Those from the Straits of Magellan (5) were sent to him by the late Professor Schmitz, and had been collected by Mr. Michaelsen. Among them he found one new species, which he named *Lithothamnion Schmitzii*. From California (6) he records three new species, a welcome addition to the flora from a little-known part of the ocean; and from the West Coast of Africa (4) sixteen species, one of which is new, *Calophyllis Lecomtei*, a small plant with very distinct pinnate branching.

Two new species of *Dermocarpa* have been recently figured and described by Mr. Sauvageau (14), *D. biscayensis* and *D. strangulata*, both of which were found growing along with *D. prasina* on a branch of *Sargassum flavifolium* that had been thrown up by a storm at Biarritz. The *Dermocarpa* cells were all in a vegetative condition; but in several cases he noted a slight median constriction, that seemed to indicate a division of the vegetative cell into a persistent basal portion, and an upper sporangial cell. Cell-measurements served to determine the new species, and such a formation would still further differentiate them from *D. prasina*, with which they might have been confounded. A revision of *Dermocarpa* was needed before, and the establishment of new species on such grounds points to its immediate necessity.

A posthumous paper by the deeply-lamented Professor Schmitz, of Greifswald, on the Florideæ of East Africa (7) has also been issued. German botanists are publishing a careful account of the whole flora of their territory in East Africa, and this paper forms one of a large series. Dr. Schmitz records from there six new species; and he has made *Gelidium variable*, Grev., which occurs in Ceylon as well as on the African Coast, the type of a new genus *Gelidiopsis*, placing it, on account of its vegetative character and development of the cystocarp, near *Ceratodictyon*. He finds the flora on this coast, as we should expect, entirely tropical, resembling that of the north-west region of the Indian Ocean; it is characteristically rich in encrusted forms. A large tract along the coast of Mozambique still remains unexplored; but the plants found nearer the south, in Algoa Bay and Natal, are very similar to those growing further north. It is a striking fact that the seaweeds from the shore west of the Cape are very different. Dr. Schmitz notes this as if for the first time, and suggests the influence of currents as a possible solution of the problem. Miss Barton has already published a convincing explanation of the great difference in the flora of these two contiguous regions. In discussing the Cape flora (*Journal of Botany*, vol. xxxi., p. 206, July, 1893) she says, "On the east, there is a strong warm current flowing southward from the Indian Ocean, bringing with it the tropical and subtropical forms to Natal and even to Cape Agulhas; while another branch of the same current flows direct from Mauritius, where the algæ are, as would be expected, very similar to those at the Cape, though the two places are in such different latitudes. On the west coast, however, we find a different state of affairs. There is a cold current which comes up from the south, bringing icebergs as far north as 35° 50′, and this has naturally a marked effect on the algæ all up this coast."

Another paper, dealing exclusively with distribution, by Mr. Murray and Miss Barton (11), in the last number of the recently-completed volume of the *Phycological Memoirs* compares the Arctic and Antarctic marine floras. There are fifty-four species common to the north and south of the tropical belt, but not occurring within it, a fact that points to a uniform temperature of the sea from equator to poles in early geological ages. The authors quote from Dr. John Murray's "Summary of the Results of the 'Challenger' Expedition," the theory first introduced into geological speculation by Blandet (*Bull. Soc. Géol. de France*, ser. 2, vol. xxv., p. 777; 1867–68), that the size of the sun was much greater in the early stages of the earth's history. The sun was so great, relatively to the earth, that at the equinox its rays fell on the planet from pole to pole, and some degrees beyond, giving a day of twenty-four hours at each pole simultaneously. There would thus be a high temperature and sufficient light to permit of the "luxuriant vegetation that once flourished in these regions." Explain the facts as we may, it is very remarkable to find so many species common to two areas so entirely separated from each other. Another fact, disclosed by the distribution-tables, is the change from the northern Fucaceæ to the Sargasseæ of the tropical belt, and then to other Fucaceæ in the southern seas, "these last resembling the northern forms in general facies, but yet generically distinct in most cases."

In the department of morphology there have been several interesting contributions, notably those by C. Sauvageau on *Ectocarpus* (12, 15); it is just such observations and careful records that are necessary to complete our knowledge of even such common Algæ as those he describes. *Ectocarpus tomentosus*, he finds, has many-chambered sporangia with zoöspores, which, after swarming, come to rest and germinate without conjugation. It bears also single-chambered sporangia, which contain motionless spores, a condition of affairs which is as yet recorded for no other species. *Ectocarpus pusillus*, an equally aberrant species, has immobile spores in many-chambered sporangia. Mr. Sauvageau gives an account of four varieties of *E. pusillus* (15), viz., vars. *typica* and *riparia*, which are epiphytic on *Corallina officinalis* and *Polysiphonia*, and vars. *Codii* and *Thuretii*, which are endophytic, the one in *Codium*, the other in *Nemalion* and *Helminthocladia*. Though differing in habitat and general facies, they correspond in the size of the filaments and in the many-chambered sporangia with the large immobile spores, as also in the presence of "short flexuous fibres," noted by Mrs. Griffiths as so distinctive of *E. pusillus*, which, tendril-like, hold the filaments together, or serve to attach the parasite to the host-plant. Kjellman's classification of the

Phæosporeæ according to the motility or non-motility of the spores would exclude this species entirely from *Ectocarpus*, and necessitate a new genus of Acinetosporeæ, but Mr. Sauvageau is of opinion that, with our imperfect knowledge of the reproductive organs, more stress ought to be laid on morphological characters in classification, thus preventing the confusion that arises from a too ready multiplication of genera and species.

C. Sauvageau (16) has also made a most interesting discovery of unilocular sporangia in *Asperococcus compressus*. Buffham, who first noted their occurrence in the genus, found them growing in sori on *A. bullosus*; in the case of *A. compressus* they grow in irregular patches almost covering the frond.

In the last number of the *Phycological Memoirs* Miss F. Whitting, in conjunction with the present writer, has published an account of the fruits of *Macrocystis* and *Postelsia* (10). It is found that the sporangia grow in sori at the base of deep, over-arching furrows, a cross-section of which very forcibly recalls the conceptacles of *Splachnidium*, and confirms the view that the function of conceptacles in the brown seaweeds is mainly protective.

Mr. Murray (9) has given an account of a number of calcareous pebbles from a pond in Michigan formed of various species of Oscillarieæ, organisms that are commonly so encrusted only in hot springs. A comparison was made with some pebbles found in Lough Belvidere, near Mullingar, and the same Alga, *Schizothrix fasciculata*, was found predominant there also.

A beautiful specimen of *Pachytheca*, more complete than any of those formerly found, has also been figured and described by Mr. Murray (8) "not out of conviction that *Pachytheca* is an Alga, but because if it be a plant at all it is most probably an Alga." The specimen lay like a little ball in an outer cup, like an egg in an egg-cup, and the broken edges of the cup showed that it was composed of radial chambers which strongly resembled the sporangial rays of *Acetabularia*. But there the resemblance ceases, there is nothing in the verticillate Siphoneæ to correspond with the *Pachytheca* sphere.

A very interesting morphological paper (13) by Professor Phillips, of Bangor College, is devoted to red seaweeds, "the development of the cystocarp in Rhodomelaceæ"; it is well illustrated and very full and clear. The author follows closely the discoveries of Dr. Schmitz, comfirming and completing them. In *Rhodomela* he has been unable to trace any oöblastema filaments from the carpogonial cell to the auxiliary cell, or any fusion between them, but suggests that there may have been a transference of nuclear matter through fine pores—a kind of fertilisation process. He has been able to follow out most minutely the development that follows fertilisation, viz., the cutting off, from the presumably fertilised auxiliary cell, of the upper cell, which gives rise to the spores, the detachment and withering of the carpogonial branch, and the branching of the central cell to form a layer of cells round the interior of the cystocarp. This layer, he suggests, may possibly supply the mucilage which is found in the mature cystocarp, and is afterwards ejected with the spores. He notes other interesting details in other species of the Order. There is a remarkable similarity among them in the structure of the procarp at the moment of fertilisation, and only when spore-formation has begun do they vary.

Dr. Friedrich Oltmanns published in Pringsheim's *Jahrbücher*, xxiii., 1891, an account of observations and experiments on the life-conditions of Algæ, all tending to prove the extreme sensitiveness of these plants to change of environment. Temperature and illumination had to be carefully attended to in any attempt to cultivate them; but the chief point of importance he decided to be variation in the salinity of the water. Any abrupt alteration of density seemed to be very hurtful, and he advocated careful and gradual change of water in aquaria. Subsequent researches (14) have caused him considerably to alter his opinion; he found that the mortality in the weeds he was dealing with was caused by undetected impurities in the water rather than by any change of medium, though that, too, was not unimportant. He was convinced that the oligodynamic effects described by Nägeli as being so fatal to *Spirogyra* cells had a potent influence on his plants. In order to secure healthy growth, he had, therefore, to be very careful to avoid using vessels made of metal to convey the sea-water. The poverty of the flora at the mouths of canals and rivers, while partly due, as he had supposed, to the constant alternation of fresh and salt water, was also largely caused by impurities and by the evolution of noxious gases due to decomposition. He was able to change the water in which the weeds grew with a variation of ten per cent. in salinity without the slightest effect on the plants. The best results in culture were obtained by keeping up a continuous stream of water through the aquarium, so gentle as not to carry off any swarm-spores. Sterilising the water supplied was advisable, if not necessary, to destroy bacteria and kill off all undesired spores. The presence of carbon dioxide in larger or smaller quantities was not of great importance within certain limits, so that the aëration of the water, which Oltmanns had thought hurtful in carrying off too much of the gas, had, in reality, no marked effects. One very interesting result was the possibility of propagating algæ by "cuttings." He grew a quantity of Polysiphoniæ and Ceramieæ in this way, only he had to see that each "cutting" of *Ceramium* included the small nodal cells, otherwise the plant would not grow.

Collectors of algæ will be glad to learn that J. P. Lotsy describes a simple method of preserving Red Algæ, so as to keep the cells and colour in their natural condition. The instructions are extracted from the *Botanisches Centralblatt*, vol. lx., pp. 15, 16. "Place the Algæ in a solution of 10 grms. chrome-alum in 1 litre sea-water for 1–24 hours. Wash carefully to remove all trace of chrome-alum, then place the Algæ in about 100 c.cm. sea-water, and add at intervals of a quarter of an hour 5 c.cm. alcohol (96 per cent.), until there are added 25 c.cm. Transfer the plants to a 25 per cent. alcoholic solution and add as before at intervals of a quarter of an hour 5 c.cm. of alcohol, until 125 c.cm. of the solution contain 50 c.cm. alcohol. Then transfer gradually to 50, 60, 70, 80, 90 per cent. alcohol, and allow to harden." As most Red Algæ maintain their colour remarkably well in herbaria, all this trouble in most cases would be thrown away.

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12. **Sauvageau, C.**—"Note sur l'*Ectocarpus tomentosus* Lyngbye." *Journ. Botanique*, vol. ix., pp. 153–157. April, 1895.

13. **Phillips, R. W.**—"On the Development of the Cystocarp in Rhodomelaceæ." *Ann. Botany*, vol. ix., pp. 289–305, plate x. June, 1895.

14. **Oltmanns, Friedrich.**—"Notizen über die Cultur und Lebensbedingungen der Meeresalgen." *Flora*, vol. lxxx., pp. 35–38. Feb., 1895.

15. **Sauvageau, C.**—"Notes sur l'*Ectocarpus pusillus* Griffiths." *Journ. Botanique*, vol. ix., pp. 274–280, 281–291, 307–318. Aug., Sept., 1895.

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ANNIE LORRAIN SMITH.

V.

The Perth Museum of Natural History.

ON Friday, November 29, Sir William Flower inaugurated the New Museum of the Perthshire Society of Natural Science. It is now almost thirty years since this Society came into existence. On February 28, 1867, some sixteen gentlemen met in a small room in Perth for the working out of the geology, botany, and zoology of Perthshire. Among the number was the late Dr. F. Buchanan White. The meetings of the little Society were successful from the first; the members soon overflowed their single room, and new premises were obtained in St. Ann's Lane. These new premises were still of a temporary character, and the then president, Sir Thomas Moncreiffe, brought forward a scheme for the building of a suitable house for the Society, in which provision should be made for library, lecture-hall, and museum. This scheme Sir Thomas did not live to see realised, but it was pressed forward by his successor, Dr. James Geikie, under whose presidency subscriptions were invited and came in to the extent of about £3,000. On October 1, 1881, the Society entered into possession of its new house, the frontage of which, as it still exists, is shown in the photograph (Fig. 1). The ground-floor of the building contains the library and lecture-room; the upper storey has for fourteen years contained the natural history museum. This space was still altogether inadequate to contain the Society's rich and rapidly increasing collections, and in the summer of 1882, on the retirement of Dr. Buchanan White from the presidency, Mr. Henry Coates, the new president, proposed that the labours of his predecessor should be crowned by the erection of a new museum. Sir Robert Pullar headed a subscription list with a donation of £1,000, and other friends of the Society contributed some £2,000 more. This new addition, which stands immediately behind the old buildings, is that which Sir Wm. Flower came down to open the other day, and with it the present paper has to deal. The main object of the Society was from the first to obtain a separate museum, to be devoted to the fauna, flora, and geology of the county. The architects, Messrs. J. & G. Young, have taken extreme pains to produce a building in all respects suitable for the purpose, and we believe that we possess a museum that will compare favourably with any provincial museum in the country for adaptation to systematic arrangement, for perfection of lighting, and for quality of material and workmanship in all its internal fittings.

The new hall measures 44 feet by 34 feet. A gallery 15 feet from the ground is supported by iron pillars which reach upwards to the roof. The whole middle part of the roof is of glass, and its curved sides over the gallery are beautifully arched and moulded, the corner alcoves being a chief triumph of the architect's skill.

The front of the gallery is handsomely constructed of pitch-pine, carved and panelled. The general colour of the interior is cream,

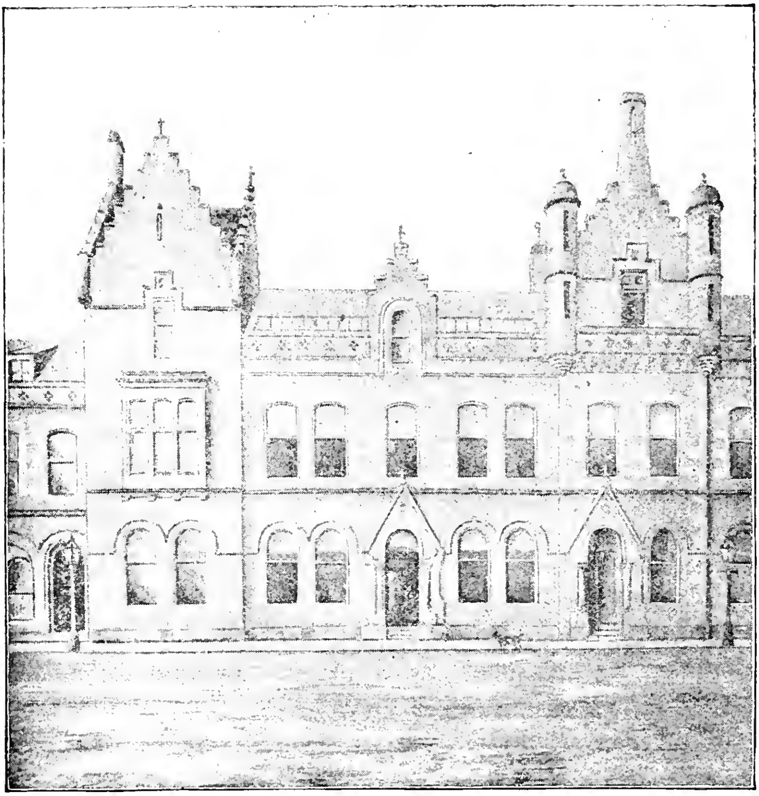

FIG. 1.—EXTERIOR OF THE PERTH MUSEUM.

relieved with gold, and the interior of the cases is painted a pale greyish blue. The wall-space above the wall-cases and below the gallery is occupied by geological diagrams of sections across the county, from designs by Mr. Henry Coates. These sections show four representative traverses across different parts of the county; they are drawn to scale, and the colouring is that of the Geological Survey sheets.

The sketch (Fig. 2) shows the ground-plan of the floor of the Museum. The range of wall-cases A A A extends round the four walls. These cases are 7 feet 6 inches high, with a 9-inch base-board, and are 1 foot 10 inches deep. They are constructed of the best Tabasco mahogany; each door is 3 feet 3 inches wide, and of plate-glass in one whole sheet; there are no locks, but each door is screwed home to a stop covered with silk velvet, by means of seven square-threaded screws.

The local birds occupy these cases, along three of the four walls. They are arranged on plate-glass shelves, the shelves in turn being supported on T-irons fitted into studded iron plates. Thanks largely to the labours of Colonel Drummond-Hay, of Seggieden, this department is well-nigh complete. With very few exceptions, we possess a specimen of every bird recorded from the district, and in nearly all

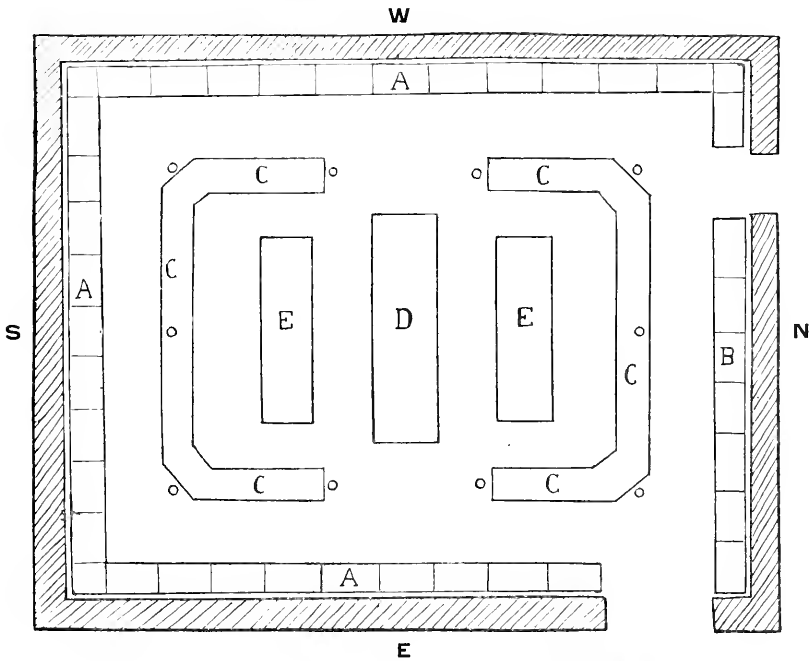

FIG. 2.—GROUND-PLAN OF THE PERTH MUSEUM.

instances they are well-stuffed, and the attitudes are good. Among the chief treasures of this local collection are the Black-throated Thrush, Grasshopper Warbler, Great Grey Shrike, Waxwing, Hawfinch, Rose-coloured Pastor, Great Spotted and Green Woodpeckers, Hoopoe; Osprey, Gyr-Falcon, a particularly fine series of Golden Eagles in different stages of plumage, and a very fine series of Peregrine Falcons; a good series of Ruddy Shelldrakes, a pair of Smews, which are extremely rare with us; a series of Ptarmigan showing seasonal changes for every two months from January to November; Pallas' Sand Grouse; Spotted Crake, Black-tailed Godwit, Bittern, Green Sandpiper, Pomatorhine Skua, Little Auk, Red-necked Grebe, and Eared Grebe.

The cases along the remaining wall are destined to contain the local fishes, amphibians, and reptiles. The newer preparations of fishes are mounted in a four per cent. solution of formalin, and, whether this method prove in the course of time to be permanent or no, there can be no doubt so far as to the extreme beauty of specimens so preserved. A large number of the fishes, including some fine salmon, are represented by coloured casts. The collection does not at present include the marine fishes of the estuary of the Tay and neighbouring coasts, but merely the fresh-water fishes of the rivers and lochs of Perthshire.

Two large cases (C C), forming an inner circle to the room, are occupied by the nests and eggs of local birds. Without aiming at the costly but beautiful arrangement adopted in the Natural History Museum at Cromwell Road, an effort is made in many cases to show the nests with their natural surroundings. Among the rarer local birds, we have, for instance, the Chiff-chaff, Goldfinch, Greenshank, Shoveller, Pochard, Tufted Duck, Goosander, Red-breasted Merganser, Osprey. The smaller nests are sufficiently displayed by being raised on neat blackened wire stands.

The great case (D) in the centre of the room contains a stag and hind of the red deer, the latter presented by His Grace the Duke of Atholl, the stag from the Marquis of Breadalbane; together with them are mounted a buck and doe of the roe-deer, the gift of Colonel Campbell. The specimens are beautifully stuffed and tread a mimic moor of heath and bracken.

The remaining cases (E E) contain the rest of the Perthshire mammalian fauna. Among the rarer forms are the wild cat and the marten, the former now nearly extinct in the county, the latter unseen for the last sixteen years. To the common river seal, *Phoca vitulina*, we have lately added a beautiful specimen of the harp seal, *P. Greenlandica*, in splendid piebald coat, taken during last summer in Invergowrie Bay.

Two sides of the wall-cases of the gallery are occupied by botanical specimens. The first shows one or more representative species, dried and mounted, of all the genera of phanerogams that occur in Perthshire.

The long wall-case on the west side is devoted to Perthshire trees, and is one of the chief features of the Museum. In successive panels there are polished longitudinal and transverse sections of the trunks of large and sometimes stately examples of our indigenous trees; and together with these are, in each case, preparations illustrating the seed, seedling, leaf, flower, fruit. The seedling, flower, and fruit are wet preparations in two per cent. solution of formalin. Above all are placed photographs taken from representative specimens of living trees under summer and winter conditions. Most of the polished logs are the gift of the Duke of Atholl.

The table-cases in front of these show specimens of the ferns and mosses of Perthshire, systematically arranged.

The south wall of the gallery contains as yet but a portion of the Society's collections of local insects. These are arranged in large, close-fitting boxes, topped with clear glass, and framed within steeply sloping exhibition cases. A portion of the Lepidoptera and a portion of the Hemiptera, the work respectively of Mr. S. T. Ellison, honorary secretary of the Society, and Mr. T. M. Macgregor, F.E.S., are all the insect collections that are as yet displayed.

The remaining wall-case contains an extensive series of local rocks, and has been arranged for the Society by Messrs. H. Coates and P. Macnair. This case contains, besides a very full collection of the rocks, minerals, and fossils of the district, series showing rock-structures and the formation of soils from the local rocks.

Desk-cases are arranged round the gallery, and contain, from the north-west corner to the south and along the south wall, our fungi, algæ, lichens, mosses, and ferns.

While the main hall of the Museum, as so far described, is destined to illustrate in the fullest possible way the natural history, botany, and geology of our great county, a smaller hall, that was once the Society's main museum, is now about to be devoted to the exhibition of an index-collection. The Society hopes to show in this index-collection, as far as possible after the model and example of the newer index-collections in the British Museum and elsewhere, teaching preparations illustrative of zoological classification of various anatomical and morphological features, of theories of descent, of phenomena of natural and sexual selection, of principles of distribution, of organisms useful or injurious to man. The task of framing these collections, morphological, biological, or industrial, may be a long and costly one; but the Society aspires to make them, in course of time, not unworthy to take rank beside the rich collections of the local fauna and flora that its members and friends have already brought together.

The Society's collection of plants is also divided into a local herbarium, illustrative of the flora of the county, and a general one, which consists mainly of the collection of European plants formed by the late Dr. Buchanan White and presented by him to the Society. The Perthshire herbarium consists largely of plants collected by him, also by Col. Drummond-Hay, Messrs. W. Barclay, J. Coates, R. H. Meldrum, C. McIntosh, and other botanical members of the Society. It forms the foundation on which Dr. Buchanan White built up the chief work of his life, "The Flora of Perthshire," which is to be published shortly under the editorship of Professor Traill. A special feature of this herbarium is Dr. White's own collections of Perthshire willows, named and mounted by himself, and intended to illustrate his important paper on that difficult genus, published in the *Transactions* of the Society.

ALEX. M. RODGER.

The Museum, Perth.

SOME NEW BOOKS.

Books on Birds.

The Fauna of British India. Birds. Vol. III. By W. T. Blanford. 8vo. Pp. xii., 450. London: Taylor & Francis, 1895.

The Royal Natural History. Edited by R. Lydekker, B.A., F.R.S. Sections VI. and VII., Birds. Pp. 1—288 and 289—580. London: Warne & Co., 1895.

Allen's Naturalist's Library. Edited by Dr. R. Bowdler Sharpe, LL.D., F.L.S. A Handbook to the Birds of Great Britain. By R. Bowdler Sharpe. Vol. II. 8vo. Pp. xviii., 308, plates xxxii.—lviii. Price 6s. A Handbook to the Game Birds. By W. R. Ogilvie Grant. Vol. I. 8vo. Pp. xv., 304, with 21 plates. Price 6s. London: W. H. Allen & Co., 1895.

The Structure and Life of Birds. By F. W. Headley, M.A., F.Z.S. 8vo. Pp. xx., 412, 78 figs. London: Macmillan & Co., 1895. Price 7s. 6d.

Birdcraft, a Field Book of Two Hundred Song, Game, and Water Birds. By Mabel Osgood Wright. 8vo. Pp. 317, xvi., with 15 plates. London: Macmillan and Co., 1895. Price 12s. 6d. nett.

Les Oiseaux de Parcs et de Faisanderies. Par Rémy Saint-Loup. Demy 8vo. Pp. viii., 354, with 48 figs. Paris: Baillière, 1895. Price 3fr. 50.

Traité de Zootechnie Speciale: Les Oiseaux de Basse-Cour. Par G. Cornevin, 8vo. Pp. x., 322. 4 coloured plates. Paris: Baillière.

Hawks and Owls from the Standpoint of the Farmer. By A. K. Fisher, M.D. Pp. 215—232.

Bulletin No. 7. Preliminary Report on the Food of Woodpeckers. By F. E. L. Beal. The Tongues of Woodpeckers. By F. A. Lucas. 8vo. Pp. 39.

The Crow Blackbirds and their Food. By F. E. L. Beal. Pp. 233—248.

Bulletin No. 6. The Common Crow of the United States. By Walter B. Barrows and E. A. Schwarz. Pp. 1-98.

U. S. Dept. Agriculture, Washington, 1895.

Our office table has, during the past month or two, become absolutely covered by books and papers and pamphlets dealing with various branches of ornithology. A few of the more important or more ambitious of these works, such as Gaetke's "Birds of Heligoland," and Dixon's "Migration of British Birds," we have already reviewed; but there remains a large number of works which considerations of space force us to deal with more shortly.

Among systematic works we have the third volume of "Birds" in the "Fauna of British India." The first two volumes of the "Aves" of this admirable series were so remarkable for their general excellence, that when Mr. Oates was unexpectedly compelled to return to his duties in Burma, we regarded the completion of the work with feelings of dismay. Happily, the editor of this series,

W. T. Blanford, has himself an enviable knowledge of Indian birds, and he has gallantly stepped into the breach. Indian students ought to be very grateful to Dr. Blanford for the amount of hard work which he has obviously bestowed upon the book before us. The rectification of synonyms must, in itself, have occupied a great deal of time, and to most of us the tracking out of the priorities of names is a wearisome duty. Mr. Oates had only time, if we recollect aright, to deal with the Indian Passeres. His successor has devoted the third volume of this series to the Broadbills, Woodpeckers, Rollers, Kingfishers, Hornbills, Swifts, Nightjars, Trogons, Cuckoos, Parrots, Owls, and Accipitrine birds. In dealing with these, Dr. Blanford has scored a very conspicuous success. Of course, there will always be some difference of opinion as to the employment of certain generic or specific names, and the day of a hard and fast uniformity among specialists will not come in a hurry. But the definitions of the structural characters of the Families and Genera adopted by the author are explained with praiseworthy lucidity, and are in complete harmony with the present state of our knowledge of avian morphology. The descriptions of plumage are also judicious, and cannot fail to enable any young sportsman to identify the birds that he may come across on his shooting expeditions. When we remember that Jerdon is scarce, and costs a five-pound note, while its letterpress though good is antiquated, we cannot disguise our satisfaction that a trustworthy handbook is now available at a reasonable price. The cuts of the heads of birds scattered up and down the book add to its interest in the eyes of the student. Though any undue haste would militate against the quality of the fourth volume, we shall be pleased to see so admirable a work safely brought to its anchorage.

Turning to works of a more popular nature, it is satisfactory to notice the progress which the Royal Natural History continues to make under the very competent hands of R. Lydekker. The ornithological sections are before us, and the standard of the earlier portions of the work appears to be maintained. The reading public are exacting nowadays, and expect a great deal for their money. Messrs. Warne & Co. deserve some credit for their enterprise, since the type is uniformly good, and the work of the printer leaves little or nothing to be desired. The illustrations are excellent, taken as a whole, but one or two are exceedingly bad. We cannot understand how the editor could allow the insertion of the effigy of a so-called bullfinch which appears at p. 400. Indeed, that of the brambling is little, if at all, more creditable than its companion. But these sorrowful exceptions only serve to enhance the general merit of the larger number of the numerous figures, and those by Wolf and G. E. Lodge are genuine works of art. Lodge is seen at his best in the engraving of an adult goshawk inserted at p. 240. The conception of a golden eagle's eyrie shown on p. 224 is a fine specimen of a great master's style. The important order of the Passeres was assigned to the Rev. H. A. Macpherson, that of the Picariæ was apportioned to Dr. Sharpe, while the editor himself contributes the remaining part of the seventh section. It is rather amazing that Mr. Lydekker should seriously cite an avowedly *anonymous* correspondent of the *Times* upon the habits of the merlin. With this exception, the quotations appear to be judiciously selected and carefully welded together. A fair amount of original information regarding the habits of birds is also forthcoming. On the whole, perhaps the most satisfactory feature of the avian portion of this work is the care which has obviously been bestowed upon explaining, in simple but accurate language, the most important points in the structure of birds. This is as it should be, and we wish all success to the completion of the work.

From Messrs. Warne we pass to Messrs. Allen, of whose Naturalist's Library we have two volumes before us. The publishers of this meritorious series of popular handbooks have been singularly fortunate in securing the assistance of members of the British Museum staff, who possess in an eminent degree the proper qualifications for elaborating the subjects apportioned to their individual share. In fact, a marked improvement in books on birds generally is the trouble that experts of the first rank, like Dr. Sharpe, are willing to expend in convincing gainsayers that birds should be regarded as exhibiting a great variety of structure, and that consequently they ought to be made the subject of much thoughtful study. It is not enough that the ornithological student should be a field observer. He ought also to have a competent acquaintance with the anatomy of birds, and be capable of giving a reason for the views which he holds on the general classification of the Class. In pursuance of this idea, Dr. Sharpe devotes a fairly large share of the space at his disposal, in the present volume, to stating with admirable lucidity and circumspection such details regarding the structure of different genera of British birds as a young and intelligent student may be expected to assimilate easily. Another praiseworthy feature is the amount of information given as to the range of so-called "British" birds outside the limits of our islands. The attention devoted to this point is calculated to broaden the views of the reader, and to banish any insular prejudices which he might otherwise retain. Dr. Sharpe treats in the present volume of a variety of birds, from owls to woodpeckers; but the birds of prey (as regards which Dr. Sharpe has long been our first authority) seem to form its major part. We should add that Dr. Sharpe has enjoyed the privilege of consulting the notes on *Anatidæ* of Count Salvadori, who is at present engaged upon the twenty-seventh volume of the "British Museum Catalogue." He has therefore been able, in a marked degree, to take advantage of the researches of his distinguished colleague. We trust that Dr. Sharpe may be able to give us the third and fourth volumes of his British birds in the course of next year.

Ogilvie-Grant has already contributed many papers on game birds to the *Ibis*. He has also found time to write a British Museum Catalogue of game-birds, which is in all respects a model of what such a catalogue ought to be. On the present occasion he treats the subject in a fresh and graphic style, which will be sure to commend itself to all the sportsmen and lovers of wild nature who may have the good fortune to read his new work. Primary importance seems to be attached to the descriptions of plumage, especially as regards the differences between the sexes, which are often puzzling when the student is dealing with plain-coloured birds. Thus, a full-page plate is furnished to illustrate the external differences which Mr. Grant has discovered to distinguish the male and female of the common partridge. Similarly, the admirable coloured plates which recently appeared in the *Annals of Scottish Natural History*, intended to explain the author's researches into the changes of plumage of the red grouse, are here introduced to a wider number of readers. They should be useful in advancing still further our knowledge of the distribution of the various types of that most varying species. But it must not be supposed that our author confines his attention to the dry and technical details of plumage which experts look for. On the contrary, he has taken the trouble to condense into his text a great many facts about the wild habits of birds, and, in so doing, he has exercised a wise discretion. As a result, he has produced a volume which is sure to find its place on the bookshelf of every traveller and of most country gentlemen.

Mr. Headley is one of the numerous people who are neither naturalists nor anatomists by profession, but who have given a great deal of time and pains to the special subject of birds. A long chapter on flight is the most important part of his book. He gives a careful account of the bones and muscles involved, and discusses the mechanics of flight from the simple beginning of the systems of levers involved to the obscurer questions of the resistance of the air to so complicated a surface as the avian wing. He betrays, perhaps, too great a tendency to lecture the world in general on its stupidity; no one with the most elementary knowledge of physics supposes that the air-sacs and hollow bones of birds have a ballooning effect. As a matter of fact, Kohlrausch in 1832 published a treatise at Goettingen entitled "De Avium Saccorum Aëriorum Utilitate," and set the matter at rest, at least for all anatomists. But we remember that Gaetke, in his "Birds of Heligoland," betrayed a weakness for the view Mr. Headley is so eager to contradict; and Mr. Headley, perhaps knowing the weaknesses of the field-ornithologist better than the present reviewer, had reason to set him right. In addition to his interesting chapter on flight, Mr. Headley has written a large number of short elementary chapters on embryology, palæontology, physiology, and so forth. These are pertinently illustrated, and no doubt will interest the amateurs for whom they are written.

Not unlike Dr. Bowdler Sharpe's excellent series on British Birds is a charming little book by Mabel Wright, brimful of information about the birds of America. "The two hundred birds chosen for description from . . . over nine hundred species of North American Birds are selected as being those which will be the most likely to interest bird-lovers." Of the four introductory chapters—The Spring Song, The Building of the Nest, The Water Birds, Birds of Autumn and Winter—it would be hard to speak too highly; they are so charmingly written. The rest of the book is admirably arranged from the point of view of the non-technical reader. First, we have a few remarks on "How to Name the Birds," then a "Synopsis of Bird Families," then follow "Bird Biographies," and lastly a "Key to the Birds." The biographies give in a concise form such details as length, coloration of the sexes, song, nest and eggs, range, and so on; this is completed by remarks of a more general character.

One of the most difficult tasks that confronts the field-ornithologist is that of coining an intelligible description of the songs and call-notes of the birds he encounters, and often, in a wild burst of despair at the barrenness of his efforts, he leaves us the information that the note is "metallic" or "silvery"! The authoress is sometimes very happy in her *rôle* of interpreter, but occasionally the task proves too much even for her trained ear, and she falls back on the poets, and not always, as we venture to think, with like success. For instance, we are told that the song of the Hermit Thrush, is "flute-like ascending." It has been set to words by Burroughs, and runs thus—

"O spheral, spheral! O holy, holy! O clear away, clear away! O clear up, clear up!"

In speaking of the enemies of birds, we read that "man is . . . the most relentless of all. The other enemies kill for food only, man kills for food casually, for decorative feathers wantonly, and for scientific research plausibly, . . . are not the lives of hundreds of song-birds a high price for the gain of a doubtful new species, which only causes endless discussion as to whether it really is a species or merely a freak?" We take exception to the third of these objections. Surely those who make scientific research a cloak to conceal, or rather justify, what is really wantonness, are the exception, not the rule. The charge of shooting "hundreds of song-birds," etc., is obviously a random shaft. It is, we protest, unjust to suppose that

> Men have no place for fine-spun sentiment
> Who spend their lives 'mongst cabinets of skins.

Twice in the pages of this book the pernicious practice of spreading poisoned corn is advocated. Verily, the end cannot justify the means, even though that end be the destruction of crows. The numerous plates, mostly coloured, contain, each of them, several figures. Some of these are most life-like, and some are as bad as they can be. The book is beautifully printed, remarkably free from mistakes, and tastefully bound. Bird lovers should accord a warm welcome to this little work, picturing to us, as it does, a country that we know not, and friends we have not seen.

Of more practical nature are the remaining books upon our list. Rémy Saint-Loup's pleasant but discursive little book has been compiled for popular purposes, its aim being to acquaint the general public with some useful particulars regarding the acclimatised birds to be met with in parks and zoological collections. The author starts with a discourse upon rheas and ostriches, from which he presently passes in order that he may describe certain species of swans which are often kept upon ornamental waters. By far the greater portion of the book is devoted to the consideration of game-birds, for which Saint-Loup exhibits a marked partiality. He does not appear to have a personal knowledge of the proper treatment of captive birds, though it may be that our author is too modest to favour us with the results of his own experience. But failing original information, he has acted judiciously in supplying copious extracts from the *Bulletin* of the Société d'Acclimatation and from other reliable sources. The result is that his pages are seasoned with salt, and will be read with a proper relish even by the initiated. For example, the curassows are easily domesticated, but are generally regarded as birds which never breed in captivity. Saint-Loup obligingly supplies us with interesting particulars of curassows nesting in France. Again, the young of blackgame (*Tetrao tetrix*) are proverbially difficult to rear artificially; Saint-Loup has collated all the particulars necessary to success. There can be no doubt that a fair-minded reader will find amusement and relaxation in assimilating the contents of this unpretentious manual. He may dissent from Saint-Loup's dictum that the pheasant (*Phasianus colchicus?*) is *monogamous*, and perhaps he will find a few faults; but on the whole he will admit that the book is a good one for unscientific readers.

G. Cornevin's "Birds of the Farmyard" completes "naturally and necessarily" a general work upon "Zootechnie" published some years since. The volume before us deals with the domesticated races of swans, geese, ducks, turkeys, and other farmyard fowls. The various birds are arranged into their respective groups, but these are the old-fashioned ones of Palmipedes, Cursores, etc. And in the definitions of the same there is no whisper of the ambiens or even of the schizognathous skull. The longest section of the book is naturally that devoted to the domestic fowl, of which there are many more races than we had before suspected; these are divided for convenience into sections, subsections, categories, and subcategories. The divisions are, perhaps necessarily, of the pigeon-hole kind, and do not pretend to any particular naturalness; still they are useful enough in introducing order into what would be, without them, somewhat of a chaos. When the author has occasion to use an English expression it is apt to be a little Gallic in form; thus a well-known engraver and naturalist figures more than once, so it cannot be a misprint, as Becwik. The Polish Swan is inverted as the Swan Polish. These are, however, but trifling blemishes, to which no attention need be paid by any person who requires a work that is comprehensive and liberally illustrated.

The first of the pamphlets from the United States Department of Agriculture deals with the vexed question of the benefit and injury conferred on agriculturists by birds of prey. Dr. Fisher divides hawks and owls into four classes: (1) Species which are wholly beneficial; (2) Those chiefly beneficial; (3) Those in which the beneficial and harmful qualities about balance; (4) Harmful species. He then gives a brief epitome of the habits and food of certain well-known species, figuring Swainson's hawk (*Buteo swainsoni*), the red-tailed hawk (*Buteo borealis*), the American sparrowhawk (*Falco sparverius*), Cooper's hawk (*Accipiter cooperi*), and three species of owls. The most destructive hawks that the transatlantic farmer has to contend with are the sharp-shinned hawk and Cooper's hawk. It is interesting to learn that these two species have increased during recent winters about the large cities of the Eastern States in consequence of the abundance of the introduced sparrows, to which these hawks are partial.

The two reports on woodpeckers are published together, but the second is the more important of the two, in spite of its brevity. F. A. Lucas has only four pages to devote to his theme, and considering his difficulty, he has done well to tell us so much. He describes the tongues of about a score of species, and gives illustrations of the tongues of several species in extreme youth, as well as of those of fully mature birds. The facts are extremely suggestive, and deserve the careful consideration of ornithologists. Thus we are informed that in very young woodpeckers the tongue is unarmed at the point, bearing neither hairs nor spines, although the patch of minute points on the upper surface is present from the first. Later on, as indicated by a fully-fledged nestling of the downy woodpecker (*Dryobates pubescens*), a species whose tongue is armed in the adult with sharp barbs, the spines are represented by short reflexed hairs. It seems, therefore, that the lateral spines are acquired after the bird has commenced to fly, and that they must be developed very rapidly. Lucas takes leave of us with the significant remark that the evidence which he has been able to bring together favours the view that *modifications of the tongue are directly related to the character of the food*, and *are not of value for classification*. F. E. Beal has taken the trouble to examine the stomachs of no fewer than 679 woodpeckers, representing only seven species, all obtained in the Eastern States. It seems a pity that such a number of valuable birds should have been destroyed even for the purposes of this inquiry, for the results are precisely what any competent authority could safely have prophesied. However, the author deserves all credit for the immense trouble he has taken, and we hope that the results of his researches will diminish the ignorant persecution to which the woodpeckers and many other American birds are unfortunately subjected. Of the seven species into whose merits Mr. Beal has inquired, it appears that the downy woodpecker is the most beneficial. At one time, as we know from the writings of the older American ornithologists such as Wilson, the red-headed woodpecker was habitually killed because it was accused of destroying great quantities of fruit. Mr. Beal has satisfied himself that the charge was enormously exaggerated. We hope that this report may induce the Department of Agriculture to take steps for the protection and encouragement of all the species of woodpeckers that are found in the United States.

From woodpeckers we pass to crows; Beal's little brochure deals with the common Purple Grackle (*Quiscalus quiscula*), and two subspecies, and is mainly concerned with the problem whether the benefits conferred on farmers by their services in destroying injurious insects outbalance the undoubted injury which they inflict on cereal crops. The additional charge against the grackle is that it destroys the nestlings of other birds, a charge which Mr. Beal considers to have been treated too seriously. He has satisfied himself that the food of the grackle for the whole year consists of animal and vegetable matter in nearly equal proportions. "Upon the whole, crow blackbirds are so useful that no general war of extermination should be waged against them. While it must be admitted that at times they injure crops, such depredations can usually be prevented. On the other hand, by destroying insects they do incalculable good." We commend these remarks to Miss Wright.

Corn is an important crop throughout the territory of the United States, and in many States the area devoted to it exceeds the combined areas of all other cereals. It was, therefore, highly appropriate that an enquiry should be made as to whether the popular opinion that the crow is highly injurious to agricultural interests, since "it devours corn under all circumstances," is or is not well founded. Mr. Barrows devotes the second, third, and fourth chapters of his pamphlet to reviewing the animal food, insect food, and vegetable food discovered in the stomachs of more than 900 crows, and arrives at the conclusion that the vegetable food of the crow amounts to about 57 per cent. of the whole food. Of this, corn is of most importance, but the crow feeds also on acorns, mast, and many other wild fruits. The insects found in the stomachs of the crows in question have been, as far as possible, identified by Mr. Schwarz, who has done his best to decide whether the insects so consumed were injurious or the reverse. In the course of the examination of the food of the 900 crows, many curious facts have come to light, as, for example, the destruction by crows of great quantities of frogs and toads. The Report is eminently worthy of the thoughtful consideration of all who are in any way interested in the Corvidæ, or in the relations of birds to modern agriculture. Much credit is due to the authors of this essay for the clear and lucid way in which they have marshalled together a wide array of facts.

The North Sea Fisheries.

An Examination of the Present State of the Grimsby Trawl Fishery, with special reference to the destruction of immature fish. By Ernest W. L. Holt. Journal of the Marine Biological Association, n.s., vol. iii, pp. 337–448 and chart. Plymouth, 1895. Price 3s. 6d.

This is an essay of over 100 pages on the North Sea Fisheries and their prospects, which occupies a whole number of the *M. B. A. Journal*, and is certainly one of the most important contributions that has yet been made by the professional zoologist to the discussion of practical fishery problems. Facts and statistics (by no means two names for the same thing) in regard to our sea fisheries are usually exceedingly dry reading, but Mr. Ernest Holt has managed, not only to invest his subject with interest, but even in places to make it amusing. His caustic humour breaks out every here and there, as, for example, where he reminds us that "a Conference is usually prolific only to the third generation. It begets a Resolution, the offspring of which adhering to the strictly discontinuous type of Variation, is a Deputation. A deputation has been described as a 'noun of multitude, which signifies many but does not signify much'; and the unanimity with which the sufficiency of this definition is accepted by those in office, of whatever shade of politics, is alone sufficient to prove that 'great minds think alike.'" And, again, when he illustrates the relative merits (*sic*!) of the in-shore and deep-sea fisherman in destroying small fish, by a reference to the Walrus and the Carpenter in "Alice through the Looking Glass," where one ate more oysters than the other, but the other ate as many as he could get! "However," says Mr. Holt, "if the assembled wisdom of Parliament chooses to consider that its business is rather to settle the squabbles of rival classes of fishermen than to take measures to increase the fish supply, one can but regret it." One of the sections of the report gives an interesting account of a twelve days' voyage in a steam trawler from Grimsby, which we can, from our experience of the similar vessels on the other side of the country, commend as giving an excellent life-like sketch of the personal peculiarities, habits, and conversation of these rough and ready mariners who sweep our sea-bottoms from Iceland to the Bay of Biscay, and who perpetuate in this degenerate age the enterprise and hardihood, along, perhaps, with other virtues and vices, of the Viking and the buccaneer.

The history of trawling in our seas has been a history of the discovery, and the destruction, one after another, of fresh fishing grounds; and it is interesting, as showing the extent of the evil, that the present agitation and demand for fishery regulation and supervision differs from all other known fishery grievances in that the complaints of the trawlers are directed, not against some other body of fishermen, but against their own practices. This agitation originated at Grimsby and Hull, and, consequently, Mr. Holt has been stationed at Grimsby for the last three years by the Marine Biological Association, in order that he might collect information as to the alleged destruction of immature fish in the North Sea by beam trawling, and as to the resulting effect upon the fisheries.

Mr. Holt has now given us a very fair statement of his methods, his material, his evidence, and his conclusions, which must, we think, carry conviction to any unbiassed mind that large numbers of immature fish are destroyed by trawling, and that the supply of the more valuable trawl fish in the North Sea is in consequence diminishing. It is no easy matter to get reliable fishery statistics, and to handle them properly. We are told that "It appears to be the peculiar function of the fisheries department of the Board of Trade to formulate statistics which shall be just sufficiently complete to bring into strong relief the importance of what is omitted from them"; and in comparing quantities or values of successive years or decades, the increase in numbers and efficiency of boats and gear, and the great extension of the area fished, have all to be taken into account. Steam and petroleum engines, ice-room, and fish-well, and lastly the new otter-trawl—which, although Mr. Holt does not know it among English trawlers, is now being used at Liverpool—are all improvements which have made such changes in the conditions of the fishery that it is a risky matter to draw definite conclusions from the numerical statements at our disposal. The difficulty of dealing with fishery "returns" is still further increased by the want of discrimination between various species, and by the fact that a fish may came into port as a codling and go out as a "Finnon haddock," may "be caught as the head of a catfish and the tail of a monk, and go out as the cheek muscles of a skate."

Mr. Holt's special attention was directed to the question of immaturity in the fish caught, and he chose out the skipper with whom he made his voyage because he had the reputation of having landed more undersized plaice than any other man in the world. It is pleasing to see that, like the true naturalist he is, Holt soon was on the best of terms with the whole ship's company. We read "by this time I had got to work with tow-nets and microscope, and the antics of copepods and such small deer were a source of constant delight to the crew . . . I was able also to introduce my friends to the mystery of artificially fertilising fish eggs, and had hatched out a small family of turbot in a pickle bottle before we got back to port." All this and much else is very pleasing (weather notwithstanding); but there is another and very appalling side to such voyages. The modern steam trawler is a terrible engine of destruction, and we find that on a moderate estimate "in a whole year's trawling, on all North Sea grounds, 57 per cent., or more than half, of the fish caught had never had a chance of reproducing their species, and so contributing to the upkeep of the supply."

In conclusion, Holt attributes the grave deterioration in the North Sea trawling industry to two causes, "(1) an immense destruction by deep-sea trawling of immature plaice and turbot on shallow grounds on the Continental coast, frequented only by immature members of the first species, and chiefly by immature members of the last; visited also by spawning soles, turbot, and brill; (2) a serious destruction on our own coast by various methods of long-shore shrimping of immature plaice, and of immature soles, turbot, and brill, in proportion to the abundance of these species," and so on. For the full details of the amount of blame attaching to the various methods of fishing, reference must be made to the report, which includes, last of all, a discussion of proposed remedial measures. Whether or not we all agree with the author in his arguments as to the benefit or the reverse likely to result from various methods, restrictive and otherwise, his carefully thought out conclusions must carry great weight, and must receive the utmost consideration from the District Fishery Committees and other legislative boards. His most important contention is that by the mere imposition of a size limit of thirteen inches on plaice alone, from March 14 to September 30, we should leave the eastern grounds entirely untouched to serve as a nursery for the whole North Sea for plaice, turbot, and to a less extent for brill and soles, and as a spawning haven for soles, brill, and turbot. This appears to be the only practicable method, at present, of checking the depletion of the North Sea grounds and of enabling the fish supply to recover.

It is deeply to be regretted, in the interests both of science and of the fisheries, that Mr. Holt has been compelled by ill health to give up his important work at Grimsby, and to resign his post as naturalist to the Marine Biological Association. Let us hope that he may soon be enabled to return to his labours with regained strength and fresh vigour. W. A. H.

Catalogue of the Marine Mollusks of Japan, with descriptions of new species and notes on others collected by F. Stearns. By H. A. Pilsbry. 8vo. Pp. viii., 196, with 11 plates. Detroit: 1895. Price, paper, $1; cloth, $1.50.

Japan, like Africa, not only largely attracts public attention just now, but also may be said always to furnish something new. Certainly its molluscan fauna seems far from being worked out, if one may judge from the results obtained by Mr. F. Stearns (who must not be confused, by the bye, with Dr. R. E. C. Stearns, the conchologist) during two visits of some duration to that fascinating region. This traveller was not content with the casual specimens collected by himself or procurable in the markets, but employed an intelligent Japanese fisherman, Morita Seto by name, to traverse the entire east coast and to visit the Loo Choo Islands on his behalf. The outcome has been eminently satisfactory, as evinced by the contents of the admirably got up volume before us, the publisher of which, moreover, is Mr. Stearns himself.

It is now thirteen years since the last list of the marine mollusca of Japan was issued by Dunker, so that a considerable addition to the number of known forms was to be expected: the present catalogue, however, contains about 500 species more than enumerated by Dunker, including forty believed to be new, and that although a considerable number of forms included by him have been sunk as synonyms or rejected from the Japanese list. In addition, very many individuals belonging to the families Rissoidæ, Eulimidæ, and Pyramidellidæ remain unidentified. Of these some are thought to be new, but "the literature of these groups," Mr. Pilsbry remarks, with more force of language than the occasion justifies, "has been so overloaded with Arthur Adams' descriptions which do not describe, that intelligent work upon the Japanese forms is impossible. The literature of descriptive zoology furnishes but few instances of work more superficial and worthless than that of this industrious dilettante."

The title of the work leaves much to be desired, for it gives no hint of the fact that the Brachiopoda are included; nor would the student of non-marine forms expect to find new species of Helices or other land mollusca. The concluding 34 pages, however, contain by way of appendix a "List of the Land and Freshwater Mollusks collected in Japan by F. Stearns," and a "List of Mollusca in the Collection of F. Stearns from the Middle Loo Choo Islands, with Descriptions of New Species." A very slight modification of the title-page would have obviated this inconvenience.

The classification employed is, we are told, "not entirely that of any one of the Manuals," which can readily be credited, for what self-respecting manual would venture to lump together three forms of Cyclophoridæ, a *Cyclotus* and a *Helicina*, to dub them "Operculata," in the same type as the surrounding family names, and plump them in between "Limnæidæ" and "Viviparidæ"? "The current generic nomenclature has been revised in certain cases," but not in others: why return to *Aspergillum* when *Brechites* has long been shown to have priority?

A truce, though, to these minor criticisms! The work is a most useful one, and will prove invaluable to future investigators of the Japanese molluscan fauna, whilst one cannot fail to be struck by the ability and energy of the man who, in the midst of curatorial duties and the heavy work of the Manual with which his name is so honourably connected, can find time to throw off, as it were, a volume of this importance. The plates, too, must be highly commended, save the last, which, though clearly and well executed, is, in its style (line-process), in painful contrast to the rest. We commend them to the attention of the Malacological Society of London, whose *Proceedings* are apparently not always illustrated by artists who may be considered adepts in lithographic work.

A Cambridge Manual of Petrology.

Petrology for Students. An introduction to the study of rocks under the microscope. By Alfred Harker, M.A., F.G.S. 8vo. Pp. viii., 306. Cambridge: University Press, 1895. Price 6s.

As the author remarks in his preface, there is room for a simple text-book of petrology for the use of elementary students. Something is wanted with more discussion of general problems than is to be found in Cole's "Practical Aids," and more detailed and less a catalogue of rock names than Hatch's "Petrology." The book that is really wanted is a Rutley's "Study of Rocks" brought up to date. Mr. Harker's book does not quite supply this, for he assumes more preliminary knowledge in his reader. He opens with a short introductory chapter referring to the use of the microscope, and the principal optical characters of simple application, such as colour, refractive index, extinction, and pleochroism. These subjects are briefly treated, and the student is referred for a systematic treatment of the subject elsewhere, and especially to Idding's translation of Rosenbusch. The principal part of the work consists of a description of the British rocks, grouped into the four divisions of plutonic, intrusive, volcanic, and sedimentary. The text bears throughout marks of sound knowledge and careful preparation. The descriptions of the rocks are clear, and as detailed as is necessary; all the principal variations from the main types are briefly referred to. The literature has been summarised very carefully, and the series of footnotes renders the book an index to British rocks. The section on the sedimentary rocks (chapters xvi.–xix., pp. 192–253) is more detailed than is usual in petrological works, and Mr. Harker is especially to be commended for his treatment of this interesting and neglected subject. The last three chapters are devoted to the problems of thermal and dynamic metamorphism, and to the description of various crystalline rocks which do not fit conveniently into either of the four classes.

The book has several strong recommendations: the descriptions are concise, the references to literature numerous and well-selected, and the facts accurate. It will, therefore, no doubt prove of great educational value. But in the absence of a glossary, the frequent use of technical terms, such as "phenocryst," before they are explained, must lessen its use to the solitary student. It has, however, apparently been written for students who are attending a university course or its equivalent, and to such it can be confidently recommended as a concise and reliable manual of British rocks.

A Cambridge Manual of Botany.

The Elements of Botany. By Francis Darwin, M.A., M.B., F.R.S. Cambridge Natural Science Manuals. Pp. xvi., 235. Cambridge: University Press, 1895. Price 6s.

This book contains the substance of the botanical part of the course of lectures in Elementary Biology given to Cambridge medical students. But it is much more than this. It forms, without question, the best introduction to the study of botany in the language. The lines on which the subject is treated are admirably adapted to build up gradually in the student's mind a harmonious conception of the plant-body and its activities. The style is characterised by perfect lucidity of description and exposition, combined with graceful phrasing and exceedingly apt, often picturesque, illustration. These qualities, indeed, unfortunately so rare in our elementary handbooks of science, form the chief and distinguished merit of the work.

We wish it were possible to praise the numerous figures with which the book is illustrated. Their cheap and common appearance is, of course, due to the style of reproduction adopted; but while those taken from Le Maôut and Decaisne are well chosen and useful, the ones drawn expressly for the book are often quite unworthy of it. What appears to be slovenly drawing is common, and actual inaccuracies are not altogether absent. Without going into details, we may draw attention to figs. 28, 38, 39, 40, 48, and 80, which are somewhat conspicuously open to one or other of these charges.

The weakest portion of the text is that devoted to anatomical description. The account of the cause of the characteristic appearance of the radial walls in the root endodermis (p. 42), and of the method of exit of a rootlet from its mother-root (p. 46), the statement that sieve-tubes contain "abundant protoplasm" (p. 58), and the omission of any reference to xylem parenchyma in the stem of *Helianthus*, are isolated instances of misleading or inaccurate description. There is no proper distinction drawn between primary and secondary medullary rays, and the statement that the rays of the seedling shoot "must still exist" in the thickened stem of the oak (p. 68) is quite misleading. The credit of "the most probable explanation" of the large size of spring vessels belongs to Haberlandt (*Physiol. Pflanzen Anatomie*, p. 371; 1884), rather than to Strasburger. The pits in the walls of the wood-fibres of the oak are distinctly bordered, not "simple oblique slits." The account of leaf-fall on pp. 106–7 is inaccurate. The "layer of separation" is quite distinct from the cork layer formed to heal the wound. The treatment of the pericycle is unsatisfactory: its existence in the stem is only recognised in a sort of grudging way, which cannot lead to the formation of clear ideas in the minds of students. The "bast fibres" are said, in a note on p. 62, to "have their origin in the pericycle." If "bast" is used as a synonym for phloem this is a contradiction, further emphasised in the Appendix, p. 206, last paragraph. If the pericycle is to be mentioned at all, it should be explicitly recognised as a separate morphological region, and a full description of its tissues should be given, with an admission of the difficulty (or impossibility) of delimiting it from the primary rays. But on p. 56 it is omitted from the divisions of the "ground tissue," where, if anywhere, it belongs; so that the pericycle becomes a sort of anatomical pariah, unrecognised alike by vascular and "ground" tissue. We have drawn attention to these defects because the great value of an anatomical training, however slight, lies precisely in the possibility of careful and accurate observation, description, and classification of tissue relations, and it is, therefore, of the utmost importance that students should be made to have absolutely clear ideas on anatomical questions: but, of course, these details form a very small part of an admirable book.

The Appendix forms a useful series of instructions for carrying out carefully-selected practical work.

Natural Science has before protested against the high price of these Cambridge manuals. Considering the style of reproduction of the figures, it ought to be possible to produce a book of these dimensions for much less; and we are afraid that its expensiveness will act as a serious bar to that wide circulation in schools to which it is so well entitled, and which could not fail to influence most favourably the teaching of elementary botany throughout the country.

A. G. T.

AGRICULTURE: PRACTICAL AND SCIENTIFIC. By James Muir, M.R.A.C. Pp. xv., 343, with 49 tables in the text and 39 illustrations. London: Macmillan and Co., 1895. Price 4s. 6d.

THE first impression this well turned-out manual leaves on the mind is not unlike that which would be produced by the play of *Hamlet* with the character of the Prince of Denmark omitted. Its subject is agriculture and--as the title prominently sets forth—*practical* agriculture. If there is one feature more characteristic than another of the agriculture of these islands it is the intense degree in which the cultivation of the soil is bound up with, and essentially related to, the maintenance of live stock. But the reader will search this volume in vain for any information upon the meat- and milk- and wool-producing animals of the farm, or for any enlightenment as to that useful revival of recent years—horse-breeding. Had the book been called "The Soil and its Cultivation," or "Soils and Crops," it would have been correctly described, and the purchaser would not be misled by the use of a name which has a far wider signification than the author allots to it, though he must be well aware that agriculture embraces *Arvorum cultus pecorumque.*

The book comprises thirty chapters, some of them scanty and insufficient, others copious and well-filled. About fifty pages are devoted to the soil and its properties, followed by an equal space dealing with the various methods of amelioration and improvement. Next are five chapters, occupying some forty pages, in which are discussed natural and artificial manures and the principles of manuring; this section of the work is well executed. Implements and machinery are dismissed in the brief space of a dozen pages, and the remainder of the book—some 160 pages—is given up to the main crops of British agriculture, and it is here, perhaps, that we find the author at his best. He has quoted freely from the publications of the Royal Agricultural Society, and students will no doubt be glad to find placed at their disposal, in so condensed a form, the material thus selected. It is incorrect, by the way, to substitute *Achillea millefolia* for *Achillea Millefolium*, and *Centaurea cyana* for *Centaurea Cyanus*, but *Lychnis vespitina* is probably a printer's error.

Is the author right in his surmise that on irrigated grass-land a film of slimy material will form on the surface of the herbage if the water be allowed to run too long? If that be the case, why does not this film appear upon the ordinary submerged plants of our streams? It is much more probable that the film is due to stagnant water, a circumstance that came prominently under our notice in the great spring flood of 1882, when water-meadows were under stagnant water for two or three weeks. In the economy of water-meadows standing water is always feared, running water never.

FOR THE YOUNG.

AN INTRODUCTION TO THE STUDY OF ZOOLOGY. By B. Lindsay. 8vo. Pp. xix., 356, with 124 illustrations and diagrams. London: Swan Sonnenschein, 1895. Price 6s.

POPULAR HISTORY OF ANIMALS FOR YOUNG PEOPLE. By Henry Scherren, F.Z.S. Medium 8vo. Pp. vii., 384, with 13 coloured plates and numerous illustrations. London: Cassell & Co., 1895. Price 7s. 6d.

NATURE'S STORY. By H. Farquhar, B.D. 8vo. Pp. 191, illustrated. Edinburgh: Oliphant, Anderson & Ferrier, 1895. Price 2s. 6d.

POPULAR READINGS IN SCIENCE. By John Gall, M.A., LL.B., and David Robertson, M.A., LL.B., B.Sc. Second edition. 8vo. Pp. 467. Westminster: A Constable & Co., 1895. Price 4s.

THE number of popular books on science that are now being published is a sign of the times, and, whether the books be good or bad, we think that on the whole it is a good sign, since it shows, at all events, that a wider interest is being taken by all classes and all ages in the world around us.

We have so often been asked by people who have been attracted to zoology, to recommend them some book that shall put them in the way of studying it for themselves, and we have so often been unable to give them any satisfactory answer, that we are glad to meet with such a book as that by Miss Lindsay. There may be statements in it to which one can object, such as this, on p. 43:—"In the invertebrates, bones are not found, except in the case of the cuttlefish"; for the cuttlebone is no more a bone than is a cockleshell. Neither do we share the author's view, expressed on p. 170, that the pinnules of a crinoid are homologous with the tube-feet of a star-fish. But, despite such inaccuracies, and too great reliance upon names and terms instead of upon facts, the book is a useful one, and we ourselves, in our early attempts at zoological study, would have been only too glad for such chapters as those headed "Advice to Students." If the readers into whose hands this book may fall will honestly follow the advice of the author, they cannot be led very far astray by her enthusiastic ignorance. Besides an account of the chief books and of the way in which they may be used, Miss Lindsay refers to courses of lectures, to classes, to museums, and to biological stations, and she gives a list of the chief dealers from whom specimens or apparatus can be obtained. In short, the book will put a solitary student in the way of finding the answers to such questions as he is most likely to ask.

We doubt whether a Natural History for children has ever combined so much excellence of illustration with so much accuracy of matter as that which comes to us from Messrs. Cassell. As in most such books, the bulk of the work is devoted to back-boned animals, but the back-boneless ones are by no means neglected, and are treated in a thoroughly scientific, though none the less interesting, manner. Coloured plates are always attractive to young people, and those of the present volume are far superior to those usual in books of this kind. Our only objection to them is that they are made in Germany. "The author's aim has been to write in such fashion that the book may serve to waken, or quicken, interest in the observation of the habits of the lower animals, and as an introduction to the study of their relations to us and to each other"—and we think that the children, who, after all, are the ultimate critics, will prove that he has attained his end.

We hope that the children will not be quite so kind to Mr. Farquhar's little book, which consists of a number of "talks," written in that peculiarly irritating kiss-mammy style that is supposed to appeal to the minds of "the little ones." Although such science as is contained in this book seems correct enough, owing no doubt to the revision by Mr. Graham Kerr, it is interlarded with a wishy-washy and illogical theology which experience has long ago taught us does far more harm than good when those who have been crammed with it begin to think for themselves. Mr. Farquhar, who, we note, is a bachelor of divinity, has, by his own account, a very intimate acquaintance with the thoughts and actions of "the Great Creator." Less presumption would have argued greater reverence.

The Popular Readings by Messrs. Gall and Robertson form a useful popular summary of the results obtained by investigators in various branches of science. The chapters on physical subjects are contributed by Mr. Gall, while Mr. Robertson is responsible for the astronomical, chemical, and biological sections. Neither author lays claim to originality; but the writings of the leaders of thought in each department have been used in compiling the various accounts, which are careful and accurate. Perhaps the amount of matter introduced into some of the chapters has led to excessive condensation; in fifty-eight pages we have, under the title of the "Vegetable Kingdom," an outline of the morphology, histology, physiology, and classification of plants, besides remarks on tropical vegetation and forestry. The chapter on "Mimicry" deals, not only with the phenomena which naturalists now understand by that term, but with the kindred phenomena of protective resemblance. The Darwinian theory is clearly enunciated, and some of the modern controversies thereon are mentioned. The author's respect for authority is shown to be rather too great by such a sentence as the following: "Considering that Huxley, who is a host in himself, substantially accepts the theory, there cannot be much doubt that natural selection is the chief factor in the evolutionary process." Huxley would have been the last to wish any man to come to an opinion about any subject by such a road as that.

THE FLOWERING PLANTS AND FERNS OF NEW SOUTH WALES. With especial reference to their economic value. By J. H. Maiden, F.L.S., assisted by W. S. Campbell, F.L.S. Part I., pp. 1–15, plates i.–iv. Sydney: 1895. Price 2s. 6d. (non-subscribers, 3s. 6d.).

THE Department of Mines and Agriculture of New South Wales is responsible for this brightly illustrated attempt to familiarise the colonists with the flora of their country. Each part of the work will, so far as possible, contain plates and descriptions of two forest trees of economic value, and of two flowering shrubs or smaller plants selected because of the beauty or scientific interest of their flowers or foliage. The trees selected for the first part are the Bloodwood (*Eucalyptus corymbosa*) and the Coast Myall (*Acacia glaucescens*), while the smaller plants, equally representative of the plant-life of the colony, are the Waratah (*Telopea speciosissima*) and the Flannel-flower (*Actinotus helianthi*). The last-named bears a strong superficial resemblance to Edelweiss, though a member of quite a different family (Umbelliferæ). The coloured plates are well executed and include sections of the flower and fruit, and other useful details. The text comprises a full botanical description (in brevier), and a good popular account of the plant, its parts, geographical distribution, and economic value, with notes on cultivation. The specimen promises well, and we echo the hope expressed in the introduction that the public will support it sufficiently to justify its continuance. Half-a-crown per part is not an exorbitant price, if the standard of excellence of the plates in the present issue be maintained.

MICROSCOPICAL STUDIES IN BOTANY. By James Hornell, Director of the Jersey Biological Station. With original photomicrographs of the subjects described. Vol. i., Pt. I., May, 1895. 8vo. Pp. 8, 3 plates. Jersey: Author. London: Elliot Stock. Price 2s.

THE little pamphlet to hand speaks well for the series of botanical slides which Mr. Hornell is issuing along with the illustrative text and original photomicrographs. This first instalment includes four "studies": No. 1, the flower of *Clematis japonica*, illustrated by longitudinal and transverse sections through flower-buds; No. 2, the Dandelion, as typical of composite flowers, with similar sections through the capitulum; No. 3, the anthers of *Eschscholtzia*, with a transverse section through the flower-bud; and No. 4, the fruit of the fig, with a longitudinal section through a portion of a young fig. We have not seen the preparations, but the photos are good and bear examination under a lens, and the explanatory letterpress is well arranged and accurate. Busy teachers as well as students should find this series helpful, and the price, 21s. per annum (8s. without the preparations), is not exorbitant.

New Serials.

Under the title *Quarterly Notes*, the Geological Survey of India has begun a new publication in folio. The three numbers received consist of statements of the work accomplished during the quarters ending January 31, April 30, and July 31, 1895. We had heard of some difficulty as to the publication of further palæontological results, so we are the more glad to learn that series xvi. of *Palæontologia Indica*, consisting of reports by Fritz Noetling on the Jurassic and Cretaceous faunas of Baluchistan, is now in the press. The price of *Quarterly Notes* is not stated, nor is there any indication of the true date of publication.

The Geological Survey of Mexico have started a *Boletin de la Comision Geologica de Mexico*. No. 1 contains 55 pages and 24 plates, and discusses the mesozoic fossils of the Sierra de Catorce in San Luis Potosi.

Messrs. Juta, of Cape Town, announce the *Scientific African*, a monthly journal of South African science, arts, and crafts, price 6d. The November number, which was the first published, contained an account of the Geological Survey of Cape Colony. In the December number we note a portrait and account of Mr. A. Geddes Bain, the discoverer of the wonderful fossil reptiles from South Africa.

Terrestrial Magnetism, edited by Dr. L. A. Bauer, of the University of Chicago, is a new quarterly announced for this month.

Archiv für Anthropologie und Geologie Schleswig-Holsteins und der benachbarten Gebiete, 8vo, published by Lipsius and Tischer, in Kiel and Leipzig, and edited, for anthropology, by Miss J. Mestorf, Director of the Museum of Antiquities in Kiel, and, for geology, by Professor H. Haas, of Kiel. The first part, price 4s., contains the beginning of a long paper by E. Stolley, on the Cambrian and Silurian drift of Schleswig-Holstein and its brachiopod fauna.

Two important bibliographical works were begun in 1895. First, *Bibliographie des Travaux Scientifiques publiées par les Sociétés savantes de la France*, 4to (Paris, E. Leroux, rue Bonaparte 28); price 5 francs for a livraison of 200 pages; it is compiled by Dr. J. Deniker, under the auspices of the minister for public instruction, and contains a list of the contents of all publications of French societies, so far as such contents are of scientific nature. Secondly, *Bibliotheca Geographica*, published by the Gesellschaft für Erdkunde in Berlin, and containing the list of current publications previously printed in the society's *Zeitschrift*. The first volume, edited by O. Baschin, with the assistance of Dr. E. Wagner, catalogues the geographical literature of 1891 and 1892. Here, too, should be noticed the *Bulletin* of the newly founded Institut International de Bibliographie (8vo, Bruxelles, 10 francs per annum), which announces the preparation of a *Bibliographia Geologica*.

It may here be mentioned that the *Journal of Botany* is this year to be enlarged by an extra sixteen pages monthly, while the price of each number will be increased to 1s. 8d., and the annual subscription to 16s. It is hoped that by this means the *Journal* may be able to publish a large number of papers on Cryptogams, which no longer have *Grevillea* to go to, and to conclude Mr. W. A. Clarke's "First Record of British Plants."

It is also to be noted that *Knowledge* is with this year enlarging its scope to include literature and art.

Our Editorial Note headed "Erratics" had gone to press when we received notice that *The Glacialists' Magazine* had changed from a monthly to a quarterly, with an annual subscription of 6s. Parts 1 and 2 of volume iii., dated June and September, 1895, were issued in December of that year. Four misdatings *per annum* is better than twelve; may we hope for even further improvement?

Literature Received.

In addition to the books herein reviewed, we have received:—

Embryology of the Invertebrates, Korschelt and Heider, translated by E. L. Mark and W. M. Woodworth; Climates of the Geological Past, E. Dubois; Nature *versus* Natural Selection, C. C. Coe: Sonnenschein. Open-Air Studies, G. A. J. Cole: Griffin. Milk, C. M. Aitman; Introduction to the Study of Fungi, M. C. Cooke: Black. Fishes Living and Fossil, B. Dean; The Structure of Man, R. Wiedersheim, translated by H. and M. Bernard; Handbook of British Lepidoptera, E. Meyrick; Mosses and Ferns. D. H. Campbell; Natural History of Eristalis tenax, G. B. Buckton; Peripatus, Myriapods, and Insects, A. Sedgwick, F. G. Sinclair, and D. Sharp: Macmillan. Africa, vol. ii., South Africa. A. H. Keane: Stanford. Catalogue of the Spiders of Burma, T. Thorell: Brit. Museum (Nat. Hist.). The Growth of the Brain, H. H. Donaldson: Evolution in Art, A. C. Haddon: Walter Scott. Darwin and after Darwin, Professor Romanes: Longmans. The Plants of the Bible, G. Henslow: Religious Tract Society. Nebular Theory, W. F. Stanley: Kegan Paul. Elementary Physiology, J. R. Ainsworth-Davis: Blackie. The Diseases of Personality, T. Ribot: Watts & Co. Monograph of the Land and Freshwater Mollusca, parts i. and ii., J. W. Taylor: Leeds, Taylor Bros. Studies in Biology, S. J. Hickson: Owens College, Manchester. Synoptical Flora of North America, A. Gray and S. Watson: Harvard Univ. Die Schöpfung des Menschen, W. Haacke: Costenoble. Manuel de Géographie Botanique, O. Drude, liv. 8, 9, 10; Flore de l'Île de la Réunion, E. J. de Cordemoy: Paris, Klincksieck. Grundzüge der Paläontologie, K. A. von Zittel: Munich, Oldenbourg. Protobasidiomyceten, O. Möller; Die Artbildung und Verwandtschaft bei den Schmetterlingen, G. H. T. Eimer; Die Spiele der Thiere, Karl Groos; Neue Versuche zur Saison-Dimorphismus der Schmetterlinge, A. Weismann; Neue Gedanken zur Vererbungsfrage, A. Weismann; Grundzüge der Marinen Tiergeographie, A. E. Ortmann; Handbuch der Paläarktischen Gross-Schmetterlinge, M. Standfuss, second edition; Lehrbuch der Botanik, E. Strasburger, F. Noll, H. Schenk, and A. F. W. Schimper, second edition; Lehrbuch der Entwickelungsgeschichte, O. Hertwig, fifth edition; Ueber einige Probleme der Physiologie der Fortpflanzung, Dr. G. Klebs: Jena, Fischer. On the Development and Structure of the Whale, G. Guldberg and F. Nansen: Bergen, Grieg. Les Cavernes et leurs Habitants, J. Fraipont: Paris, Baillière.

Princeton Contributions to Psychology, Mark Baldwin: Univ. Press, Princeton, U.S. Cladodus Clarki, Claypole: *Amer. Geol.* Reconnaissance of the Gold Fields of the Southern Appalachians, G. H. Becker: U.S. Geol. Survey, Washington. On Memory and the Specific Energies of the Nervous System, E. Hering: Open Court Publishing Company. Crush-Conglomerates of the Isle of Man, G. W. Lamplugh and W. W. Watts: *Quart. Journ. Geol. Soc.* A New Theory of Hearing, Dr. C. H. Hurst: *Trans. Liverp. Biol. Soc* Fossil Mammals of the Uinta Basin, H. F. Osborn. On the Osteology of Agriochœrus, W. L. Wortman. On the Platypus Embryo from the Intra-Uterine Egg, J. P. Hill and C. J. Martin: *Proc. Linn. Soc. N.S.W.* Sensory Canal System of Fishes, W. E. Collinge: *Proc. Zool. Soc.* New Molluscs from Borneo, Godwin-Austen and Collinge: *Proc. Zool. Soc.* Les Variations periodiques des Glaciers, F. A. Forel: Rey and Malavallon. Notes on Geography, Geology, &c., of Iceland, Dr. H. J. Johnston-Lavis: *Scottish Geographical Mag.* The Relations between the Movements of the Eyes and the Head. A. Crum Brown: Frowde. On the Cœlomic Fluid, Lim Keng: *Phil. Trans.* A Journey to Roraima, Quelch: *Timehri.* New Facts bearing on Glacial Features, W. Howchin. Decimal Classification, Bibliographia Sociologica, Bulletin, &c.: Institut International de Bibliographie, Brussels.

Knowledge, October. The Museum, Sept. & Oct. (Albion, U.S., W. F. Webb). Review of Reviews, December. The Essex Naturalist, Nov. & Dec., 1894, Jan. to June, 1895. Journal Essex Technical Laboratories, October. Naturalists' Chronicle, Sept. & Oct. The Photogram, Jan. to Dec., 1895. Journal of Marine Zoology, October. Nature, Nov. 21, 28, Dec. 5, 12. Literary Digest, Nov. 23, 30, Dec. 7. Revue Scientifique, Nov. 16, 23, 30, Dec. 7, 14. Johns Hopkins University Circulars, November. Irish Naturalist, December. Feuille des jeunes Naturalistes, December. American Journal of Science, December. Victorian Naturalist, September. Science, Nov. 15, 29, Dec. 6. Scottish Geographical Magazine, December. Westminster Review, December. Knowledge, December. Proc. Roy. Soc. of Victoria, vol. vii. Naturæ Novitates, November. Trans. Perthshire Soc. Nat. Sci., 1894–5. Year Book for 1895: Library Association. Rod and Gun, December 14.

OBITUARY.

HENRY SEEBOHM.

BORN JULY 12, 1832. DIED NOVEMBER 26, 1895.

WE regret to record the death of Mr. Henry Seebohm, the distinguished ornithologist and traveller, who had never fully recovered from an attack of influenza experienced last spring. Though of Scandinavian descent, his parents belonged to a Quaker family residing at Bradford, Yorkshire, where he was born sixty-three years ago. His sole education was received at the Quakers' School in York, and he early entered business. He eventually amassed a fortune in the steel industry, and retired from active management of business affairs about twenty years ago. From his earliest youth, Seebohm had been devoted to the study of natural history, and when ample leisure and means came he entered the pursuit of ornithology with enthusiasm. He travelled first in the Eastern Mediterranean region, making observations and collections; next he accompanied Mr. Harvie Brown in 1875 in a journey to the Petchora River; and finally, in 1877, visited the tundras of the Yenissei region, being taken out by Captain Wiggins. The general results of these later travels were embodied in his popular works, "Siberia in Europe" (1880) and "Siberia in Asia" (1882). The scientific results appeared in the *Ibis* and the *Journal of the Royal Geographical Society*. At the same time, Mr. Seebohm made a detailed study of the thrushes, and prepared vol. v. of the British Museum Catalogue of Birds, which deals with that family and was published in 1881. He also published valuable treatises on "British Birds" (4 vols., 1882–85), on "The Geographical Distribution of Plovers, Sandpipers, and Snipes" (1888), and quite recently on "The Birds of the Japanese Empire." His latest efforts were devoted to the classification of birds. Mr. Seebohm was for many years a generous donor to the British Museum, where the whole of his valuable collection is now safely housed. His great donation of birds' eggs forms one of the most conspicuous features of the study series. His genial presence will also be sadly missed by the Royal Geographical Society, of which he was an honorary secretary at the time of his death.

GEORGE EDWARD DOBSON.

BORN SEPTEMBER 4, 1844. DIED NOVEMBER 26, 1895.

AFTER a long illness, Surgeon-Major G. E. Dobson died on November 26 last. An Irishman by birth, he graduated in the

Faculties of Arts and Medicine in the University of Dublin, and entered the Army Medical Service in 1868. He retired, owing to ill-health, in 1888. Taking a deep interest in comparative anatomy, he devoted himself to the study of the small mammals belonging to the Orders Chiroptera, Insectivora, and Rodentia, and contributed articles on these groups to the last edition of the "Encyclopædia Britannica." Besides numerous small papers, he published a "Monograph of the Asiatic Chiroptera" in 1876, and the British Museum Catalogue of Bats in 1878. He also left unfinished "A Monograph of the Insectivora, Systematic and Anatomical," of which the first two parts appeared in 1882–83. He was elected a Fellow of the Royal Society of London in 1883.

LUDWIG RÜTIMEYER.

BORN 1825. DIED NOVEMBER 27, 1895.

DR. RÜTIMEYER, the eminent Professor of Zoology in the University of Basle, who had been in failing health for some years, died on November 27 at the age of 70. He was born at Biglen, in the Emmenthal, and received a liberal medical education, having pursued his studies in Berne, Leyden, Paris, and London. Pure science early had charms for him, and in 1848 he published his first paper on the geology of the mountains between the Lake of Thun and his native valley. After election to his Professorship in 1855, he devoted his original researches chiefly to fossil vertebrate animals and the human skull, and began with a study of the bones found in the pile-dwellings of Switzerland. In 1861 there appeared his well-known memoir on the remains of the pig from these dwellings, and this was quickly followed by others. In 1864 he published the fine volume of "Crania Helvetica" in conjunction with his colleague Professor His. In 1867 appeared his important work on cattle, which reviewed the osteology of recent forms with special reference to all the known fossils. He was thus led to study the series of Siwalik fossils presented by Falconer and Cautley to the British Museum, and another memoir followed in two parts in 1877–78. His memoirs on the osteology and dentition of the Cervidæ (1881–83) are also of great importance to palæontologists. In 1867 and 1873, Rütimeyer published a now classic memoir on the Upper Jurassic Chelonia of Soleure, Switzerland; and his latest monograph of importance, issued by the Swiss Palæontographical Society in 1891, dealt with early Tertiary mammalian remains from Egerkingen, Switzerland, especially in comparison with corresponding fossils discovered in America, in deposits supposed to be of the same age. Up to the last, the old Professor's interest in the collections with which he had been so long associated was actively maintained, and his decease was painfully sudden and unexpected.

JÖNS JÖNSSON.

BORN MARCH 31, 1848. DIED AUGUST 29, 1894.

WE regret to learn of the death by accidental drowning of this energetic field-geologist attached to the Geological Survey of Sweden. Intended at first for the priesthood, it was not till about his thirtieth year that Jönsson turned to geology. Son of a landed proprietor in South Scania, and connected with quarries in his early youth, he was naturally led to the practical side of the science, and greatly assisted in the agronomic development of his country by his investigation of the softer rocks and superficial deposits. Of late years he had largely devoted himself to an examination of the composition of the clays of Sweden, with reference to their utility for bricks and terra-cotta, and it is a loss to his land and to science that he died before his contemplated work was published. Jönsson's name is to be found on five agronomic maps published by the Swedish Geological Survey, and in other publications of that department. He also published in *Geologiska Föreningens i Stockholm Förhandlingar*, in *Tidning för Stockholms läns Hushållningssällskap*, in *Orebro läns Hush.-sällsk. quartalskrift*, and in the memoirs of the Royal Agricultural Academy (*Kgl. Landbr. Ak. Handl.*). The value of his work, which is great, is due to the strictly scientific manner in which it was conducted, and to his study of natural processes in preference to empirical beliefs. A sympathetic notice by Hjalmar Lundbohm, from which our information is extracted, appears in *Geol. För. i Stockholm Forhdl.*, vol. xvii., which has only just come to hand.

ON November 11 last, European naturalists were startled by a telegram announcing the death of Dr. George Dawson, of the Geological Survey of Canada. The person meant was probably Professor GEORGE LAWSON, of Dalhousie College, Halifax, who died in that town on November 10.

Among other deaths which it is our misfortune to announce are those of Professor A. E. FOOTE, the mineralogist and dealer, of Philadelphia, who died at Atlanta, Ga., on October 10; Dr. F. M. STAPFF, the geologist, at Usumbara; he had only recently proceeded to Africa, at the request of the German East African Company, to prospect for gold; CHARLES TYLER, who was formerly associated with the late Dr. J. S. Bowerbank in his researches on sponges and protozoa, on November 2, in his 70th year; A. J. WÖRTOW, Professor of Bacteriology at Moscow; DR. CARL STECKELMANN, the African explorer, who was drowned on August 25; MR. EDWARD PHILIP LOFTUS BROCK, Honorary Secretary of the British Archæological Association, on November 2; E. L. RAGONET, President of the Societé Entomologique of France, and an eminent lepidopterist, in Paris, on October 17.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

The following appointments are announced:—H. A. Miers, of the British Museum, to be Professor of Mineralogy in the University of Oxford; Henry Lewis to be Professor of Mining in the Durham College of Science, in succession to Professor Merivale; Dr. J. D. Gilchrist to be Marine Biologist to the Government of the Cape of Good Hope; Professor Edward Grant Conklin, of the North-western University, Evanston, Ill., to be Professor of Comparative Embryology at the University of Pennsylvania, in place of the late Dr. John Ryder; Dr. Harrison Allen, Ex-Director of the Wistar Museum, to be Emeritus Professor at the same University; Edward Pierce, Ph.D. (Harvard), to be Instructor in Psychology at Michigan University; W. D. Frost, of the Minnesota Board of Health, to be Assistant in Bacteriology to the University of Wisconsin; Dr. R. M. Bagg to be Assistant in Geology, Johns Hopkins University; Dr. J. C. Merriam, a former pupil of Professor von Zittel, to be Instructor in Palæontology in the University of California; Dr. H. P. Johnson to be Curator of the Museum of the same University; D. T. MacDougal to be Professor of Botany in the University of Minnesota, U.S.A.; Dr. G. P. Grimsley to be Professor of Geology and Biology at Washburn College, Topeka; Dr. G. Lagerheim, of Tromsö, to be Professor of Botany and Director of the Botanical Institute in the University of Stockholm; N. Kusnetzoff, of the Botanical Gardens in St. Petersburg, to be Professor of Botany at Dorpat University; Dr. R. Metzner, of Freiburg, to be Professor of Physiology at Basle; Professor W. Branco, of Tübingen, to be Professor of Geology and Mineralogy at the Academy in Hohenheim, Würtemberg; Dr. J. Sobotta, of Berlin, to be Prosector at Würzburg University; Dr. Strahl, of Marburg, to be Professor of Anatomy in Giessen, in succession to Professor Bonnet; Dr. Th. von Wienzierl, teacher in the High School of Agriculture, to be Director of the State Seed-Testing Station in Vienna; Dr. F. Krasser, as Assistant in the Botanical Department of the State Museum in Vienna; Dr. F. Czapek to be Assistant and Dr. W. Figdor to be Demonstrator at the Institute of Physiological Botany of the Vienna University; Professor F. Ruth, of Vienna, to be Professor of Geodesy in the Technical High School at Prague; Professor M. Vladescu, of Jassy, to be Professor of Botany at Bucharest, in place of the late Professor Brandza; Professor Vladescu is succeeded by Dr. A. P. Popovici.

We are glad to learn that Mr. H. N. Ridley has been definitely re-appointed Director of the Department of Gardens and Forests in Singapore, the Government having reconsidered its proposition to abolish the office.

Sir William Flower has been elected a Foreign Member of the Royal Academy of Science, Stockholm.

The Rev. Canon A. M. Norman has been presented by the Bishop of Durham to the Rectory of Houghton-le-Spring.

The first meeting of the General Committee for the promotion of a memorial to the late Professor Huxley was held in the theatre of the Museum of Practical

Geology, London, on November 27, under the Presidency of the Duke of Devonshire. It was unanimously resolved that a statue should be offered to the Trustees of the British Museum to be placed in the Natural History Museum at South Kensington; that a gold medal should be established as a students' prize for Biology in the Royal College of Science; and that any surplus fund should be disposed of as the executive committee might think best for the promotion of Biological Science. Numerous local committees are being formed for the collection of subscriptions, and it is hoped that the fund will be of an international character. The promises of support from abroad are remarkably numerous.

On December 16, Professor T. G. Bonney received a well-merited compliment at University College, London. His former students, both in Cambridge and London, presented him with a portrait of himself.

Mr. E. S. Goodrich, of Merton College, Oxford, has been elected to the Biological Scholarship at Naples for the year 1895–96.

The Walsingham medal has been awarded by Cambridge University to Mr. J. L. Tuckett, fellow of Trinity College. Essays for the next award are to be sent in to Professor Newton by October 10, 1896.

On October 30. 1895, Mr. John D. Rockefeller gave a million dollars to the University of Chicago, and has promised to go as far as another $2,000,000 in equalling any contributions that may in future be promised by others. Mr. Rockefeller's donations to this institution now amount to about $7,600,000.

According to *Science*, the University of Minnesota has five new buildings nearly completed. They are (1) Medical Laboratories ($40,000); (2) Armory ($100,000); (3) Dairy Laboratories ($30,000); (4) Dining-hall and Dormitory for School of Agriculture ($30,000); and (5) Astronomical Observatory ($10,000). The new die-testing works ($25,000) are this year opened for experimental work.

We have before (vol. vi., p. 430, June, 1895) alluded to the energetic field-work in geology carried out by Kansas University. A regular Geological Survey was started in the spring of last year in connection with the University, and receiving money from the State through that channel. Professor Haworth is at the head of the Survey. The legislature has also created a State Board of Irrigation, of which the Professor of Geology in the University is *ex officio* a member, and this places additional funds at the disposal of the University. During the summer of 1895, some dozen men were employed, five working on the water problems in the western part of the State, two mapping the Cretaceous, one studying the salt deposits, one the glacial phenomena in north-eastern Kansas, and others working on the stratigraphy of the Carboniferous rocks. On the last subject a volume is now ready for publication, as well as a preliminary report on the water supply of West Kansas. As yet, however, no provision has been made for the publication of this and other material. Meanwhile, Professor Haworth has given an account of the stratigraphy of the Kansas Coal-measures in the December number of the *American Journal of Science*.

Toronto University has just completed a new museum, which was opened on November 15 last.

The late Mr. James Carter has left his collection of fossil Crustacea to the Woodwardian Museum, Cambridge, in which his collection of local fossils has long been deposited.

The Trustees of the British Museum have just published a "Guide to the British Mycetozoa exhibited in the Department of Botany. . . . by Arthur Lister"; the appearance of the real author's name on the title-page is a commendable innovation. The Guide consists of forty-two 8vo pages, with numerous text-figures, and is sold for 3d. Mr. Lister is responsible, not only for the Guide, but for the collection, which, together with the beautiful coloured drawings by Miss Lister, was presented by him, and now forms one of the most intelligible and attractive exhibits in the Natural History Museum.

We understand that the Council of the Geological Society of London has decided to recommend the Fellows to offer their large collection of minerals, rocks, and fossils to the Trustees of the British Museum. The Royal Society and Zoological Society of London disposed of their museums in this manner many years ago. Negotiations are now pending, and it is hoped that some definite proposition may be submitted to the consideration of the Fellows before the annual meeting in February next.

In connection with the Education Department's decision, to which we have often alluded, to allow time spent in museums under certain conditions to count as school attendance, the authorities of the Manchester Museum have organised a series of demonstrations, to be given by Mr. Hoyle, to school teachers. It is intended not so much to impart systematic instruction in natural science as to afford teachers an opportunity of becoming acquainted with the resources of the museum, and to suggest methods of effective museum teaching. We hope other museums will follow the lead of Whitechapel and Manchester.

Huddersfield is singularly behind the times in the fact that it possesses neither free library, art gallery, nor rate-supported museum. Some time ago Sir Joseph Crosland offered £6,000 as a start for a free library, but the offer was declined by the Town Council. More recently, Mr. S. L. Mosley offered the whole of the contents of the Beaumont Park Museum—about 100,000 specimens—to start a town museum, but this offer also was declined after six months' consideration by the Town Council. We also understand that the School Board of Huddersfield continues to ignore the study of natural history. Under these circumstances, we are glad to refer to the valuable work being done by Mr. S. L. Mosley, who has now put up a new museum building, in which he is continuing and increasing the educational work that he has been carrying on for the past fifteen years. His museum is largely used by beginners from all parts, who in him find a willing helper. It is pleasing to record that this museum is open on Sundays, on which day many working-people avail themselves of the opportunity to bring specimens for comparison and naming. A meeting of local naturalists takes place at the museum on the first Monday of each month. Mr. Mosley has sent us his *Report and Monthly Circular* for 1895; in future this will be merged in the *Naturalists' Journal*, which has been acquired as the organ of the museum.

We are glad to learn, from one of our special correspondents, of good work being done at the Saffron Walden Museum. This is a private museum, founded by the Gibson family of that town, and is governed by trustees. It is supported out of the trust funds, supplemented by the annual subscriptions of interested residents. It is, however, open to the public other than subscribers, at the discretion of the curator. The Museum contains a valuable African collection brought home in the early part of this century, also a set of the Crag fossils of the county, and some interesting local antiquities, all arranged as well as the limited space permits. G. M. Maynard, who has sole charge of the Museum, has found time to elaborate some instructive exhibits with good labels, such as the small case explaining the structure of a sea-urchin. Some cases showing the life-histories of certain insects have very lengthy labels; these have been cut up and pasted on a strip of canvas wound on two cylinders like a perpetual almanack. The pleasure of winding these labels attracts the youth of Saffron Walden to their perusal; so that the ingenious contrivance has more than one advantage. Mr. Maynard, whose wax models of fungi are well-known, and may be seen in the Museum of the Science and Art Department in South Kensington, is now preparing a series showing the various stages of harmful insects on their appropriate food-plants. The educational value of this Museum to the well-known Grammar and other schools of Saffron Walden is so great that we hope some co-operation between the Trustees, the Municipality, the Schools, and the enlightened Essex County Council may place it on a more permanent and satisfactory financial basis. A single curator in want of funds is too little for the scientific advantage of the Museum, the credit of Saffron Walden, or the material prosperity of the community.

A GUIDE to the Norwich Castle Museum has been prepared by Mr. Thomas Southwell. It chiefly deals with the collection of birds, and is cheap at 6d.

MR. T. M. MACGREGOR has presented the Perth Museum of Natural History with his fine collection of insects, both local and general. An account of this Museum, recently opened by Sir William Flower, has been furnished us by its energetic curator, and will be found among our articles.

THE Report of the Trustees of the Australian Museum, Sydney, for 1894, which has recently been sent us, shows that the Museum is still suffering in all its branches from the financial depression of a few years ago. No more than £20 has been spent in the purchase of specimens, and no collecting expeditions have been sent out. "The staff still continues at the reduced strength, and the forced economies of late years are beginning to tell on the efficiency of the institution. The duplicate collections are almost exhausted in some groups, and no means of replenishing them are available. The few hands allowed being insufficient for the proper maintenance of the Museum, it may be found impossible to open the new hall and galleries to the public until Parliament shall have granted sufficient funds for the engagement of further attendants to clean and watch them." The cases of the new Geological Hall, built in 1891, have long remained useless owing to the absence of locks. £400 has at last been voted by Parliament to supply these necessary fittings, and the collections are now being arranged in the cases, the fossils on the ground floor, the minerals in the first gallery, and recent Invertebrata in the upper gallery. The necessity for new cases is very greatly felt, and Mr. Etheridge thinks that he can hardly find room for additions, especially in the divisions of Mammalia, Osteology, and Ethnology. Circumstances, we presume financial, have prevented the appearance of the *Records* of the Museum; but, altogether, the Report is so disheartening that we forbear to quote further complaints. We are glad to see that the snakes are to be exhibited to the public by means of a series of casts, coloured from nature, which will show, not only the largest adult forms, but also variation in colour and stages of growth. The successful appearance of these casts in the National Museum at Washington fully warrants this new departure (see NATURAL SCIENCE, August, 1894, Supplement). A new method of exhibiting fish has also been begun, namely, "by placing the dried skins, suitably prepared, on a clear run of vertical fittings, immediately within the glass front of the containing case. In preparing the specimens, the latter are flattened on the unexposed side, so as to accommodate them to the vertical surface." For the exhibition of the Australian Lepidoptera, Coleoptera, and other insects, Mr. F. A. A. Skuse has devised a series of thirty-six large cork trays held in a suitable frame-work in the wall-cases, immediately within the glass. Upon the trays is placed a framed series of plates from Scott's "Lepidoptera." The new arrangement of the Invertebrata by Mr. Thomas Whitelegge, who has arranged 1,340 specimens of Foraminifera, Porifera, and Actinozoa, is very highly commended by Mr. Etheridge. The fine collection illustrating the ethnology of Australia and the South Pacific Islands has long been exceedingly crowded, and an extension of the building is urgently required. This collection has recently been enriched by a set of weapons and implements of the

Alligator River Tribes, Northern Territory, and by numerous urns and vases from the burial mounds of Arkansas, U.S.A., as well as by a series of objects recently obtained by the secretary, Mr. S. Sinclair, in the New Hebrides. Mr. Etheridge's duties as curator of the Museum have necessarily interfered with his valuable palæontological work, since he has hitherto been practically the only palæontologist at the service of both the Museum and the Geological Survey. It is to be hoped that he may receive some additional assistance in this department. We note that while the average attendance on week-days of seven hours' duration is 330 per diem, it reaches 660 per diem for the Sunday afternoons of three hours.

WE have received the Annual Report of the Provincial Museum at Lucknow for the year ending March 31, 1895. The completion of the alterations in one of the buildings has enabled Dr. Führer, the Curator, to re-arrange the collections in a more satisfactory manner, and a guide-book is now being prepared. The Government grant for the purchase of specimens is still extremely small; but the liberality of private and official donors fortunately goes far to make up for this want of funds. The Museum staff also collected 124 natural history specimens during the year. The Curator being Archæological Surveyor of the N.W. Provinces, many important inscribed slabs and images have been secured for the Department of Archæology, including six polished marble slabs, with Sanskrit and Prakrit inscriptions, dating from the middle of the 12th century A.D.

THE staff of the Department of Insects of the U.S. National Museum has been re-organised as a result of the death of C. V. Riley. L. O. Howard, entomologist of the U.S. Department of Agriculture, has been appointed Honorary Curator of the Department of Insects; Wm. H. Ashmead, custodian of Hymenoptera, and D. W. Coquillett, custodian of Diptera. All museum custodians are honorary officers. M. L. Linell will remain as general assistant to the Honorary Curator.

IN view of the eleventh International Congress of Americanists, which was held last October in the City of Mexico, the National Museum of Mexico prepared six new catalogues, (1) of the collection of mammals, (2) of birds, (3) of reptiles, all by A. L. Herrera, to whose remarks on nomenclature we allude on another page; (4) of the collection of Anthropology, by A. L. Herrera and R. E. Cicero. There was also a guide to the Museum and a new catalogue of the Archæological Department.

THE Pharmaceutical Society of Great Britain has sent us its "Museum Report for the year 1893-4," compiled by the curator, Mr. E. M. Holmes. This consists chiefly of a list of plants used in medicine, of which specimens have been presented or recently purchased. Useful information and references are given, so that the book will be valuable to others than those visiting the museum.

MR. GEORGE W. VANDERBILT has started a museum and arboretum at his home at Biltmore, in North Carolina. He has recently purchased the collection of Southern plants which formed the material for Dr. Chapman's "Flora of the Southern States."

THE Belfast Naturalists' Field Club is to be congratulated on the energy its members are displaying in the pursuit of natural history. The course on Botany (structural and systematic) which Professor Johnson, of the Royal College of Science, Dublin, conducted under the Club auspices in the spring of this year is being continued this winter under the guidance of the Rev. C. H. Waddell, M.A., who himself went through the spring course. Recently the Club has published a substantial *Supplement*, by S. A. Stewart and R. H. Praeger, to the "Flora of the North-East of Ireland," by Stewart and Corry. It is a matter for regret that the flora of the rest of Ireland is not as well worked out as that of the north-east portion. But workers so devoted as Mr. Stewart are rare. The Field Clubs of Dublin and Belfast began their winter sessions with successful conversaziones. Professor Grenville Cole succeeds G. H. Carpenter as president of the former society.

AT the General Meeting of the City of London College Science Society on November 27 it was decided to select a president "who will make a point of presiding at the society's meetings." The choice happily fell upon Professor J. Logan Lobley.

THE Oxford University Junior Scientific Club has prevailed on Professor W. Ramsay to deliver the fifth 'Robert Boyle' Lecture next summer term. Mr. E. C. Atkinson, of St. John's, is the president-elect.

THE "Triton," a kind of aquicultural society in Berlin, proposes to give three prizes as follows:—(1) for a means of destroying the animal and vegetable ecto-parasites of fish, 700 M.; (2) for a means of destroying the hydra of fresh-water, 400 M.; (3) for a plan for killing *Tubifex rivulorum*, 200 M. These plans are destined to be used principally in aquaria, and must be simple, practical, and innocuous to both fish and aquatic plants. The papers, in German, French, English, Italian, or Russian, should be sent signed with a motto, and accompanied by a sealed envelope, containing the motto and the sender's name, to Professor F. E. Schulze, 43 Invalidenstrasse, Berlin, before July 1, 1897.

THE *British Medical Journal* states that a bacteriological laboratory, under the directorship of Professor Hankin, is to be established at Agra by the Indian Government. Health officers are to have a six months' training in bacteriology, and 1,900 municipalities will be expected to appoint trained men for sanitary work. Further laboratories are likely to be started in other parts of India.

The Health Committee of the Glasgow Town Council also intends to establish a complete Bacteriological Department in the sanitary buildings now being erected.

THE November number of the *Journal of the Essex Technical Laboratories* states that a three weeks' course of instruction in agriculture will be given at the laboratories during January, 1896. The course will be confined to the study of the cultivation of farm crops, and classes will be held daily from Monday, January 6, till Saturday, January 25. The classes are intended for farmers, farmers' sons, or other persons engaged in agricultural pursuits, and are open to all such as are residents in the county. The lectures will be given by Professor E. Blundell, of the Royal Agricultural College, Cirencester.

A special course of lectures, practical instruction, and laboratory demonstrations is now being given on Marine Zoology at Brightlingsea. The lectures and practical instruction for students are given weekly by Mr. Houston, while the popular demonstrations are given by Mr. Walter Crouch at the Marine Biological Laboratory, on two days a week during the course.

WE learn from *Nature* that the Egyptian Government will this year begin a Geological Survey of Egypt. This will occupy about three years and cost £25,000. Captain H. G. Lyons, R.E., who is already known by his papers before the Geological Society, and who is now superintending the excavation of the ruined temples of Philæ, has been appointed to carry out the work.

PROFESSOR R. KOEHLER, of Lyons, has communicated to the *Comptes Rendus* of the Paris Academy of Sciences an account of deep dredgings from the "Caudan," in the Gulf of Gascony, between August 20 and September 2, 1895. The vessel was provided by the Minister of Marine, but the greater part of the material and necessary expenses were furnished by the local authorities. During the short time at its disposal, the expedition let down the trawl twenty times, and made thirty-two deep-soundings. The results have shown that successful deep-sea dredgings can be carried on with very limited means.

A number of Fellows of the Royal Geographical Society interested in Antarctic exploration are discussing the possibility of organising an expedition by private subscription. It is estimated that a sum of about £50,000 would be required for an adequately-equipped fleet.

Mr. F. O. Pickard-Cambridge, a nephew of the well-known specialist on spiders, and himself a competent naturalist and artist, has been appointed by the British Museum (Natural History), with the sanction of Messrs. Siemens, to assist Mr. Austen, who, as we have already announced, has left this country in the "Faraday" for Para. Messrs. Siemens intend to lay their telegraphic cable from Para to the mouth of the Rio Negro at Manaos, a distance of 1,100 miles.

The *Glacialists' Magazine* states that Dr. Karl Grossmann, of Liverpool, who visited Iceland last summer with a medical expedition for the investigation of leprosy, was able to make some interesting observations on the glaciation of little-known parts of that island.

According to *Nature*, the Austrian Expedition to establish meteorological stations at Jedda, Koseir, and other places on the Red Sea, has made some satisfactory zoological collections, and during the winter will investigate the southern parts of the Red Sea, between Jedda and Massowa.

Mr. Charles Schuchert informs us that he has spent a successful summer collecting Devonian fossils, chiefly from New York, Ontario, and Michigan, or as he expresses it, dry-dredging in the Mississippian Sea. An account of his collections, which are now in the U.S. National Museum, is given in *Science* for November 2, 1895. It appears that in some parts of North America the lookers-on imagine that the fossil collector takes his specimens home to gild them; but at Thetford, in West Ontario, a famous locality for Middle Devonian fossils, the inhabitants are so accustomed to the visits of the collector that they have begun to think he may not be insane.

Professor Frederick Starr, of the University of Chicago, has gone to Guadalajara, Mexico, to study a submerged city in Lake Chapala, and to determine whether the dwarfs who inhabit the neighbouring mountains owe their small stature to disease or inherit it from their ancestors.

ERRATUM.

Mr. Chalmers Mitchell writes to us: "In a 'Note and Comment' in the December number of Natural Science ('Chauna,' p. 380, vol. vii.) you transpose the authorship of two memoirs on Screamers to which you allude. It was Garrod who wrote upon *Chauna derbiana*; the memoir on *Palamedea cornuta* was written by Beddard and Chalmers Mitchell."

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22, St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

The "Challenger" Number.—*In reply to enquiries, we remind our readers that, although the* First *edition of this ran out of print immediately, there are still some copies of the* Second *edition to be obtained at the usual price—* One Shilling. *No more will now be printed, so orders should be sent at once.*

YOUNG GREY-LAG GEESE.

From a photograph by C. Kearton, in "British Birds' Nests," by R. Kearton. Kindly lent by Messrs. Cassell & Co.

[*See p.* 128.

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NOTES AND COMMENTS.

The Preliminary Notice.

THERE is, we are gravely assured, much to be said for the Preliminary Notice. This much is usually said by two classes of people: first, the priority-hunter; secondly, the type-hunter. The priority-hunter is the man who is, as a rule, more concerned with adding a new name to the literature of science—to which name his own, as he fondly supposes, is to be attached for ever—than he is with investigating the structure and relationships of the species which he forces upon an unwilling world. He lives in a perpetual fear lest some colleague shall anticipate his work, and finds it necessary to rush his driblets of papers through the press, with but scant attention to the soundness of their workmanship, and with little care that they shall prove intelligible to his readers. The type-hunter is usually a museum official. In common with the officials of other museums, he one day receives some specimens from a distant country. He imagines it to be his duty to the institution which he serves to fly to the printing-office with a hastily-composed description of those among them that he believes to be new species, in order that those specimens may acquire the fictitious value of what are known as "types." His business, like that of the priority-hunter, is not with his scientific colleagues; he cares little whether his description can be understood either by his fellow-workers or by future generations, for, to do him justice, he usually excuses his action on the ground that a museum catalogue, or a Government report, or some other ponderously moving publication, will eventually provide the world with all the details for which it is anxious. Even if the monograph never appears, it matters little to him; the museum has the type, and, in the absence of proper figures and description, this renders it all the more necessary for students to visit his museum. Hence, fame to the museum, and promotion to himself as an active official! But these two classes do not, we earnestly hope, represent either a baser majority or an enlightened minority of scientific workers. Rather, we venture to affirm, do they constitute a minority which we prefer to leave without epithet. In a fair-minded discussion their arguments should not be given undue weight. From the point of view of pure science the only advantage that can be ascribed to the preliminary notice is that the writer of it may possibly have his mistakes corrected and additional information given to him before he commits himself to quarto form. But a worker in love with his subject is usually in sufficient touch with his colleagues to obtain criticism, advice, and information through the simple medium of the Post Office, without airing his half-baked opinions before the world at large.

On the other hand, the charges that may be brought against the preliminary notice are varied and weighty. It affords undoubted inducement to a writer to scamp his work, since he salves his conscience with the thought of that wonderful and richly illustrated paper that is to establish his reputation—some day. Meanwhile, his readers are presented with statements of irritating insufficiency and of doubtful validity, excused, perhaps, by some such remark as that the periodical in which they appear is "not a permanent medium of publication," and that those people who, owing to their private sources of information, are able to understand the statements, find this preliminary publication of considerable service. The less fortunate public wishes that such people would be content with their private sources of information. Though the foundling be cast upon the world, there is still much fear that it may never reach maturity. Countless accidents may prevent the publication of the completed work. There are, indeed, instances of preliminary notices that have been calmly thrown over by their reputed parents, owing to some doubt cast upon their legitimacy. Other notices, again, when they have served their turn, are not alluded to in the final monograph, an action that is distinctly ungenerous. As a result, even the priority-monger becomes involved in some confusion, for a species may be introduced as new, although the curious bibliographer knows that it was really published two years ago. But two years is a long time, and it is often found that names have undergone such transformation in the interval that the connection between the preliminary and the final form is hard to recognise. Even in many cases that do not deal with species or their names, but with presumed additions to our knowledge of scientific facts, it is eventually found that the chief result of the preliminary notice has been to start a number of errors upon their eternal career.

If, after all that has here been urged, it still be maintained by any of our readers that under certain circumstances the preliminary notice is a necessity, let us at least ask that the statements published in it shall have been verified with as much care as those of the final monograph, and that any new species therein introduced shall be provided with diagnoses that are not merely diagnostic, but also intelligible to every worker. Even fossils, whether from the Eocene of the

Middle Atlantic slope or from other better known formations, are to be regarded as something more than counters for the stratigraphical geologist to gamble with. We will not insist upon illustrations, but if these are not given it is all the more necessary that the description should clearly convey the appearance of the species. Still, though we make this concession, we urge again that what is really wanted nowadays is careful and detailed work, accompanied by a thorough revision of all the imperfect and inaccurate statements launched upon the world, chiefly in the form of preliminary notices.

The Variation of Yeast-Cells.

The *Annals of Botany* (vol. ix., no. 36) contains a short account of some experimental studies on the variation of yeast-cells by Professor E. C. Hansen, of Copenhagen. Professor Hansen had already shown that the form and size of the cells cannot be used alone, as was done by Reess, to characterise species; for from each of the species it is possible to produce the rest by varying conditions of cultivation. Thus the large oval cells, characteristic of *Saccharomyces cerevisiæ*, the beer-yeast, under favourable circumstances of nutrition, may be developed by wine-yeasts with small oval cells, Reess's *S. ellipsoideus*, and the converse change may also be effected. Again, the sausage-shaped cells of *S. Pastorianus* can be produced in several ways from the other two yeasts. There are many reasons which make it probable that the oval form is the primitive.

Hansen has also shown that cultivation for a long time in aërated wort, at a temperature above the maximum for spore-formation and approaching that for vegetative growth, causes a complete and permanent loss of the powers of spore-formation, and of producing films on the surface of liquids. The loss of the latter property causes a marked alteration in their influence upon the liquids in which they grow; the cells of the film which develops on fermented beer-wort cause the liquid to become lighter in colour, and also produce a vigorous oxidation by which the alcohol is broken up into carbonic acid and water. Thus, while an ordinary yeast-culture, left to stand for six months, contained only 1·5 per cent. of alcohol in the fluid, that of a non-film-producing variety obtained from the same stock showed an alcohol percentage of 5·5, that is, the same amount as at the end of the first month. By cultivation on the surface of nutritive gelatine, varieties were developed having a greater fermentative power than their primitive forms, in one case amounting to the production of as much as 3 per cent. more of alcohol. Another experiment which has an economic bearing shows an effect of the chemical composition of the nutrient liquid. *S. Pastorianus* is one of the disease-yeasts of beer, imparting an offensive odour and a disagreeable bitter taste. When cultivated for a number of generations in a solution of cane-sugar in yeast-water, a growth was obtained which for a time had lost these properties. Frankland and others have proved that when bacteria are cultivated in a certain way they may lose their special fermenting powers. Hansen, however, was unable to demonstrate a similar behaviour in the case of alcoholic yeasts. Their cells may be temporarily much enfeebled, and varieties may be produced yielding less alcohol than the primitive forms, but, hitherto, it has been impossible to produce one which has completely lost its power as an alcoholic ferment.

A propos of the possibility of replacing the yeast of cultivation (*S. cerevisiæ*) by some of the species occurring in nature, with a view to obtaining new or better products, Hansen emphasises the fact that we know nothing of the history of existing supposed variations from a primitive form; for "we have never been able to carry one single Saccharomyces species back to its progenitor." The question as to whether the species are mere developmental phases of various common mould-fungi must still be considered an open one. Since, however, we now know many moulds that develop alcoholic fermentation fungi, it would not be surprising if some should be found to develop yeast-cells with the characteristic internal spores.

As regards the causes of the variations, Hansen finds that there are three important external factors, the nutritive substratum, aëration, and temperature. As regards the two former, it is only required that they should allow of a vigorous multiplication, and the range in which they may vary is a wide one. But as regards temperature, one or two degrees too much or too little is enough to prevent the changes. If the temperature is a little too low the effect will not be sufficiently marked, if too high, the multiplication of the cells ceases too soon, and the change that has begun does not become fixed.

THE NUTRITIVE MATERIALS IN WHEAT-GRAINS AND WHEAT-EMBRYOS.

IT is a fact familiar to students of botany that the seeds of flowering plants correspond, not to an egg that has just been fertilised, but to an egg within which the chick-embryo has proceeded some little distance in its development, and has then for a time become quiescent. In some seeds, such as, for instance, the common broad-bean, the young embryo has absorbed the whole of the food-material which had been provided for it, and has packed that into its young seed-leaves. Thus, the part of the bean or of a walnut which one eats is the actual embryo. In other seeds, as for instance wheat-grains, the embryo remains very small until it germinates, and the part which is ground into flour and used as food is the endosperm or food-store, not yet absorbed by the embryo. In the number of the *Annals of Botany* referred to in our last paragraph, Mr. O'Brien gives the results of investigations he has made into the composition of the endosperm or food-store, and the germ or embryo of wheat-grains. The embryo is richly stored with aleurone-grains, thus contrasting with the endosperm, in which the proteid material is stored as gluten.

No starch is present, but there is a small amount of sugar and much oil. A further analysis of the germ-proteids showed that globulins and proteoses existed as in the endosperm, but that the gluten was replaced by soluble albumen.

Polyembryony in a Lily.

Mr. E. C. Jeffrey, in the same number of the *Annals*, describes an interesting case of polyembryony in a liliaceous plant, *Erythronium americanum*. It resembles the polyembryony which is so frequent in gymnosperms in the fact that the several embryos, two, three, or rarely four in number, originate from a single egg-cell. After fertilisation, which occurs in the normal way, the egg-cell forms a mass of embryogenic tissue, from the lower part of which several rudimentary embryos grow out. Ultimately, however, as in the gymnosperms, all except one perish, which in the seed is attached to a large, broad suspensor, the remains of the embryogenic mass.

Mr. Jeffrey's discovery adds another form of polyembryony to those already described in the order Liliaceæ. In *Funkia* and *Nothoscordum* Strasburger showed that the multiplicity of embryos arose from adventitious buds derived from the nucellus growing into the embryo-sac after fertilisation of its egg-cell. Early last year Tretjakow published an account of the formation of embryos from the antipodal cells in *Allium odorum*. Two modes of origin are distinguished by the present writer, *extrasaccal* and *intrasaccal*, from their occurrence outside or within the embryo-sac, that described in *Erythronium* coming under the second heading, where also must be included the case, described by Dodel and Overton, of *Iris sibirica*, where polyembryony is said to arise from fertilisation of the synergids.

The "Revue Scientifique" and Bibliography.

We observe that the *Revue Scientifique*, in its issue for December 28, 1895, announces that it will adopt the system of heading its articles with their proper decimal indices. A very lucid explanation of this method of bibliographic classification is given by the editor, Dr. Charles Richet. He concludes his article by saying, "Nous serons fiers d'avoir été les premiers à l'appliquer, en Europe, après MM. Lafontaine et Otelet." We are sorry that a journal which has done such good work in the cause of scientific bibliography as has the *Revue* should have been forestalled by another journal, even though that be Natural Science. We venture, however, to point out to Dr. Richet that the system was put into force in our January number, which was in the hands of the public on Monday, December 23, 1895, whereas it did not appear in his paper until January 4 of the present year. The learned editor of the *Revue Scientifique* will doubtless join with us in the hope that we may not be the only amicable rivals.

THE BIBLIOGRAPHIC CONFERENCE.

WE have at intervals alluded to the schemes of the Royal Society for the preparation of a complete catalogue of scientific papers, from the year 1900 onwards, classified under both authors and subjects. We have retailed to our readers such information as we could glean from our foreign contemporaries, or as was supplied to us by our foreign correspondents. From some papers which the Royal Society has at last kindly supplied to us, and from the recent address of Lord Kelvin, a few additional facts may now attain the publicity they deserve. Through the Foreign, India, and Colonial Offices invitations have been sent to the Governments of the twenty-one nations that are engaged in scientific work, of India, and of our colonies, to send representatives to a conference to be held in London during the first half of July next. It is proposed that the representatives appointed should communicate beforehand with the Royal Society, and make suggestions, by the help of which, as well as of those already received in preliminary correspondence, the President and Council might draw up some outline scheme which could serve as a basis for discussion, both before and during the conference.

In the original letter, dated 1894, which asked scientific bodies and individuals for their opinions, the scope of the catalogue was confined to scientific literature. This letter produced favourable replies. In the letters of August 15, 1895, it is proposed that the catalogue "shall be as complete as possible, in respect to all papers and other publications and works relating to pure and applied science." This extension will, without doubt, treble or quadruple the task, which even before was of appalling magnitude, and it is not surprising that it has—so our foreign correspondents inform us—met with strenuous opposition. We learn, for instance, that the Berlin Academy has signified its strong disapproval by declining to send a representative to the Conference, and that the Swedish Academy is not unlikely to follow suit. Doubtless the inclusion of engineering, medicine, and sanitation will gain financial support from practical men; but it will enormously increase the cost, and pure science may get stranded on the way. Certainly it is hard to see what the Berlin and Swedish Academies, or even the Royal Society, have to do with drains, electropathic belts, or liquid manure. Patentees and purveyors of such goods are able to take care of themselves. But surely the objectors would do better to give their arguments first and to retire afterwards. The object of a conference is to promote criticism, and to sulk in a corner is hardly a courteous response to a courteous invitation.

Among the details to be discussed at the Conference are: the question of language, for which English appears to have the suffrages of the majority; the mode of quoting titles, which most people wisely think should be in the original language, though a few would restrict them to English, French, or German, and perhaps Italian; the manner of publication, for which the system adopted by the Bibliographical Bureau for Zoology is warmly advocated. It is, we suppose, probable that, with regard to the subject-index, the claims of Decimal Classification on the Dewey plan will be strongly urged, although we understand that the authorities of the Royal Society are themselves unfavourable to the scheme. Whether it meets with a welcome at the Conference will doubtless depend on the number of practical bibliographers and experienced cataloguers whose presence has been invited. If the Decimal method be adopted, the work of classification in the subject-index will be enormously facilitated, and if the example of NATURAL SCIENCE and the *Revue Scientifique* be followed by other publications, the work might be entrusted to the very young ladies who have lately been invading the public scientific libraries of London on behalf of the Royal Society's Catalogue. We believe, however, that another system, more understanded of the people, though more cumbrous and less certain, has lately been proposed by the Royal Society. This is that short abstracts, or detailed contents, of the contained papers should be inserted in each issue of a periodical. To this end certain societies have, we understand, been approached. Anything that will aid research is to be welcomed; but it may be pointed out that an abstract in French or Japanese, though more readily intelligible (in France or in Japan), is not so universally intelligible as the Decimal Index-number will, it is thought, before long become. Moreover, if the Conference decides to adopt the latter system, already in work in a large number of libraries and bibliographic centres, then the Central Office, when it begins its own labours, will be able, without friction, to use those of the many disinterested toilers in the same field.

We have made one or two suggestions, because suggestions are sought; and it is possible that those made by practical journalists, who have devoted much study to the subject, may be as valuable as those made by scientific investigators. In any case, this attempt is so great and so important that it is the duty of everyone who has seriously considered the question to speak out his honest opinion, without waiting till he is asked for it.

SIR JOSEPH PRESTWICH.

IN the New Year's list of honours no award could have given greater pleasure to men of science than the knighthood conferred on the *doyen* of British geologists. Prestwich's first geological paper was read in 1834, and he is still writing. Before 1840 he had made his mark by discoveries of fish remains in Banffshire, and by a masterly monograph on the Coalbrookdale coalfield. His series of papers on the Tertiary deposits of the London and Hampshire basins, issued in 1846-1847, placed him in the front rank of British geologists; they settled for ever the main facts in the correlation of these deposits, and the accuracy of the observations has never been questioned. In 1857, Prestwich announced the memorable discovery of marine Pliocene deposits on the summit of the North Downs; this conclusion was long denied by the officers of the Geological Survey, but, as in most cases, Prestwich's view finally gained universal acceptance. In 1860, he placed the question of the antiquity of man on a new footing, by his memoir on the implement-yielding gravels of Amiens and Abbeville. This was the first of Prestwich's classical papers on the drifts, a subject on which he had first written in 1851, and one which has ever since been his favourite. Most of Prestwich's work was done in the intervals of business life, and it was not till 1874 that he was appointed Professor of Geology at Oxford, where he taught till 1888. During his stay there he compiled his great Text-book of Geology, a work rich in suggestions, though unfortunately so behind the times in two departments that it has never exercised so wide an educational influence as it otherwise would have done. After Professor Prestwich had left Oxford for his picturesque home in the gorge of the Darenth, he returned with enthusiasm to his old love—the English gravels. In 1890, he issued his series of papers on the "Westleton Shingle." In these his genius for summarising complex controversy and for picking out the fundamental facts from a bewildering crowd of trivial and apparently contradictory observations enabled him to build up a theory which has gradually gained ground, and will certainly be the starting point for all future work. In the following year, he took up the defence of the rough flint implements found by Harrison on the chalk downs of Kent, a discovery almost as memorable as that of the implements in the gravels of the Somme. Until Professor Prestwich's defence of the claims of these stones to be regarded as shaped by man, the discovery was not accepted, owing to the startling alterations rendered necessary in the interpretation of the geology of the south-east of England. In some later papers, Prestwich has taken to deluges, with results unfortunate for his reputation among many younger English geologists. But those who regret most that he has, perhaps unwittingly, given encouragement to a reactionary school of theologians, will rejoice most at the official recognition of the value of his work. For, in former times, no one did more than Prestwich to lead geology out of bondage, and to point out possible lines of march through the wilderness. But for his far-seeing guidance in the past, we should not now be able to look together so far forward into the unexplored country that lies before us, and to discern there the streaks of light in which Sir Joseph Prestwich sees mists upon the hill tops, but in which his followers see the glow of dawn.

New Literature on the Foraminifera.

Foremost among the numerous works lately published on the Foraminifera is Professor Rupert Jones's "Monograph of the Foraminifera of the Crag." It is the second part of a paper begun in

1866 and published by the Palæontographical Society. This portion is practically a new work, as the long interval of time that has elapsed since part i. was issued has allowed the accumulation of much material, which has to be taken in zoological order. The paper opens with a valuable analysis of the stratigraphy of the Crags, written by H. W. Burrows, and dealing with all the beds from the Bridlington to the Lenham deposits. Those of the Coralline Crag are arranged according to Prestwich's zones, and for the first time are shown the characters of these divisions from their included Foraminifera. The descriptive portion of the paper opens with a short but lucid general account of the Miliolinæ (more elaborately discussed in Professor Jones's paper in *Ann. Mag. Nat. Hist.*; December, 1894), and is concluded by the descriptions of the species. In this connection we may mention the synonymies appended to each species, the result of considerable research, and limited mainly to those references not included by Brady in his great monograph in the "Challenger" Reports. A distinctly new and most useful feature is the section-plan of the various *Spiroloculinæ* and *Cornuspiræ*, a series of diagrams which greatly assist the worker in the comprehension of the different types. Three plates accompany the paper, which is a most important contribution to the literature of the Crag.

Among other recent publications devoted to this group of animals mention must be made of R. M. Bagg's "Cretaceous Foraminifera of New Jersey" (*Johns Hopkins Univ. Circular*; October, 1895), where ninety-four species are listed and carefully compared with their European representatives. Dr. Bagg has, we understand, sought the knowledge of some of his English colleagues, and has thus been enabled to publish a valuable and accurate list of forms, and one not burdened with the customary useless quantity of "new species," an advantage to science sufficiently rare to be worthy of high recognition. It is only to be wished that he had chosen a permanent medium of publication. Fornasini, still busy with his subject, has produced a report on "Foraminiferi della Marna del Vaticano illustrati da O. G. Costa" (*Palæont. Italica*, i.), in which many of Costa's forms are now correctly described for the first time. He has also published another of his privately-printed notes on *Lagena clavata*, d'Orb. var. nov. *exilis*. We should like to see these notes printed in the publications of some society, as they are inaccessible to the majority of students. Gustave Dollfus has given, in the *Annuaire Géologique* (1895), a careful digest of the literature of 1893, a year in which work on the group was particularly abundant. Frederick Chapman's paper on "Rhaetic Foraminifera" from Wedmore, in Somerset, has appeared in the *Annals and Magazine of Natural History* for October, 1895. This paper has been worked out with the author's customary care. It is the first exact account of Foraminifera from this horizon, and will be hailed with satisfaction by every student of the group. The most interesting part of the paper deals with Brady's genus *Stacheia*, which was founded on obscure and imperfectly-known material of Carboniferous age. Chapman, as the result of his researches, has been enabled to complete and amend Brady's determination and diagnosis, and has thus avoided the objectionable method of founding a new genus for what are obviously similar forms, a result for which all zoological students are thankful. He has also been enabled to understand the obscure fossils known as *Psammosiphon*, Vine, as well as the "Plaques des Rayonnés" and *Asterocanthion* of Terquem and Berthelin, a result not less important than the elucidation of Brady's genus. Two plates accompany the paper. Dr. Rhumbler discusses the phylogeny of the entosolenian *Lagenæ* in the *Zoologischer Anzeiger*, no. 474, and the natural system of the Thalamophora in the *Nachrichten der k. Gesell. Wiss. Göttingen* (1895). In the latter paper he makes numerous new genera, but we have not the space to discuss their value here.

Australian Exploration.

From South Australia comes the Report of the Government Geologist, H. Y. L. Brown, on the Explorations of the Northern Territory of that colony, made by him between July, 1894, and May, 1895. The Report is illustrated by photographic views and geological maps and sections of much interest to students of Australian geology. The discovery of Carboniferous and Cretaceous rocks, identified by their fossils, which have been examined by R. Etheridge, junior, adds two formations to those previously known from this region. The Carboniferous rocks are on the coast, not far from Port Darwin, and Mr. Brown holds out the hope that they may be found to contain workable seams of coal. Auriferous rocks also have been discovered near the mouth of the Fitzmaurice River, and more may well be found in this hitherto unexplored country. Of even greater interest to geologists is the announcement that an undoubted *Olenellus*, of Scandinavian rather than American type, was collected at Alexandria, on the boundary between South Australia and Queensland, in the far north. The fossil is well preserved in a light yellow, slightly micaceous schist. Cambrian rocks containing *Olenellus* are already known in the Yorke Peninsula and other localities within 300 miles of Adelaide, also from the Kimberley district of West Australia. The present discovery considerably extends their range.

In our June number, vol. vi., p. 364, we gave an account of the investigations into sources of artesian water in Queensland. The Government Geologist, R. L. Jack, has now sent us his Report for 1894, which contains a detailed account of the explorations made in connection with this subject, together with a geological sketch-map of part of the eastern margin of the artesian water district of Queensland by himself and A. Gibb Maitland. Apart from the main question of water-supply, with which we have already dealt, the Report contains a few items of special interest.

Opportunity was taken to examine the "bone drifts" of King's

Creek, a locality from which a great number of the bones of marsupials and other extinct animals of Tertiary or Post-Tertiary age have been derived. Although time did not permit of a systematic search for bones, a collection was made of the shells of fresh-water Mollusca associated with them, of which little notice has hitherto been taken. These molluscs do not furnish many species, although individuals are incredibly numerous; all the species, with one doubtful exception, a *Unio*, are still extant in the same geographical area, *e.g.*, *Corbicula nepeanensis*, *Melania balonnensis*, and *Hadra jarvisiensis*. The question of age cannot, however, be settled until a larger collection has been made.

Upon certain grits and sandstones of Lower Cretaceous age there occur at certain localities, such as Flinders and Whetstone Station, curious markings, which are generally considered to have been made by aboriginals in grinding their tomahawks. The markings occur generally in groups up to five in number, and are individually up to a foot in length. They diverge slightly at one end, and are gathered into a bunch at the other. Mr. Jack points out certain difficulties in accepting the usual explanation, and suggests that the markings are the footprints "left on a beach sand by the passage of some heavy five-toed animal and partly filled up by the falling in of the sand."

In the valley of the Claude River, there occurs a formation consisting of grey shale, with which are intercalated beds of hard grey calcareous sandstone and grey sandy limestone. The shales contain numerous nodules of limestone, roughly cylindrical like segments of the trunks of trees, but with rounded ends; no organic nucleus has been discovered in these nodules. The sandstones and more sandy beds of the shales are full of large segments of silicified trunks of trees, in one of which were counted 130 rings of growth. The whole formation is absolutely unlike any other yet known in Queensland, and, although the country where it occurs resembles the "Rolling Downs," the age of the formation is possibly Permo-Carboniferous.

There are many other points of scientific importance which it is refreshing to find in a report that is professedly of a practical nature. The report by William H. Rands, on the "Leichhardt Gold Field and other Mining Centres in the Cloncurry District," which has been sent to us from the Survey, appeals more purely to the working miner. It appears that this area is likely to yield rich results if those who prospect there can overcome the difficulties of want of water and want of food. The former difficulty, at all events, will best be grappled with if the colony will extend a generous support to its energetic Geological Survey.

The Origin of Slugs.

Lieut.-Col. H. H. Godwin-Austen and Mr. W. E. Collinge have lately contributed a paper to the *Proceedings of the Zoological*

Society (1895, pp. 241–50; pls. xi.–xiv.) on some of those slug-like molluscs which, after the manner of our own little *Vitrina*, are too big for their shells. The specimens in question were collected in Borneo by Mr. Everett, who has added so largely to our knowledge of the Mollusca inhabiting that interesting region. The conclusions to which the authors came are, as might almost be expected, that these slug-like Bornean forms bear the same close relationship to the shell-bearing molluscs, among which they are now found living, as do similar forms in other quarters of the globe, and that future research will clearly show that many of the slugs cannot rightly be placed in families by themselves, but will find their true position before or after the genera they have developed into or are descended from.

THE APTYCHUS.

So much has been written on the structure and functions of the curious body or bodies known as the Aptychus, which are shaped something like the two valves of a *Trigonia* shell, and are found in connection with ammonites, that a paper recently published by Dr. Richard Michael, in the *Zeitschrift der Deutschen geologischen Gesellschaft* (*Jahrg.*, 1894, pp. 697–702, plate liv.; 1895) is of general interest. Dr. Michael has discovered in the museum of Breslau University a slab of Solenhofen slate with a specimen of *Oppelia steraspis*, the body-chamber of which is not merely closed by an aptychus, but contains some sixty tiny shells of young individuals, each with its own little aptychus. The conclusions drawn from this discovery are that the young of the ammonites were carried for some time in the shell of the mother, just as they are in the nidamental shell of the modern *Argonauta*, that the aptychus and the shell were both developed at a very early stage, that an aptychus was possessed by all the individuals of a brood, and therefore that the aptychus cannot be considered as a structure confined to the female and intended to protect the nidamental glands. As to the function of the aptychus, Dr. Michael endorses the opinion now generally held, that it was a true operculum to the shell, covering the mouth of the body-chamber when the animal was withdrawn into it.

THE EMBRYOLOGY OF CIRRIPEDES AND ISOPODS.

IN the last few years a large number of important memoirs have been published, containing the results of embryological investigations upon Cirripedia and Isopoda. Attention may be drawn to those by Theodore T. Groom (*Phil. Trans. Roy. Soc.*, London, vol. clxxxv., pp. 119–232); by Carl Chun (*Bibliotheca Zoologica*, heft xix., pp. 77–106; Stuttgart, 1895); by Carl Aurivillius (*Kongl. Svenska Vetenskaps Akademiens Handlingar*, vol. xxvi., no. 7, pp. 1–89); and by J. P. McMurrich (*Journal of Morphology*, vol. xi., pp. 63-154).

Of Mr. Groom's conclusions one of the most striking is this, that probably throughout the Cirripedia thoracica the structure of the appendages in the Nauplius is almost exactly the same for all species. In the various forms examined he found the same number of joints on corresponding branches or basal pieces, and the same number of bristles, spines, or teeth on each of the joints, the agreement extending even to the distinction between simple and plumose spines and bristles. That earlier descriptions did not entirely confirm this conclusion was the less surprising, since sometimes Mr. Groom's own failed to do so; but he had only to see a difference in two of his sketches, "to discover upon re-examination of the object that a mistake had been made in one or other." From this perfect similarity he infers "that the character of the appendages is a primitive one, actually possessed by the common ancestor of the thoracica at some stage in its life-history." But this common ancestor is of ancient lineage, for "a careful study of the thoracic Cirripedes indicates that the Balanids, on the one hand, have probably diverged from *Pollicipes*, and the majority of the Lepads, on the other, from *Scalpellum*," these two genera being connected, as Darwin and Hoek (and more recently Aurivillius) have shown, by various intermediate forms. Hence it may well be said that the "permanence of such minute characters as the arrangement of the bristles on the appendages for the vast time represented by the Tertiary, Cretaceous, and probably, at least, part of the Jurassic periods, is highly remarkable, and well shows the slow rate of evolution which may take place in so highly specialised a group."

It is perplexing, however, to find that Professor Chun, though expressing the highest appreciation of Mr. Groom's work, by no means corroborates his opinion as to any precise agreement in the number and armature of the joints of the appendages in different Nauplii. There is little room for supposing that Professor Chun has given a wrong account of the facts under his own observation, so that, unless the appendages vary at different stages of nauplian life, it is likely that Mr. Groom's rule may have a less extensive application than he was led to expect.

Before leaving the subject of embryonic agreement, it will be worth while to quote the following passage from Dr. McMurrich:—

"The regularity of the entire process of growth of the meta-naupliar region of the Isopods is most remarkable, and the more one studies it the greater is the wonder it excites. The regular rows of ectoderm and mesoderm cells are wonderful in themselves, and when there is added a more or less definite number of rows for all the species, we see that we are dealing with laws of growth which are at present far beyond our powers of explanation. It is true that the number of ectodermal teloblasts is not always quite constant, though approximately so, but it is exceedingly interesting to find that where, as in *Asellus*, they can be traced back to their earliest differentiation, there is a definite number of them—namely, eleven. And this definiteness of number is not confined to the Isopods, but is found also in *Mysis* (Bergh, 1893). As regards the mesoblast, however, the number is more constant, eight, and eight only, occurring in *Cymothoa*, *Ligia*, and *Porcellio*, and again we find exactly the same number in *Mysis*."

Side by side with the more or less exact similarity of the appendages, Mr. Groom shows that there are numerous differences in other parts which distinguish the various cirripede Nauplii, though not in all cases very conspicuously, for those of *Conchoderma virgata* and *Lepas anatifera* can only be known apart by the slight fork in the tail of the latter. Of these two species the ova and embryos are almost indistinguishable. As a rule, however, differences between species go back as far as the new-laid ovum, affecting its size, shape, colour, and constitution. In *Balanus* the ova are brown, in *Chthamalus* orange-coloured, in *Dichelaspis* vermilion-red, in *Lepas* and *Conchoderma* blue. But the observations only refer to a limited number of species, and in *Lepas anatifera*, for example, "the blue colour becomes in older embryos replaced by red."

According to Mr. Groom, when the cirripede egg has been laid, a small mass of clear protoplasm is constricted off from it, known as the *first polar body*, the external hyaline layer of protoplasm meanwhile secreting a delicate firm pellicle—the vitelline or perivitelline membrane. Then, it is supposed, fertilisation takes place, the ova without this undergoing no further changes. But "the entrance of the spermatozoön has never been witnessed in Cirripedes." After fertilisation, the contents of the egg contract considerably, the protoplasm undergoes marked rhythmical contractions, the clear area at the anterior end becomes amœboid, and throws out short, blunt pseudopodia, which are often retracted. Then the *second polar body* is constricted off.

Here it may be noticed that in the isopods Dr. McMurrich places fertilisation before, instead of after, the formation of the vitelline membrane, for which, he says, "the *primary* condition is understood more especially through the observations of Fol and the Hertwigs (1887) to be normally a stimulus imparted to the egg protoplasm by the spermatozoön."

To return to the cirripede ovum. By degrees the protoplasm is mainly collected at the anterior pole and the yolk at the other. The yolk at this stage, Mr. Groom says, is devoid of a special nucleus, and, contrary to the general opinion, "is in no way comparable to an endoderm cell." He rejects Nussbaum's theory of a rotation of the plane which separates the protoplasm from the yolk. "The shape of the protoplasmic portion of the egg at this stage is generally ovoid, a central plug of greater or less extent reaching into the middle of the yolk, which thus fits like a thick-bottomed bowl on to the central mass." Another point on which Mr. Groom insists is that "the protoplasm of the first blastomere gives rise to a portion only of the ectoderm," and that "the second blastomere does not come from the first, but *from the yolk*."

When he comes to discuss the formation of the Nauplius segments, Mr. Groom remarks that most authors have transposed the dorsal and ventral surfaces, and that the whole account of embryonic development has been thus thrown into great confusion. The reason he assigns for the mistake is that the appendages appear first on the dorsal side of the embryo. "It is only, however, the free ends which are thus seen, the main part of the appendage being applied to the sides of the body, and the origin, as usual among appendiculate animals, ventral." It appears almost certain, he adds, that in copepods, as well as in cirripedes, "the surface of the embryo, on which the median longitudinal and transverse furrows appear, and which has been described as ventral, is in reality dorsal."

On the stimulus of light, Mr. Groom refers to experiments upon the Nauplii of *Balanus perforatus*, from which he and his colleague, Dr. Loeb, inferred "that light of sufficient intensity and duration ordinarily causes them to turn the oral lobe away from the light, while weaker light has after a time the contrary effect." He has probably not seen the criticism by Dr. Giesbrecht ("Pelagische Copepoden," p. 807), that the authors have misapprehended the distribution of light in a cylindrical glass filled with water, and illuminated from one side only, in which they have supposed that to be the darkest part which is really the most brightly lighted.

In a second paper (*Quart. Journ. Micr. Sci.*, vol. xxxvii., pp. 269–276) Mr. Groom passes to the latest nauplian stage, having had the opportunity of observing this metanauplian or immature Cypris-stage in a species of *Balanus* from Jersey. Professor Chun, on his part, has had the means of describing the metanauplian stage in two species of Lepadidæ. A little earlier Dr. Aurivillius published some remarkable facts as to the post-embryonal development in various species of *Scalpellum*. Here the metanauplian stage of the young was found within the capitulum of the mother, leading to the inference that, instead of half a dozen free nauplian stages, in these instances there is an abbreviated course of development, with none of the nauplian stages free.

In regard to the food of the Nauplii, Professor Chun testifies to finding in the intestines needles of Radiolaria, well-preserved skeletons of Dictyochæ, carapaces of diatoms, and remnants of Globigerinæ. He considers the bristles of the appendages well adapted for the ingathering and sieve-like retention of particles of food. Some of the long spines, armoured and glandular, are admitted to be weapons offensive and defensive. But on the whole he thinks that the rich apparatus of elongate spines and plumose bristles is chiefly subservient to flotation.

Two points in Dr. McMurrich's essay must be mentioned for the bearing they appear to have on the question now under debate of separating the tribe Chelifera from the Isopoda. Dr. McMurrich confirms the observation by Nussbaum (1891) that there is a transitory exopodite on the thoracic appendages in the embryo of *Ligia*, and adds that the exopodites may also be seen, though less distinctly, in embryos of other isopods. Further, he finds in the development of *Jæra* a fold which extends backward to behind the first thoracic leg and represents a rudimentary carapace. Thus two of the characters which separate the Chelifera from the rest of the Isopoda apply only to a part of their life-history and lose at least some of their supposed importance.

In all the memoirs there are copious details worthy of discussion, but there is no space left even to trace the thrilling history of the "vitellophags," or to describe that movement of the nucleus which becomes at once so simple and so solemn when spoken of as karyokinesis.

THE SENSE OF ROTATION.

IN the second number of the "Princeton Contributions to Psychology," reprinted from the *Psychological Review*, under the editorship of Professor Mark Baldwin, is a paper by Mr. H. C. Warren on "Sensations of Rotation." Special arrangements were made to introduce, in addition to the internal sensations due to rotation on a turn-table, visual sensations. The subject was allowed to see, through an aperture in a screen at the foot of the rotating board, a number of strips of paper hung on two opposite walls of the room. Behind the aperture a mirror could be introduced, thus causing an apparent reversal of the direction in which the white strips seemed to be moving. It is well known that when a subject is rotating at a moderate and uniform velocity he supposes himself at rest. Only when the velocity is altered does he have sensations of being turned through a certain angle. If the uniform rotation is in any given direction an increase of velocity is interpreted as a slight turn in that direction, while a decrease of velocity is interpreted as a turn in the opposite direction. These results were confirmed by Mr. Warren's observations in a darkened room. But when the strips were illuminated and became visible there arose a conflict between the dicta of the internal sense and the dicta of the visual sense.

From a number of experiments, of which we cannot give the details, Mr. Warren draws the following conclusions: (1) that the internal sense of rotation is in the head alone and is something other than the general indication furnished by the vaso-motor system; (2) that the organ for the sense of rotation is the same as that for progressive movement; (3) that the results seem to favour the view that the semicircular canals constitute that organ. These conclusions differ from those reached on various grounds by Delage, Ayers, and others; but they seem to be drawn with caution from carefully conducted observations.

I.

Lamarck and Lyell: a short way with Lamarckians.

I AM much surprised to find my name in Romanes' list ("Post-Darwinian Questions," American edition, p. 14) of "the most prominent American Representatives" of the Neo-Lamarckian School, since I know of no reason for assigning this prominence to me except that I am an American. I trust, however, that, in order to define my position, I may be permitted to say that I studied the first edition of the "Origin of Species" with intense interest, and that I have been from that time an ardent disciple of Darwin, so far as his great law of selection is concerned; although I read at the same time the examination of the views of Lamarck in the "Principles of Geology," and was thus convinced that, while natural selection may possibly be no more than *a great but not the exclusive means* of adaptive modification, there is no evidence that the "Lamarckian principles" are among the other means for securing this result.

Since none of the modern Lamarckians seem to me to have answered Lyell's argument, I have seen no reason for changing my opinion. As this was formed years before the publication of Weismann's speculations, his *à priori* objection to the possible inheritance of "acquired characters" has not influenced me, since I have learned from Lyell that there is another question at issue—a question more fundamental and important than the question of their inheritance or non-inheritance.

In order to illustrate this I propose to examine Romanes' opinion that, if the inheritance of the influence of nurture is "in any degree operative at all, the great function of these (Lamarckian) principles must be that of supplying to natural selection these incipient stages of adaptive modification, in all cases where, but for this agency, there would be nothing of the kind to select." (Page 153, American edition.)

Unless these "factors" can be proved to have this "function" they are unworthy of consideration as a contribution to the history of adaptive modification; and I, for one, have found little to interest me in the interminable dispute as to the inheritance or non-inheritance of the effects of the conditions of life, because my study of Lyell taught me, long ago, that the gist of the whole matter is the deeper question whether these effects are inherently adaptive. Lyell was ignorant of the principle of selection when he wrote the first edition of the "Principles"; but to us, who know the value of this adaptive mechanism, the question narrows down to the evidence that the "Lamarckian factors" can give rise to even "the incipient stages of adaptive modification."

As the strengthening of muscles by exercise is one of the simplest examples of the beneficial effect of the conditions of life, we may find instruction in its attentive consideration. In the strict sense of the words, it is not use, but increase in the food-supply, which enlarges the muscle, and this increase may be brought about by massage or by electrical stimulation as well as by exercise. Contractions and relaxations of the muscle increase the supply of food, because the muscle is so constructed that the nutritive fluids are drawn through it, in the right direction, by its normal contractions. The improvement of the muscle by exercise is the effect of a structural adjustment for securing this useful end—it is an adaptation; and the muscle is as obviously, if not as definitely, adapted for improvement by use as the heart is adapted for propelling blood. Exercise increases its efficiency only so far as structural adjustments for bringing this about already exist, and the real problem, the origin of the adaptation, is in no way different from that presented by any other structural adaptation.

This is still farther illustrated by the fact that organs are improved only by normal or natural use, while abnormal or unnatural use is well called abuse, as contrasted with use. It is only when our organs are used in that way which is popularly described as "the way they were intended to be used," that use is beneficial.

Romanes tells us, p. 59: "Inasmuch as we know to what a wonderful extent adaptive modifications are secured, during individual lifetime, by the direct action of the environment on the one hand, and by increased or diminished use of special organs and mental faculties on the other, it becomes obvious of what importance even a small measure of transmissibility on their part would be in furnishing to natural selection ready made variations in required directions, as distinguished from promiscuous variations in all directions. Contrariwise, if functionally produced adaptations and adaptations by the direct action of the environment are never transmitted in any degree . . . there would be an incalculable waste, so to speak, of adaptive modifications."

This argument has seemed, to many persons, a plausible one, but it is clear that it involves a most serious fallacy, unless the inheritance of the effect of the "Lamarckian principles" can be proved to be selective; for the ways to use a muscle are few, while the ways to abuse it are innumerable, and the inheritance of *all* the effects of the conditions of life must lead, not to "cumulative adaptation," but to cumulative destruction. Unless these factors can be shown to have, antecedently to selection, a determinate influence in beneficial lines, it seems to be, on the whole, rather fortunate than otherwise that evidence of the inheritance of their effects is so hard to find.

Now is there any ground for the belief that the case is any different with intellectual and moral improvement? All known mental phenomena have structural correlatives, and are capable of development and improvement only so far as structural adjustments for bringing about this development and improvement already exist. Capacity for individual improvement under the normal conditions of life is an adaptation; the most wonderful and admirable of adaptations; and the beneficial influence of the "Lamarckian factors," so far as this influence is beneficial, is not an explanation, but a fact which itself calls for explanation.

Is there any evidence that the influence of the environment is inherently beneficial? If there is no such evidence we must believe that all its effects, except the effects which are already deducible from adaptive structure, must be hap-hazard.

When we remember how narrow the range of adjustment of each organism is, it must be clear that the probability that hap-hazard effects will be injurious or neutral rather than beneficial is prodigious. Even if they are inherited, the effects of the "Lamarckian principles" cannot cumulate in adaptation, except as an accident, which is so improbable that we are justified in doubting whether it has given rise to any specified adaptation until the possibility of a better explanation has been rigorously excluded.

While I find a difficulty in reconciling all Romanes' published opinions on this subject with each other, he seems to hold, p. 153, that "These Lamarckian principles are direct causes of determinate variation in adaptive lines," although it is clear that this must be proved before we can agree with him that "variation in these lines being cumulative, the result is that natural selection is in large part presented with the raw material of its manufacture—special material of the particular kind required, as distinguished from promiscuous material of all kinds."

Some fifteen years ago I published a book in which I sought to prove that we have in sexual reproduction a mechanism, produced by selection, for the purpose of causing changes in parts which need change, and that this mechanism expedites selection. My book found the oblivion which it no doubt deserved, but I suspect that it may have led, in some circuitous way, to the enrolment of my name in the list of Neo-Lamarckians, although I explicitly stated that I did not believe that these changes in parts which need change are adaptive; and I still believe, as I did then, that the "Lamarckian principles" must be proved to be adaptive, antecedently to selection, before we can seriously consider them as factors in adaptive modification.

There is, in Romanes' book, one sentence,—only one so far as I have discovered,—in which he seems to admit that this is not only unproved but disproved. On page 73 he tells us, of the "Lamarckian factors," that "No question of value, as selective or otherwise, can obtain in their case." If we grant this, as I think we must; if we admit that these "factors" involve "no question of value," but that it is, to say the least, no better than an even chance whether their influence be good, bad, or indifferent, how do modifications produced by them differ from "fortuitous variations"?

Those who attribute the opinion that the so-called Lamarckian principles have not yet been proved to be factors in organic evolution, to the influence of Weismann, will do well to remember that we owe to Charles Lyell the demonstration that, until the influence of the conditions of life has been proved to be determinate, until their competency to cause a tendency to progressive development, antecedent to selection, has been made clear, they are of no value whatever as a contribution to the solution of the problems of adaptation.

It is quite possible that, in the long history of living things, adaptive structures have occasionally been produced by the fortuitous coincidence of fortuitous variations, but the chances against this are so overwhelming that we are justified in demanding demonstrative evidence before we accept this explanation of any adaptation. The production of words and sentences by turning a crank is not impossible, but many generations of readers have approved Swift's statement that this method of advancing knowledge failed to produce a single learned treatise.

Since all the past history of life is beyond our reach and cannot be made the subject of experiments, and since the scientific study of domesticated animals and cultivated plants is very modern, most of the evidence for natural selection is, and must be, indirect or deductive. Romanes holds, p. 57, that, since there seems to him to be the same sort of evidence of the influence of the "Lamarckian factors," these stand upon as good a logical footing, in the explanation of adaptive structures, as selection; but the cases are not parallel, and the sort of evidence which is adequate in the one case is totally inadequate in the other case.

If natural selection acts at all it must result in adaptation; while the advocates of the "Lamarckian factors" have yet to prove that these "factors" can account for any adaptive structure whatever, incipient or otherwise, except so far as this is the result of pre-existing adaptive machinery.

Satisfactory evidence that an event is the sequence of antecedents which are adequate may be totally unsatisfactory as evidence that it is the sequence of antecedents which seem inadequate. Indirect or deductive evidence may convince us that an adaptation is the result of selection, and may yet be totally unsatisfactory as proof that it is the result of the inheritance of the effect of nurture. Until this factor has been proved to be determinate and adaptive, the proof we must demand before we can believe that it has produced adaptive modifications is like the proof which would convince us that words and sentences have fallen from a hopper filled with loose type. We must have demonstrative evidence that no undiscovered adaptive mechanism is at work.

Those who hold, with Romanes, that we find in nature structural adjustments which are inexplicable by selection alone, would do well to rest on their oars and look about them for some other determinate factor, or perhaps, for a better acquaintance with the resources, of selection, before they attribute them, without demonstrative evidence, to indeterminate "factors."

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II.

The Pigments of Animals.

. Part I.

THE problems connected with the colours of animals have always attracted considerable attention, both on account of their intrinsic interest and, more recently, on account of their relation to general theories. It is, perhaps, an unfortunate consequence of this latter fact that the subject has been chiefly studied from the binomical standpoint. Important as this aspect of the question undoubtedly is, it has been of late so exclusively dwelt upon that it has been thought better in this paper rather to consider recent work from the standpoint of chemical physiology.

As is well known, the colours of animals are due to one of two causes, either to pigments deposited in the tissues, or to light-effects produced by the structure of the tissues. Of the meaning to the individual of the latter kind of colours we know practically nothing; but our knowledge of the pigments of animals is slowly but surely increasing.

We will take up, in the first case, the pigment hæmoglobin, not because of its importance in producing coloration, for this is rarely marked, but because, at least in the higher vertebrates, it has been carefully worked out from the physiological side.

First, as to the distribution of hæmoglobin. It occurs in the blood of the craniate vertebrates with the exception of *Amphioxus*[1] and the little fish *Leptocephalus*. In the striped muscles of vertebrates it is widely but irregularly distributed, often in a single species being invariably absent in some muscles, and invariably present in others. Of this peculiarity the rabbit is, perhaps, the most familiar example, but the common fowl affords another as well known to the physiologist as to the epicure. Other notable cases are those of the fish *Hippocampus*, where only the muscles of the dorsal fin are red, and of the rare fish *Luvarus*, where the difference between red and pale muscles is very well marked; but it would be easy to multiply examples almost indefinitely. Among the unstriped muscles of vertebrates, hæmoglobin is said to be found only in the wall of the rectum.

Among invertebrates, hæmoglobin shows the same peculiarities of distribution as in the muscles of the vertebrates. Thus it is present in the perivisceral fluid of some turbellarians, of *Glycera*, and of *Phoronis*; in the hæmolymph of *Lumbricus*, *Tubifex*, and other annelids; in the muscles of the pharynx in *Buccinum undatum*, *Littorina*, and other gasteropods; in the sheath of the nerve-cord in *Aphrodite aculeata*; in the cephalic slits of nemerteans, and so on.

[1] Its absence in *Amphioxus* has, however, been denied.

As to the function of hæmoglobin under the circumstances in which we know it best, that is, in the blood of vertebrates, there is, fortunately, no doubt. In this case, it is the active agent in the conveyance of oxygen from the organs of respiration to the tissues.

Among vertebrates, hæmoglobin has very rarely any part to play in producing colour. Such a function has been suggested for the human species, but the suggestion is quite unimportant for our present purpose, and hardly affects the general conclusion that in vertebrates the function of hæmoglobin is purely physiological. Of its origin and primary meaning in the metabolism of the animal we unfortunately know nothing; on the question of its fate, however, we have at least the beginnings of knowledge. Leaving aside for a moment the question of the pigments derived from hæmoglobin, we may note generally that modern physiology teaches that hæmoglobin is only a stage in the metabolism of the animal. We now know that it is constantly being broken down, and as constantly re-formed; that special organs—the liver, the spleen, the supra-renal capsules (?)—are concerned in these processes, and that the products of its decomposition are continually being expelled from the body. These facts certainly seem to suggest that the continued production of a large amount of hæmoglobin, which is actively employed in the physiological processes of the individual, involves physiological disturbances of great importance to the organism. That it is certainly a great strain upon the organism is confirmed by the great prevalence of anæmia among civilised races, whenever the conditions of development are at all unfavourable. That is to say, the organism under these conditions is unable to produce sufficient hæmoglobin to make up for that which is being continually decomposed. We thus see that while hæmoglobin is supremely useful in vertebrates, yet its presence is associated with modifications of the organism of fundamental importance.

So far, in dealing with hæmoglobin, we have had to do with certainties as regards function; but the case is far otherwise when we come to the hæmoglobin of the muscles of vertebrates, and to the hæmoglobin of invertebrates. Here is no direct experimental evidence, but in spite of this there has been apparent a general tendency to assume that, wherever found, hæmoglobin has important respiratory functions, and to account for its irregular distribution in the muscles of vertebrates and in various parts of the body in invertebrates, on the hypothesis of special activity or special need. In point of fact, the proofs of universal usefulness which this hypothesis necessitates are difficult to obtain.

We will consider, in the first place, the question of the red muscles of vertebrates. As is well-known, the red and pale muscles differ in histological character and chemical composition; and where the matter has been investigated, it has been found that the muscles differ also physiologically in their reaction to stimuli. Thus, under a single stimulus, pale muscles contract more rapidly and completely than do red muscles, for the contraction of the latter is prolonged and sustained. This is in itself a curious fact, for the theory of increased oxidation in the red muscles would lead one to expect that such muscles would contract more rapidly and not more slowly than the pale. It may, of course, be said that the hæmoglobin provides a store of oxygen which is used up during the long-continuing contraction of the red muscles, but it is questionable whether the increased blood-supply to such muscles is not in itself sufficient for this purpose. In the rabbit, indeed, according to Meyer, the association between the colour and the other characters is not very close, some red muscles corresponding in character to the ordinary type of pale muscle. In this connection, we may note the well-known fact that insects possess two kinds of muscle, distinguished both by colour and by histological peculiarities; in this case, the extensive development of the tracheal system forbids the idea of the presence or absence of a special respiratory pigment.

Again, in fishes the red muscles are frequently those connected with the skin, and are certainly not remarkable for great activity. Krukenberg (7) suggests that in this case the hæmoglobin is of special importance in the respiration of the muscle, and is necessary on account of the superficial position of such muscles and the slowness of the circulation in fishes. In the fish *Luvarus*, however, he remarks that, besides the pale muscles and the red, there are muscles of an intermediate shade which he calls "halbroth." Are we to suppose that these muscles have only half as great a need of oxidation as those which are bright red? This question of the quantity of hæmoglobin is very important in the consideration of function.

As to hæmoglobin in invertebrates, we have the same hypothesis and the same difficulties. It is said that hæmoglobin is especially necessary to *Lumbricus* on account of its peculiar habitat; that its presence in the head-slits of nemerteans is essential for the oxidation of the brain; that it is present in the muscles of the buccal mass of *Littorina* because these muscles are especially active; and so on. On the other hand, many large marine worms have no hæmoglobin, whatever their habitat, and many gasteropods have none in their buccal muscles. Can we suppose that these muscles are less active in the limpet, the snail, and many others than in *Littorina*? Again, the amount of hæmoglobin present in the tissues of invertebrates seems to be usually small, so that the amount of oxygen which it can take up must likewise be small. Not that hæmoglobin in invertebrates has no function, but there is not much evidence to support the view that it is invariably of supreme importance to the organism in which it occurs. If this were so, we should surely find that hæmoglobin, when once acquired by the members of a group, would be retained by all their descendants, however widely they might diverge in other respects; and the irregular distribution of hæmoglobin among the invertebrate groups is contrary to this supposition.

We have already seen that in vertebrates hæmoglobin is constantly undergoing decomposition. As to the fate of the products of its retrogressive changes, there is reason to believe that the proteid constituent and the iron are re-employed in metabolism, while the pigment itself (hæmatin) undergoes various modifications. Thus the pigments of bile, bilirubin, biliverdin, etc., are almost certainly derived from the hæmoglobin of the blood; in *Amphioxus*, where hæmoglobin is absent, there are no bile-pigments (Hoppe-Seyler). Under ordinary circumstances, the bile-pigments seem to be reduced in the small intestine, and reappear in the fæces as hydrobilirubin (stercobilin). Urobilin and hæmatoporphyrin or iron-free hæmatin, other derivatives of hæmoglobin, are excreted in small quantities in the urine. Thus, so far as our present knowledge extends, the pigments derived from hæmoglobin do not under ordinary circumstances play an important part in producing coloration. The only notable exception is, perhaps, the pigment of the skin in the dark races of mankind, which is said to be derived from hæmoglobin. Under diseased conditions, on the other hand, the derivatives of hæmoglobin may produce marked pigmentation. Thus in jaundice the skin and conjunctivæ are stained with bile-pigment; in Addison's disease, or after removal of the supra-renal bodies, the skin is coloured with pigment which is said to be derived from hæmoglobin.

Again, although the derivatives of hæmoglobin are, in vertebrates, unimportant for the individual, they may have some importance for the species. Thus, according to Wickmann (17), the pigments of the eggs of birds are directly derived from the pigment of the blood which fills up the *corpus luteum*. In the *corpus luteum* the blood stagnates and undergoes retrogressive metamorphoses which result in the formation of derived pigments. This may be compared to a similar process in mammals, where hæmatoidin crystals are formed in the *corpus luteum*; the difference may, perhaps, be explained by remembering the difference in size of the eggs of birds and mammals, and the consequent diminished outflow of blood in the latter. The pigments of birds' eggs are thus related to bile-pigments in that both are derived from a similar source, *i.e.*, hæmoglobin. Wickmann further states that the pigments after their formation in the ovary are shed into the oviduct, in the uterine portion of which they are mingled with the materials of the shell. The differences in the pigments of different eggs may, he suggests, be due to differences in the composition of the blood itself. It is well known that in mammals the blood varies in different species, as is shown by the differences in the shape of the crystals of hæmatin, the colour of the plasma, and so on; similar differences may express themselves in birds as differences in the products of decomposition.

As to the occurrence of derivatives of hæmoglobin among invertebrates we have only a few isolated observations, mostly due to Dr. MacMunn (10), and largely dependent on the use of the spectroscope.

MacMunn claims to have found hæmatin in the tissues of many invertebrates, such as gasteropods, starfishes, and others. We unfortunately know almost nothing of the history of hæmoglobin in the invertebrates in which it occurs; but according to MacMunn the pigment of the skin in *Uraster rubens* is due to hæmatoporphyrin, probably derived from the hæmatin of the tissues. If pigments derived from hæmoglobin were found in invertebrates to any considerable extent, we should expect to find that they were less rapidly eliminated than in most vertebrates, and so played a more important part in coloration; but as to this there is no direct evidence.

As to hæmoglobin, then, its primary physiological significance is unknown. It is an unstable substance, by the retrogressive changes of which certain pigments are produced. Pigments, therefore, may arise as products of the katabolic change of a substance of direct importance in the physiology of the individual. In this case thay have no primary importance, but may acquire secondary importance as colouring agents, *e.g.*, in the case of birds' eggs.

Another method by which animal coloration may arise, is the direct introduction of pigment into the body by means of the food. This is less uncommon than might have been expected.

What might be called the simplest case is that of "green oysters," fully described some years ago by Professor Ray Lankester (9), and more recently studied by A. Chatin (1). As is well-known, the very marked pigmentation in this case is produced by a green pigment derived from a diatom taken in as food. The pigment is extremely stable, and apparently undergoes no change in the alimentary canal, and for some unknown reason is not eliminated with the excreta but absorbed into the tissues and there deposited. The great interest of this case in connection with theories of animal coloration is that no one has suggested that the colour of the green oyster is of any use to it. The coloration is a consequence of the nature of the food, and of the incapacity of the oyster to completely eliminate or to digest the pigment. Similarly, it is said that the colour of "red mullet" is due to a pigment derived from the crustaceans of its food. In his book on "Animal Coloration," Mr. Beddard gives some other instances.

As to this subject of extrinsic pigments, the most detailed information which we have is due to the observations of Mr. Poulton (11, 12), who has recently made some careful experiments on the subject. Mr. Poulton has chiefly worked at the colouring of caterpillars, and has found that in some cases the coloration is due to two sets of pigments: first, true or cuticular pigment, which is found in the cuticle; and secondly, adventitious pigment, found in the connective tissues, and forming a background to the other pigment. Some years ago, Mr. Poulton gave his reasons for supposing that this second kind of pigment was derived from the chlorophyll of the food; more recently he has endeavoured to prove this experimentally.

For the purpose of this experiment, Mr. Poulton obtained a number of eggs of *Tryphæna pronuba*, and divided them into three sets. From the time of hatching, the three sets of larvæ were kept under similar conditions in the dark, and were fed respectively with the yellow etiolated leaves from the heart of a cabbage, the white midrib from which the yellow blade had been removed, and the ordinary green outer leaves of a cabbage. Of the three sets, the first and third developed well and showed almost identical colouring, the colour being in the early stages usually pale green, or occasionally dark green, but all turned brown, mostly dark brown, when maturity was reached. In this last respect they were contrasted with control specimens developed in the light, as these usually retained the green colour until maturity. This was apparently the only effect produced by the absence of light, which was necessary to avoid the risk of the conversion of etiolin into chlorophyll. In the second set, those fed with white midribs, the mortality was very great, only one larva out of a great number attaining complete maturity. The growth of these larvæ throughout was extremely slow, and they were invariably devoid of green colour, although the cuticular pigment was developed as completely as in normal larvæ.

Mr. Poulton's conclusion is that this experiment, taken in connection with previous observations on the nature of the pigment, tends to prove that the green or brown colouring matter in this species is derived from the pigments of the food, and may owe its origin either to etiolin or to chlorophyll. The experiment proves also that the cuticular pigment does not depend for its development upon the nature of the food. Mr. Poulton notes that the unhealthy appearance of the second set of larvæ may of course be held to indicate that it was owing to constitutional weakness that the larvæ were incapable of forming the green or brown pigment, and not to the lack of pigment in the food; but this is rendered improbable by the following considerations. The unhealthiness of the larvæ was most probably due to the fact that the white stalks upon which they were fed were so hard that it was difficult for them to obtain sufficient food, especially in the early stages when the mandibles were weak. (We might suggest that, in a repetition of the experiment, *chlorotic* leaves would be a fairer test.) Further, the single larva which did attain maturity was large and apparently in no way unhealthy. Again, the normal development of the true or cuticular pigment certainly suggests that the ordinary green pigment is in some way connected with the food. It is interesting to note that either etiolin or chlorophyll can produce the adventitious pigment of the larvæ. Both seem to undergo similar changes in the digestive tract, and in the altered condition find their way to the tissues. The whole of the pigment taken in with the food is apparently not retained within the body, for it was noticed that the fæces in the case of the first and third sets of larvæ were always yellow when fresh, but after exposure to the air oxidised and turned brown. This may be compared to the change in colour of the larvæ themselves from green to brown, and is perhaps connected with a similar change of colour in solutions of chlorophyll when exposed to the action of organic acids or bright sunlight.

There seems little reason to doubt that Mr. Poulton's conclusion as to the green colouring matter in this case is quite correct, and that we have here a genuine example of the transference of pigment from one organism to another, with relatively slight change. As to the direct bearing on the physiology of the caterpillar, we have no detailed evidence; perhaps the following may not be thought to transgress the bounds of legitimate speculation. It is a well-known physiological fact that if one mammal be fed to excess with the fat of another, the fat which is ultimately deposited in the tissues of the former does not exhibit the specific peculiarities of the normal fat of the animal, but partakes more or less of the characters of the fat of the food. In other words, an animal is unable to impress its own individuality on the fat of its food, if this be ingested in very large quantity. Now both chlorophyll and etiolin undoubtedly contain a basis of lipochrome pigment, and the lipochromes are very frequently found associated with fats; in the case of chlorophyll, indeed, the association has been directly affirmed. Is it not possible that in the caterpillar—a notably voracious feeder—a process occurs similar to that noted above for mammals? That is, may not caterpillars, which have a practically unlimited food-supply, be unable to assimilate completely all the fat ingested, but yet have the power of storing-up in their tissues this extra fat, and with it the pigment with which it is associated in the food? If this be so, we can understand why in Mr. Poulton's experiments, when larvæ of set 2 were removed and furnished with etiolated leaves, they failed to develop green pigment, even when they continued to live for about a fortnight under the new conditions. These larvæ had previously been starved, and so were perhaps unable completely to assimilate all the constituents of the food finally supplied. According to this theory, food containing chlorophyll is a richer diet than food without it, and leads to the deposition of extra reserves in the tissues, and indirectly to additional pigmentation. The theory is not inconsistent with the fact observed by Mr. Poulton, that in some species (*Smerinthus ocellatus*, for example) the green colouring-matter may be found also in the eggs, and so be passed on to a second generation. As nutrition in the butterfly is unimportant, there is reason to believe that the caterpillar must provide the nutritive substance subsequently employed in the formation of yolk, and the association of lipochrome pigment with yolk is frequent enough; possibly the reserve substances deposited in the tissues may in such cases be directly employed in the production of yolk.

(*The References will be given at the end of Part II.*)

MARION J. NEWBIGIN.

III.

Foraminifera of the Chalk and of To-day.

WE have read with much interest the able and suggestive paper contributed by Dr. W. Fraser Hume to the October number of NATURAL SCIENCE, under the title, "Oceanic Deposits Ancient and Modern." We do not propose to deal directly with the main question underlying Mr. Hume's remarks, namely the conditions under which the Cretaceous deposits of Europe were laid down; but we venture to put forward some considerations upon the evidence adduced by him from the Foraminifera.

In the first place we observe that Dr. Hume, in dealing with an objection raised to the argument brought forward in his paper on the "Genesis of the Chalk,"[1] lays down as a general proposition that, "if a whole group of organisms retains precisely the same aspect throughout long ages, it may well be asked whether similarity of conditions during long periods should not be regarded as a determining factor in such a conservation of structure, and whether, therefore, the onus of proving objections to suggestions based on such identities should not lie with the objectors."[2] He does not, however, proceed to discuss the relationship subsisting between the Cretaceous Foraminifera as a whole and the corresponding fauna of recent seas; nor, indeed, does he deal with any considerable proportion of the forms found in the Chalk, but confines himself to a limited number of species, and those for the most part of the arenaceous type.

As to the general conditions under which arenaceous Foraminifera are found in recent seas, the writer appears to be seriously misinformed. He states[3]: "At the present day, the coarse arenaceous Foraminifera are found at depths rarely exceeding 400 fathoms." This, however, is by no means the case. To take the genus *Haplophragmium*: the "Challenger" Report[4] shows it to be plentiful at great depths, and at least four species have been found at a depth of 3,950 fathoms. We have ourselves recently had the opportunity, through the kindness of Admiral Wharton, F.R.S., Hydrographer to the Admiralty, of examining a large number of marine soundings,

[1] *Proc. Geol. Assoc.*, xiii., p. 221; May, 1894.

[2] NAT. SCI., vii., p. 270; Oct., 1895.

[3] NAT. SCI., vii., p. 273; Oct., 1895.

[4] Rep. Chall. Zool., vol. ix., pp. 301 *et sqq.* and p. 775; 1884.

including five from the Indian Ocean[1], taken at depths of 1,040 fathoms, 1,277 fathoms, 2,190 fathoms, 2,550 fathoms, and 2,694 fathoms respectively. From these five soundings we have obtained thirty-one species of arenaceous Foraminifera. Of these, only four are found in the first two soundings named, while thirty species occur in the remainder, the richest sounding being the deepest. The increase of arenaceous Foraminifera with depth is also strikingly shown in two soundings which we have recently examined from Torres Straits, about seventy miles east of Raine Island.[2] The first sounding, at a depth of 790 fathoms, yielded ten arenaceous species; the second, at a depth of 985 fathoms, yielded twenty species, including such coarse varieties as *Verneuilina propinqua*, *Reophax nodulosa*, *Haplophragmium latidorsatum*, and *H. globigeriniforme*.

In connection with the distribution of arenaceous Foraminifera, we may here remark that Messrs. Balkwill and Wright, in their paper on Recent Foraminifera from the Irish Sea,[3] have shown in a striking manner that arenaceous Foraminifera, while very common on muddy bottoms, are rarer on bottoms composed of mud with sand, and are absent from bottoms consisting of pure sand. Our own examination of the soundings already quoted also goes to show that the arenaceous Foraminifera flourish on bottoms which contain little or no admixture of free sand-grains.

We now proceed to consider in greater detail the evidence brought forward by Mr. Hume. He states: "Those species which are restricted to the Chalk Marl and Lower Grey Chalk are those which occur to-day at depths of less than 400 fathoms."[4] In support of this statement he cites *Textilaria turris*, *T. trochus*, *T. agglutinans*, *Gaudryina pupoides*, *Bulimina presli*, *Haplophragmium latidorsatum*, *Ammodiscus incertus*, *Tritaxia tricarinata*, *Spiroplecta annectens*, *Gaudryina rugosa*, and *Frondicularia archiaciana*.

1. Much stress is laid upon the occurrence of the three species of *Textilaria* together at the same spot, viz., off Culebra Island. We cannot, however, think that much importance should be attached to this. *T. agglutinans* occurs in all seas and at all depths, and probably few soundings could be taken without finding a specimen. *T. turris* and *T. trochus* are species very closely allied to each other, if, indeed, they are not mere varieties of the same form. *T. trochus*, the depressed and more common of the two, is plentiful in the shallow waters of many tropical and subtropical seas, and is by no means confined to localities having the peculiar position assigned by Mr.

[1] The exact localities are (*a*) lat. 6° 37′ 15″ N., long. 79° 26′ 21″ E.
(*b*) ,, 6° 25′ 47″ N., ,, 79° 24′ 14″ E.
(*c*) ,, 2° 13′ 30″ S., ,, 44° 13′ 00″ E.
(*d*) ,, 2° 20′ 03″ S., ,, 46° 3′ 06″ E.
(*e*) ,, 2° 47′ 12″ S., ,, 47° 39′ 45″ E.

[2] The exact localities are (*a*) lat. 11° 16′ 7″ S., long. 145° 14′ E.
(*b*) ,, 11° 07′ 6″ S., ,, 146° 39′ E.

[3] *Trans. Roy. Irish Acad.*, xxviii., pp. 317 *et sqq.*; 1885.

[4] NAT. SCI., vii., p. 274; Oct., 1895.

Hume to Culebra Island. For instance, we have ourselves found it abundantly in soundings from the Holothuria Banks off the north-west coast of Australia. It may further be mentioned that specimens have also been recorded from several zones of the Coralline Crag of the east of England.[1]

2. *Gaudryina pupoides*, again, is by no means characteristic of localities such as Culebra Island. The "Challenger" Report states it to be "a common deep-water foraminifer,"[2] and we have several specimens from our own Indian Ocean soundings at a depth greater than that recorded by Brady, namely, 2,550 fathoms.

3. *Bulimina presli* does not appear to be recorded by the "Challenger" Report from Culebra Island, but two forms usually looked upon as varieties of *B. presli*, namely, *B. buchiana* and *B. aculeata*, are recorded from that station.[3] The first-named, according to Brady, "affects tolerably deep water" and has a range down to 2,375 fathoms;[4] while *B. aculeata* is commonly found in deep water and has been recorded from a depth of 2,740 fathoms.[5]

4. *Haplophragmium latidorsatum*, as we have already mentioned, is a very common deep-water form, and has been found at a depth of 3,950 fathoms.

5. *Ammodiscus incertus*, as Mr. Hume admits, is "a marked feature in all modern deep-sea soundings."[6] We may add that its geological range extends to the Carboniferous strata, and it has been recorded from nearly all subsequent formations.

6. *Tritaxia tricarinata* can, we fear, afford evidence of very little value. It is extremely rare in recent seas. It was found by the "Challenger" at Raine Island only, and it is not recorded in Egger's "Gazelle" Memoir.[7] On the other hand, it was extremely abundant in Cretaceous times, and records of its occurrence in later formations appear to be wanting.

7. *Spiroplecta annectens* is recorded by the "Challenger" Report[8] from depths of 140 and 155 fathoms, both in the neighbourhood of Torres Straits. At the time the "Challenger" Report was written it had not been found elsewhere in recent seas; but we have lately obtained characteristic and well-developed specimens from the Arafura Sea at depths of 1,926 and 2,413 fathoms.[9]

8. *Gaudryina rugosa* is found in comparatively shallow water at the present day (11 to 675 fathoms), but it is met with at localities very different in character from Torres Straits.[10]

[1] "Foraminifera of the Crag. Part II.," p. 152. *Mon. Pal. Soc.*; 1895.

[2] Rep. Chall. Zool., ix., p. 378; 1884.

[3] *Tom. cit.*, p. 759.

[4] *Tom. cit.*, p. 407.

[5] *Tom. cit.*, p. 406.

[6] Nat. Sci., vii., p. 274; Oct., 1895.

[7] *Abhandl. k. bayer. Akad. Wiss., II. Classe*, xviii. (ii.), pp. 195–458; 1893.

[8] Rep. Chall. Zool., vol. ix., p. 376; 1884.

[9] The exact localities are (*a*) lat. 7° 23′ 8″ S.; long. 128° 48′ 18″ E.
(*b*) lat. 4° 28′ 56″ S.; long. 128° 2′ 12″ E

[10] Rep. Chall. Zool., ix., p. 381; 1884.

9. *Frondicularia archiaciana* can furnish, at the best, very unsatisfactory evidence. Its record as a recent form depends upon the occurrence of one specimen only (and that not quite typical) at Raine Island,[1] and there appears to be no other record of its occurrence since the Cretaceous era.

10. In reference to the question of the depth at which the Taplow Chalk was probably laid down, Mr. Hume places great stress upon the occurrence together at Culebra Island of *Verneuilina pygmæa*, *V. spinulosa*, and *V. triquetra*; and he states that "*nowhere else do they occur together*."[2] *V. pygmæa*, however, is, as stated by Brady, "a common deep-water foraminifer."[3] Its geographical range extends from lat. 60° N. to the Antarctic Ice Barrier, and its bathymetrical range from 129 to 3,125 fathoms. Its occurrence at Culebra Island can therefore prove little. *V. spinulosa* and *V. triquetra* are recorded together by Egger, in the "Gazelle" Memoir, from the neighbourhood of Mauritius, at a depth of 411 metres.[4]

We have thus dealt in detail with some of the forms cited by Mr. Hume. The process might be carried further; but we venture to think that enough has been stated to show that the evidence adduced by him has many weak points. We cannot refrain from again pointing out the unfortunate fact that, in bringing forward his evidence as furnished by the Foraminifera, he has altogether neglected many of the most characteristic of the Cretaceous forms, including nearly all those of the hyaline and porcellanous groups.

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[1] Rep. Chall. Zool. ix., p. 520; 1884.
[2] NAT. SCI., vii., p. 271, and *Proc. Geol. Assoc.*, xiii., p. 239; May, 1894.
[3] Rep. Chall. Zool., ix., p. 386; 1884.
[4] *Abhandl. k. bayer. Akad. Wiss., II. Classe*, xviii. (ii.), pp. 280, 281; 1893

IV.

Serum Therapeutics.

IT is a matter of common knowledge that an attack of scarlet fever or smallpox usually gives immunity from subsequent attack. This is true of the majority of specific fevers, but not of all: it will be within the memory of many that influenza confers no such privilege upon its victims, and the protection given by an attack of diphtheria seems to be of a very transitory nature. Of no disease is it absolutely true: second attacks even of smallpox are not unknown, while in measles and scarlet fever they are fairly common. It is also a familiar fact that individuals vary much in their susceptibility to infectious diseases; to most, children are notoriously more susceptible than adults, and the latter present wide individual variations in their liability to attack. The different races of mankind vary also in their susceptibility to certain infectious diseases; in some cases there seems to be a sort of natural racial immunity, in others, a relative tolerance seems to have been acquired by repeated exposure to a given infection for many generations, the most susceptible individuals having been weeded out. Natural selection plays its part, in fact, in our struggle against disease, as against other adverse circumstances: hence the mortality produced by certain of our common diseases when they are introduced for the first time among uncivilised races.

Similar facts are even more conspicuous in the susceptibility of the lower animals to infectious diseases. From some human diseases, such as typhoid fever and cholera, they appear exempt. Carnivora are remarkably insusceptible to tubercle and to anthrax; Algerian sheep are said to possess a racial immunity from anthrax; rodents, on the other hand, are exceedingly susceptible to most infections. In the case of nearly all pathogenic bacteria, it is the rule to find wide variations in the virulence which they manifest upon different species of animals.

Long before any explanation of the true nature of immunity was possible, attempts were made to produce it artificially in man against at least one disease—namely, smallpox. By the practice of inoculation, used for centuries in the East, and much employed in England in the last century, it was attempted, by selecting a mild and favourable case of smallpox from which to inoculate the healthy, to produce in them a correspondingly mild attack which should confer subsequent protection; and the attempt was in a measure successful. The substitution of vaccination for inoculation was, at its inception, a purely empirical step, since at that time the identity of cowpox and smallpox was only a surmise. But in the light of recent knowledge vaccination receives its full scientific justification, as being a protective inoculation with a virus attenuated by transmission through a relatively insusceptible animal.

The discovery of the bacterial nature of infective diseases was a necessary preliminary to the right understanding of the true nature of immunity, and to Pasteur belongs the credit of first deliberately attenuating the virus of a specific disease with a view to protective inoculation, *i.e.*, to the production of a mild and non-fatal attack of the disease, which should confer subsequent immunity. Modern bacteriology has pressed chemistry into its service, and our knowledge of the mode of action of at least some pathogenic organisms in producing disease is tolerably clear.

Various explanations have been advanced of the essential nature of susceptibility and immunity. They fall into two groups, the chemical and the vital, and the truth probably lies between the two. To the vital group belong the doctrine of phagocytosis, advanced by Metschnikoff, according to which the leucocytes of the body are charged with the duty of destroying micro-organisms which gain access to it, and also Sternberg's theory of acquired tolerance to the toxic products of bacteria on the part of the cells of the body. It may be admitted that leucocytes possess the power of swallowing foreign bodies, such as bacteria, and they probably swallow them alive as well as dead; but Metschnikoff's attempt to represent the leucocytes of the body as a sort of local police, on the success or failure of which to cope with an invading army of micro-organisms immunity or susceptibility depends, is not a complete and satisfactory explanation of all the observed facts. Valid objections were soon urged, also, against some of the earlier chemical theories of immunity: such were the "exhaustion" theory, once advocated by Pasteur, according to which a given micro-organism, having once flourished in an animal body, used up some pabulum necessary to its growth and never subsequently renewed, and the "retention" theory of Chauveau, which postulated the retention in the animal body, as the result of bacterial growth there, of some substance produced by the bacteria, and inimical to their own further development. The view which has gradually gained ground as affording the best explanation of observed facts is the "antitoxin" theory, which is at once a chemical and a vital conception. It supposes that the animal body has the power of forming some substance either directly germicidal or capable of neutralising the toxic products of bacterial activity. The natural presence of such a substance gives immunity; its absence leads to susceptibility; its development, as the result of an attack of the disease, represents acquired immunity.

The reasons for accepting some such theory are shortly as follows. It has been known for some time that the freshly drawn blood of certain animals possesses germicidal power, and Buchner showed that such power resided in the serum. It is destroyed by heat. The body to which it is due appears to be a proteid, and in some cases, at least, a globulin: Buchner and also Hankin have isolated a germicidal globulin from the spleen and serum of rats. The germicidal power varies widely according to the animal from which the serum is derived, and is much more marked upon some species of micro-organism than upon others. Speaking broadly, the serum from an animal which is naturally immune against a given pathogenic organism possesses the greatest germicidal power for that organism, but there are exceptions to this rule. This germicidal power of animal blood is not the only one concerned. The action of pathogenic organisms in producing disease is mainly a chemical one. In many instances, such as tetanus and diphtheria, the bacilli remain localised at the seat of infection, and the severe constitutional effects of the disease are produced by the absorption of the virulent chemical poisons, or "toxins," to which they give rise. The existence of such toxins is not hypothetical: they have been recovered from the bodies of patients who have died, and they are readily produced in artificial cultures of the bacilli in question, from which they can be separated by filtration through unglazed porcelain. With the sterile filtrate, containing the toxins in solution, the phenomena of the disease can be in large measure reproduced in animals. The toxins have been found to be proteid bodies. Now it has been shown that, under certain circumstances, a substance is present in animal blood which can neutralise the toxins produced by pathogenic organisms even when it has not a direct germicidal action upon the organisms themselves. This, then, is a property of a different kind, but of equal importance: to this substance the term "antitoxin" should in strictness be applied. It has been found that serum from animals which have been artificially immunised against certain diseases by inoculating them with an attenuated virus is able to neutralise the toxins produced by the bacilli of those diseases, and also—a still more important step—that such serum injected into susceptible animals confers upon them immunity from the diseases in question. The first suggestions as to this important property were made in 1889 by Babès and Lepp in connection with rabies, but the credit of first clearly demonstrating the principles of serum therapeutics belongs to Behring and Kitasato, who in the following year applied it to tetanus and subsequently to diphtheria. They showed that serum from a rabbit which had been immunised against tetanus protected mice against virulent tetanus cultures, and further, that the toxins in a filtered culture of the tetanus bacillus were neutralised by admixture with the blood of an immunised animal. Similar facts have been shown for diphtheria, pneumonia, and some other diseases.

This body of evidence, which might be largely amplified, is sufficient to show the secure basis upon which the antitoxin theory rests. It is proved that germicidal proteids exist in the blood of some naturally immune animals: it is proved that, as the result of a non-fatal attack of an infectious disease, the subsequent immunity, of longer or shorter duration, is associated with the presence, in the blood, of a substance capable at least of neutralising the specific toxins of the disease in question, if not of killing the organisms which cause it. Klein has suggested that there may be both a chemical antidote, or true antitoxin, and a germicidal body in the blood of an immunised animal, and that one or the other, or both, may be present, according to the method of immunisation employed. It is not yet known how or where this antitoxin is formed—what tissue or organ is charged with its production, or whether it is derived from the very bacteria themselves. It seems likely that there may be a separate antitoxin for each specific infective disease: there is at least no evidence pointing away from such a supposition.

The discovery of antitoxic bodies in the blood is clearly one of the highest moment and capable of the most important practical applications. The success or failure of such practical applications will go far to prove or disprove the truth of the theories upon which they are based. The system of "serum therapeutics" is, however, the direct outcome of experimental facts rather than of preconceived theory. Though still in its infancy, enough has already been achieved in the case of diphtheria to warrant the belief that it is as valuable in practice as it is sound in theory.

The first practical step was the outcome of the observations of Behring and Kitasato on the immunisation of animals against tetanus. It was found that, in favourable cases, the symptoms of declared tetanus in animals might be removed or alleviated by the injection of antitetanic serum. Wider experience, however, soon showed that it was a much easier thing to prevent the appearance of symptoms than to cure them when they were once manifest. Nevertheless, in a disease so fatal and so intractable as tetanus, it seemed well worth while to try the effect of antitetanic serum in human cases. This has now been done in a number of instances and with varying success. Eight successful cases have been reported from Italy, treated with serum prepared by Tizzoni and Cattani; but most of them seem to have been slight or chronic cases, the natural mortality of which is not high. Roux and Vaillard have reported seven cases with only two recoveries, and the results of other observers have not been very encouraging. Hewlett has, however, collected 61 cases treated with tetanus antitoxin, with a fatality of 36 per cent., and this is a distinct improvement on the ordinary fatality of the disease, which, according to Conner, is as high as 80 per cent. in cases of wound infection; though less than 50 per cent. in cases of apparently spontaneous origin. Severe and acute cases seem to be less benefited by the treatment than chronic cases. It is probable that, in a disease with an incubation period so long as that of tetanus (about ten days), the appearance of severe symptoms indicates that the mischief is done and that it is then too late to hope for much from serum therapeutics. It may be, however, that improved methods will overcome this difficulty.

Public attention has been chiefly directed to the application of the method to the treatment of diphtheria. Here success has been much more apparent, and a sufficient body of facts is forthcoming to allow of definite conclusions on the subject.

The original discoverer of the diphtheria bacillus was Klebs, but the demonstration of its causal relation to the disease is due to Löffler, while the work of Roux and Yersin has added important confirmation to the proof. It has been shown that the bacillus, remaining localised at the seat of infection, usually the throat, produces its constitutional effects by the powerful toxins to which it gives rise. With filtered cultures of the bacillus, containing these toxins in solution, it is possible to reproduce experimentally in animals many of the phenomena of the disease, including post-diphtheritic paralysis. Actual membranous inflammation of mucous membranes, such as characterises the disease in man, is with difficulty produced in animals by living cultures of the bacillus, though this can be done, notably in the trachea of kittens: nevertheless the organism is highly pathogenic for many of the lower animals, producing typically an intense local inflammation and swelling at the seat of inoculation, frequently with rapidly fatal results. Animals vary, however, in their susceptibility to the poison. The artificial immunisation of animals against diphtheria was carried out by Fränkel, Behring, and others, and Behring showed that the toxins in a diphtheria culture were neutralised by admixture with serum from an immunised animal, though the bacilli were not killed. Dogs and goats were found to be less susceptible to the disease, and hence to be more readily immunised than rabbits and guinea-pigs, but Roux's choice of the horse proved a happy one, since that animal is not only readily immunised, but on account of its bulk is capable of furnishing antitoxic serum in large quantities. The horse, therefore, is the animal now employed, and it can be immunised by successive inoculations, either with the filtered toxins from diphtheria cultures or with living bacilli. It would appear that the method advocated by Klein, in which, after a preliminary injection with diphtheria cultures sterilised by heat, increasingly virulent doses of living bacilli are successively inoculated, yields a good result in a shorter time than does the method of Roux, in which toxin only is injected, and, moreover, that the serum so obtained has more antitoxic power, and can therefore be employed in smaller doses than that of Roux. In any case, the effect of one dose must, as Behring pointed out, have completely passed away before the next is injected. After four or five inoculations, extending over a period of several weeks, the horse is bled and the serum collected with all possible antiseptic precautions. By careful drying at a comparatively low temperature it can be stored safely without any loss of its antitoxic power.

Before use each sample of serum requires testing as to its antitoxic strength. This is done in the laboratory, and consists in determining what amount is required to protect a guinea-pig against a known standard fatal dose of a diphtheria culture, the result being stated in terms of the amount required to protect one gramme of guinea-pig. From this the dose for a child or adult human being can be calculated. With the more powerful antitoxic serums this amounts to about 10 c.c. With the weaker serums 30 c.c. or more have to be injected.

Before forming any opinion as to the results of antitoxin treatment in cases of human diphtheria, it is necessary to consider one or two important points as to diphtheria statistics. In the first place, diphtheria has not been in the past—and, perhaps, still is not—a disease to be recognised with certainty. It may be confounded with other exudative affections of the throat, and in its slighter forms is readily passed over as simple sore throat. According to Dr. Thorne Thorne, the main way in which it is spread is by means of slight and unrecognised cases in elementary schools. It is probable that we now have, in the presence or absence of the diphtheria bacillus, a positive criterion as to the nature of any given case, and no statistics are at the present time of much value unless based on bacteriological diagnosis. It follows that the statistics of past years are not wholly comparable with those of the present. It is to be noted also that, since only the more severe and well-marked cases are, as a rule, treated in hospitals, the fatality deduced from hospital statistics will be relatively too high. Further, the fatality of diphtheria varies very widely in different epidemics and in different years, so that statistics of one year are not necessarily comparable with those of another. The most reliable results will be attained by comparing the statistics of cases treated with and without antitoxin during a given epidemic. Since accurate bacteriological diagnosis is rarely practicable except in hospitals, hospital statistics are those that have the most value, and it is plain that the value of a new treatment, if it have any, will be most apparent among the severer cases which come into hospitals. Statistics of tracheotomy cases will have a special importance from this point of view, for these are the most severe and dangerous cases of diphtheria that have to be dealt with.

Diphtheria is a disease which has of late years shown a considerable increase in urban districts, though there is no evidence that its fatality has increased. In London, the statistics of the Metropolitan Asylums Board Hospitals show a fatality[1] which has fallen from 46·4 per cent. in 1888, when diphtheria was first admitted into

[1] *Fatality* means case-mortality.

these hospitals, to 29 per cent. in 1892, and rose again to 30·3 per cent. in 1893. This diminution is probably due, at least in part, to the fact that at first only a few cases were admitted, and those probably very severe ones with a high fatality. The fatality shows very wide variations, according to the age of the patients: the figures of these hospitals show that in children under five years old it is as high as 53·8 per cent., falling with each quinquennial period, till at the ages of fifteen to twenty it is as low as 3·9 per cent. Washbourne and others give the average hospital fatality in England as 38·9 per cent., and this is probably as accurate an estimate as is possible. The general fatality is, of course, much lower than this, as all the slighter cases which do not come under hospital treatment will be included. According to the figures of the New York Board of Health, the average fatality of diphtheria in that city for the four years preceding the introduction of antitoxin was 34·63 per cent. The average Berlin fatality is given by Baginsky as 41 per cent.; that of several children's hospitals in Vienna varies on either side of 50 per cent., which is about the same as that shown by the Paris hospitals for children.

When a new remedy such as diphtheria antitoxin is introduced, the temptation is to apply it indiscriminately to each and every case of the disease, however mild and favourable. Hence, in considering the statistics of diphtheria mortality under the antitoxin treatment, some allowance must be made for this fact: the figures may appear a little too good. There can, however, be no doubt that the fatality has been very materially reduced, in some cases to one-half or even less, and this is too striking to be attributable to mere variation in the epidemic constitution of the disease. We have not as yet a sufficient body of statistics from this country, but a few examples may be given. In December, 1894, Drs. Washbourne, Goodall, and Card reported 72 cases treated with antitoxin, all under 15 years of age, with a fatality of 19·4 per cent.: the previous fatality in similar cases had been 38·8 per cent. In February of last year, Dr. Ruffer reported 274 cases treated with antitoxin in four London hospitals, with a fatality of only 13·5 per cent. As regards tracheotomy cases, Washbourne, Goodall, and Card report 9, with only 3 deaths, the previous fatality having been 91·7 per cent., while Herringham reports 10 cases with only 3 deaths, the previous fatality having been 65 per cent. From the Belvedere hospital in Glasgow, Dr. Johnson reports 105 cases treated with antitoxin, with a fatality of 15·2 per cent. (excluding very mild cases and those who were moribund on admission): the lowest fatality in the previous five years had been 28·6 per cent., and the highest 41·4 per cent.

From abroad more extensive statistics are available. During the first nine months of the year 1895, the diphtheria fatality in New York has fallen to 19·43 per cent., with only partial antitoxin treatment: during the four preceding years it had averaged 34·63 per cent.

Roux, Martin, and Chaillou report from the Hôpital des Enfants Malades in Paris 300 cases treated with antitoxin, with a fatality of 26 per cent., the previous fatality having been 50 per cent. From Berlin, Dr. Baginsky reports 525 antitoxin cases with a fatality of 15·6 per cent., the previous fatality having been 41 per cent. Some of the most striking illustrations of the value of the antitoxin treatment are to be found in instances where the supply of serum has suddenly failed. At the St. Joseph Kinderspital in Vienna the average diphtheria fatality for ten years had been 51·1 per cent.: on the introduction of the serum treatment 27 cases were treated, with a fatality of 22·6 per cent. The supply of serum failed, and 32 cases had to be treated without antitoxin, and they showed a fatality of 65·6 per cent. When the supply was re-established the fatality in 21 cases fell to 19 per cent. Similarly at the Leopoldstädter Kinderspital in Vienna, the fatality, which had been 26·6 per cent. with antitoxin, rose at once to 66·7 per cent. when the supply of serum failed. The same happened to Baginsky in Berlin: his fatality rose from 15 per cent. to 51 per cent., when in August and September of 1894 the supply of serum failed.

Welch presents a summary of 82 reports on the antitoxin treatment of diphtheria up to July, 1895; the total number of cases, from all over the world, treated with antitoxin, amounts to 7,166, with an average fatality of 17·3 per cent., and these are nearly all hospital cases, and the great bulk from children's hospitals. He further tabulates 38 reports, containing 1,167 cases of laryngeal diphtheria, in which tracheotomy or intubation was required: the fatality in these under antitoxin treatment was 37·2 per cent., a very great improvement on previous figures, which showed in most instances a fatality of 50 to 80 per cent. in these cases.

It will be seen from the above statistics, which have been selected as giving a fair average of the results of serum therapeutics in diphtheria, that, in this disease at least, the method is passing out of the stage of trial into one of assured success. A reduction of fatality by something like 50 per cent. would mean the saving of not far short of a thousand lives yearly in London alone. And these would be young lives, since the improvement is shown to be mainly manifest in the earlier years of life. Nor is the statistical evidence the only evidence that can be adduced in favour of the new treatment; the general impression left on the minds of those who have employed it is strongly in its favour in nearly every instance, and the clinical impressions of physicians of large experience and known ability must be allowed great weight.

In the immunising power of antitoxic serum we have also a prophylactic of the highest value. It may be employed in the case of those children or other members of a household who have been exposed to infection. Dr. Hermann Biggs records from New York no less than four instances in which the prevalence of diphtheria in large children's institutions was checked, and the disease completely stamped out by immunising the inmates *en bloc* with antitoxin. He states, however, that the immunity so conferred lasts only about a month, but this is in most cases all that is required.

The success which has attended the serum treatment of diphtheria has naturally led to attempts at preparing antitoxic serum for other diseases. Among these may be mentioned the "anti-streptococcus serum," which is designed to protect against cellulitis and erysipelas, and which already appears to have met with some success in practice. The elaborate researches of Tizzoni and Centanni on antirabic serum have still to bear their practical fruit, but there is good ground for believing that this will be the case. There appears, indeed, scope for the widest extension of the method. As fast as suitable animals can be immunised against a given infectious disease, so fast, we must believe, can their serum be employed as prophylactic or antidote in its treatment. The method constitutes an entirely new departure in medicine, and is indeed the greatest therapeutical discovery which this generation has witnessed. Every man of science will rejoice that at length experiment, in its rigid scientific sense, is taking its place as the foundation of a rational system of therapeutics in infectious disease.

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V.

Casual Thoughts on Museums.

Part III.[1]

Palæontological Museums.

PALÆONTOLOGY is an ugly word, which there was little need to coin. Instead of enlightening, it has largely mystified. In museums it has created mischief and confusion. As usually understood, it means the science of fossil creatures, which many people think are something quite different from living creatures, to be preserved in a different part of a museum, to be taken care of by a different set of men, and to be investigated by another class of students. Can anything be more preposterous?

Once upon a time, when men fancied that words like species and genus (really terms of logic, useful in the arrangement of our knowledge and nothing more) corresponded to actual facts in nature, and that every variation to which some ambitious student chose to give a name was a separate and independent creation, there may have been some excuse for a science of palæontology, or a museum or a department of palæontology, as there was for one of astrology or alchemy. Now that we know, or think we know, that living beings are linked to each other by long and continuous chains, perhaps including eventually all living forms and perhaps not, we must believe more or less in the continuity of life, and are nervously anxious to trace its pedigree. We have no patience with those who would separate our fathers and our grandfathers from ourselves because they happen to be dead, and refuse us the privilege of studying together the broken links which unite us to our primæval relations; if it be feasible to bring the links together for exhibition or for study, it ought to be done at all hazards. It is, in fact, impossible to separate them without absurdity. Where are we to draw the line?

A young American lady, who was looking through the museum at Lincoln the other day, asked my friend Canon Nelson what certain curious-looking stones were. He explained that they were fossils. "And what are fossils?" she asked. "The remains of animals and plants which lived a *very* long time ago, and are now preserved in

[1] For Parts I. and II., *see* Natural Science, vol. vii., pp. 97 and 319, August and November, 1895.

stone," said he. "Have you no fossils in America?" "Oh, no," she replied, "America is such a *new* country." There you have an object lesson in "palæontology."

Look at some of the results of this same reasoning. In the Natural History Museum there are some very interesting remains of the dodo, of which too many relics have not been preserved. It would be incredible, if it were not true, that the bones of this hapless bird have been fought over by two departments of the museum and have been torn asunder, and are now exhibited in two entirely different departments. A similar fight took place over the recently extinct Madagascar tortoise. The excuse for this absurd struggle is that these animals, although extinct, have so recently become so that they ought not to be called fossils. The fact is, there is really no gap at all between the graveyards in which we are now burying our fossilised friends and the graveyards of former days. There has been a continuity of deposition.

So much do I value this continuity, that I hold that in every specially geological museum, in which the different ages of the earth are successively illustrated, the last room should be always one devoted to the actual living things of to-day arranged according to their geographical distribution. The actual world as we know it is really the last chapter of the geological book.

If this be just, *à fortiori* must it be just and sensible that in a museum illustrating as nearly as may be the great lessons of *biology*, there should be shown, in sequence if possible, the various forms that bridge over gaps, and that people should learn early and often that these queer-looking bones and shells, etc., etc., which we dig out of the ground were really once parts of living animals more or less like those they now know, and were not mere sports and toys of Nature.

We are told that, however wise in theory, this is fantastic and unworkable in practice. I have been told so many a time, and I remain as obdurate as John Huss at the stake. In the first place, I claim to have on my side the two most accomplished and experienced directors and keepers of museums of my acquaintance, namely, the late John Gray and the present Sir William Flower; secondly, the plan has actually been tested in some cases, though not quite in the way in which I should like to see it carried out.

I must here point out that I am referring only to the exhibition part of the museum, and not to the study department; the latter is an entirely different matter. I am speaking only of what the great mass of philistines like myself, who ramble about the museum for pleasure and for profit, would like to see there. I hold very strongly that far too much is exhibited of certain things, and not half enough of others. Every type or rare specimen that will spoil or alter by exhibition should be removed from the cases and placed in the safest keeping possible. At the British Museum this has recently been done largely, to the joy of us all; but it is only a year or two ago since such rarities as the Mauritius starling and the Labrador duck were exposed to the danger of ruthless destruction, while elsewhere in some of our great provincial museums, and in some of the great Continental ones too, such as Leyden and Paris, everything seems to be stuffed, and every animal, however rare and precious, is exposed to dust and sunlight and other causes of ruin and decay. It is really shameful, for in these matters we are trustees for those who come after, and if we are destroying the wild creatures wholesale, we ought at least to let our children see what they looked like.

These are not the only things that ought to be put by in lavender; everything that requires a special label to show that it is part of a fossil at all should be removed at once into the students' cabinets. The palæontological galleries at Kensington, which have been arranged with great skill and intelligence by Dr. Woodward, suffer greatly from this cause. They are literally crowded with broken and imperfect specimens, whose proper place is the students' room, where they are more accessible to the specialist and less distracting to the passer-by.

In the next place, it is a great mistake to exhibit too much. Do as we will, we cannot exhibit every species, we must make a selection; it is better, therefore, to exhibit a moderate number of properly mounted and labelled specimens, each of which teaches something, than to stuff the cases full of objects two or three deep, which nobody can see properly. Here again, referring to Dr. Woodward's galleries, I am bound to say that the ordinary philistine is quite bewildered by the immense number of duplicates exhibited. It is simply appalling to think of the herd of mammoths represented by some bone or tooth in the gallery of mammalia. It ought surely to be sufficient to exhibit as perfect a skeleton of the beast as we can get, as good a series as we can make to show his dentition at different ages, sections of the teeth to show their structure, and perhaps one series of disarticulated bones. It is merely a ridiculous mistake to exhibit vast rows of duplicates of the same thing, instead of remitting them to the study series. Geographical distribution should be taught by maps, not by reduplicated specimens, while a scale of strata can indicate geological distribution when necessary.

I hope these references will not be interpreted as meaning that I am not deeply sensible of, and deeply grateful for, what has been done for us all in this department of the museum by Dr. Woodward and his merry and aggressive boys since the removal of the collections from Bloomsbury. There is nothing like these fossil collections anywhere, either in their actual wealth, or in the way in which they are exhibited. Having said this, I cannot honestly, before passing on, avoid contrasting their work with that I have lately seen in another museum, namely, the Museum of the University of Oxford, where young men at an impressionable age are supposed to be inspired with the love of natural science, and a distaste for drinking and dissipation, by what they see in their museum. I do not know, and I do not care, who is responsible for the state of things, but it is simply shocking to look over the cases devoted to palæontology. A more distressing show it is impossible to conceive: the specimens neglected and dirty, many of the type-specimens illustrating Phillip's Monograph of Oxford Geology unlabelled, the great collections from Kirkdale of our Father Anchises, Dr. Buckland, still in the hampers in which they were sent to the museum. How it is possible for an impressionable man to feel anything but loathing for fossils and their teaching after looking at this show, I do not know; and it is made more hideous when contrasted with the beautiful and most instructive preparations which are rapidly filling the cases in charge of Professor Ray Lankester and his assistants, to whom these neglected fossils might well be handed over.

Let us pass on, however! The burden of this homily is the exhibiting of the fossil and the recent specimens together in a biological museum. Now shells, whether of molluscs or brachiopods, are perhaps the most valuable of all things for showing the continuity that exists in nature; they run right through the geological record. In the case of large groups, like the ammonites, we can trace the intergradation of forms by the introduction of very small differences; we can see certain stocks represented at one horizon by a few kinds only, and in the next, perhaps, breaking into an afflatus of change, so that we get an immense number of species appearing, and then again as sudden a shrinkage. Lastly, we have the very interesting fact that certain genera such as *Lingula* have been persistent right through the long story of life. These, and other facts like these, are what arouse men's interest and invigorate men's ideas far more than looking at half-a-dozen cases full of beautiful shells. How are they to be illustrated unless we show our fossil forms and our recent forms together, instead of separating them and putting them at two remote poles of the museum? How is the student of fossil shells, especially of Tertiary and Post-Tertiary shells, to understand them or to classify them unless he is steeped to the finger-ends in a knowledge of the recent shells? And how is a man to understand the recent shells who never comes in contact with those ancestral forms, most of which are extinct, and which are so necessary to the proper interpretation of their descendants? Not only so, but it seems impossible to avoid creating fictitious species (which mislead us all in our induction, when following Lyell in discriminating the Tertiary beds by the proportion of extinct forms which they contain) if these Tertiary shells are discussed and described by men who have not a direct and intimate knowledge of the recent forms.

For these various reasons it seems to me as plain as can be that the fossil shells and the recent shells should be exhibited together and should be looked after and described by a common staff. This does not mean that the same man should have the same minute knowledge of both sections. The British Museum is fortunate just now in commanding the services of two conchologists, remarkable not only for their knowledge, but what is more valuable than knowledge in a museum curator, namely, zeal and love for their work; and the galleries in which the Mollusca, both recent and fossil, are exhibited bear testimony to the work of Mr. E. A. Smith and Mr. R. B. Newton: nor should one overlook the valuable assistance rendered by Mr. G. C. Crick, Mr. B. B. Woodward, Mr. G. F. Harris, and Mr. H. W. Burrows. I am quite certain, however, that it would be a great gain if the two disjointed departments were united, and the shells arranged as they are at Caen, and I believe now at Paris, in a continuous series, not stratigraphically, but according to their affinities, with all the species of a genus placed together. Each genus should, so far as it is known, be represented by a model of the animal, with some illustrations also of its internal economy. If this were done, not only would it be a gain to us but to the curators themselves. I see no reason of any kind that is not fantastic against it. How slight a change would be required to effect this may be seen by any visitor to the gallery of Cephalopoda in the Geological Department of the Natural History Museum. Most of the recent genera are already exhibited here, either in the form of models, or drawings, or actual specimens. This gallery proves that the officials even of the Geological Department see the necessity for a large part of the reform here proposed, and the success that has so far attended their efforts is proof enough of the practicability of the scheme.

But the Mollusca and Brachiopoda are only one example out of many that might be brought to support the views of this paper.

HENRY H. HOWORTH.

SOME NEW BOOKS.

Faxon's "Albatross" Crustacea.

Reports on an Exploration off the West Coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross," during 1891, Lieut.-Commander Z. L. Tanner, U.S.N., commanding. XV.—The Stalk-eyed Crustacea. By Walter Faxon. Pp. 292, with sixty-seven plates (ten of which are colored) and one chart. Memoirs of the Museum of Comparative Zoology at Harvard College, vol. xviii. Cambridge, U.S.A.; April, 1895.

The artistic plates by Mr. A. M. Westergren make this volume very attractive. His coloured drawings vividly suggest the beauty of deep-sea crustaceans as they appear when first brought to the surface. There is a certain splendour in the prevailing red tints, "which pass through various shades of pink, orange, and yellow, to straw color and ivory white." Some shore species are found to turn red when kept in the dark; hence Mr. Faxon is inclined to believe that in the deep-sea species the prevalence of red is "due to a modification of the pigments, induced by the darkness in which these creatures dwell, either through chemical action or more probably through a physiological process originating in the eye and affecting the pigment cells by a reflex action. In either case the prime cause is a purely physical one—the more or less complete absence of light in the depths of the sea." He proceeds to infer that "this color, then, is to be regarded as entirely useless to its possessor." Nevertheless, he presently contrasts the free-swimming Crustacea from great depths, which are "commonly of a very bright red color and endowed with visual organs of a high order," with the sedentary, concealment-loving, bottom species, which "are most often pale of hue and frequently blind." But surely, when difference of habit is thus associated with difference of colouring, it is illogical to take it for granted that natural selection is unconcerned in the coincidence.

To those who may wonder why deep-sea crustaceans should be red-tinted in general rather than of any other colour, Mr. Faxon gives Pouchet's explanation, that "the pigments of the xanthic series (red, orange, and yellow) in crustacea are contained in contractile anatomical elements—the chromatoblasts—while the blue pigment is never found in the substance of the chromatoblasts, but is held in free solution." Under the influence of the abyssal darkness there is supposed to be so great an expansion of the red chromatoblasts that any effect from the cyanic tints is completely overpowered.

In his Essay on the Distribution of Marine Crustacea, Mr. Faxon accepts the general opinion that the chief factor governing it is the temperature of the sea. He imputes inconsistency to Dana, who first of all divided the waters of the globe into five zones of marine life, "determined by isocrymal lines, or lines of equal mean temperature of the surface water during the coldest month of the year," and then proceeded to base his faunal areas, except in the two polar zones, "chiefly on north and south lines running *across* the isocrymes, in accordance with the general trend of the great continental shores." So far, however, as crustaceans are concerned, the inconsistency is, perhaps, less the fault of Dana than of nature, which is for ever interfering with our methodical arrangements. It spoils in various ways the neat simplicity of zonal distribution. The isocrymal lines themselves are far from being exactly parallel. Beneath the warmest surface-waters there are temperate and frigid areas, of which species may, and sundry of them certainly do, avail themselves, to pass from zone to zone across the tropics. The commerce of mankind, as shown in Professor Catta's well-known paper, may help to distribute Crustacea in various directions, as well between north and south as between east and west. As Giesbrecht says in regard to the Copepoda, the arrangement of the fauna by latitude is much more favoured by the waters of the southern hemisphere than by those of the northern. Mr. Faxon seems surprised that Miers and Henderson in their "Challenger" Reports should have followed Dana's method. Obviously they did so simply because the facts relating to the Brachyura and to the Macrura anomala, so far as they knew them, agreed with Dana's plan. But Miers safeguards himself by observing that the researches of naturalists are always adding to the number of species common to the Indo-Pacific, Atlantic, and Occidental regions. Henderson declares that "the Atlantic and Indo-Pacific regions stand clearly apart from one another, each containing many species with a wide range of distribution, though, if the deep-water forms be excluded, a comparatively small number are common to both." Darwin, though unable to fit the cirripedes into Dana's scheme of distribution, nevertheless maintains on his own account that "the east and west coasts of the two Americas form two quite distinct cirripedial provinces" ("Balanidæ," p. 167). These considerations may be allowed to modify, without invalidating, the general proposition that the distribution of marine life accords with the zones of temperature. The arrangement may be compared to a textile fabric in which the warp is closely compact, while the transverse threads of the woof are comparatively few and scattered. This, indeed, seems to be Mr. Faxon's own view, although in his opening statement he disparages it.

By pointing out how large a number of littoral species of Crustacea in the so-called Panama province closely resemble species in the Caribbean province, Mr. Faxon makes an important contribution to the proof of the theory that, within moderately late geological times, there was water communication between the tropical Atlantic and Pacific.

A study of the deep-sea Crustacea, Mr. Faxon says, "leads to the conclusion that this fauna is one of cosmopolitan range, indivisible into subordinate local provinces like those of the littoral and terrestrial faunæ." Dr. John Murray has recently remarked that in the "Challenger" results there is "no striking evidence of a universal deep-sea fauna spread all over the floor of the ocean" (Summary, p. 1439), even if there may be an extended distribution of fishes and crustaceans which move freely over the bottom. Mr. Faxon's statement may be applicable to some orders or families of Crustacea, but it is far from having been proved as yet that it is applicable to all of them.

In the descriptive part of the volume it will be found that the fusion of the families Maiidæ and Inachidæ, proposed by Miss M. J. Rathbun, is accepted. In addition to this, there is more than one suggestion offered for the fusion of genera, once more illustrating the point that the systematist is apt to find in nature, not a dearth of links and gradations, but an embarrassing glut of them. Among the many valuable specimens, new or rare, which are here carefully described, some of the most interesting are those belonging to the genus *Eryoneicus*, founded by Spence Bate on a single imperfect specimen half-an-inch long. As the "Albatross" obtained eight specimens, of which the largest was nearly two-and-a-half inches in length, various corrections and improvements in the description of these singular animals have become possible. It is discovered, for instance, that the ophthalmopods, instead of being absent, "consist of a large lobe, immovably fixed in a deep sinus in the anterior border of the carapace, this lobe sends forth an elongated cylindrical process outward and downward below the antero-lateral angle of the carapace; the anterior margin of the lobe, moreover, bears a prominent papilla, or tubercle." Among the Schizopoda of the deep-sea, Mr. Faxon describes one in which the eye-stalks are transformed to sharp spines, the visual elements being absent, and another in which also the eyes are absent, "their stalks assuming the form of slender styles whose tips are soft and delicate, perhaps serving as tactile organs."

In a work of this importance the characters of genera, revised and, where possible, condensed by so trustworthy an authority as Mr. Faxon, might appropriately have been given, and would have been highly welcome. What with the brevity of some authors and the prolixity of others, the student has no easy task in making out the real distinctions of genera, even with the requisite literature at his command. But how few have time or opportunity to supplement the study of Faxon by consulting the works of Roux and Rathbun, Leach and Lockington, de Haan and Dana, Stimpson and S. I. Smith, Miers and Alphonse Milne-Edwards, and the other eminent writers by whom these distinctions have been established.

In one small particular Mr. Faxon must be considered to have wilfully defaced his otherwise admirable volume. He takes upon himself repeatedly to alter the spelling of established names, with no prospect of any material advantage, and with the certainty of producing some amount of confusion. For example, the genera *Ethusa*, Roux, and *Ethusina*, S. I. Smith, are changed respectively into *Æthusa* and *Æthusina*. These altered forms are assigned to the original authors; but they are, in fact, new names, and, if accepted, would have to be accredited to Faxon. A change affecting an initial letter is particularly objectionable, because the name is thereby displaced in indices, and becomes difficult to find. But what is, above all, wanted in a scientific name is permanence. If every fastidious scholar is to be allowed to do a little furbishing, there can be no fixity. A change of fashion may insist that the Greek αἴθουσα should be transliterated neither into Ethusa nor Æthusa, but into Aithousa, or written in the character of the language to which it belongs. The latter change might have a chastening effect on the inventors of mongrel compounds. By improving Savigny's *Pasiphæa* into *Pasĭphăēĭă*, Mr. Faxon inflicts on natural history a name of six syllables where one of four hitherto sufficed. As he himself points out, Risso had already in 1826 improved the name into *Pasiphae*. Risso's action was mischievous enough in using up a name which no less then three entomologists have since attempted to appropriate, but now we are brought to a pretty pass. If we cannot be content with the form which Savigny himself passed for press, namely, *Pasiphæa*, we must for the future range ourselves in opposing camps, maintaining a ridiculous contest, not in natural history, but in mythology, to determine whether this genus of prawns ought rather to be named after the wife of Minos, or, by an Ovidian circumlocution, after her infamous daughter. The moral is that one name is as good as another—and a great deal better, if people would only leave off meddling.

After this emphatic discussion of a small blemish, it is pleasant to offer, for what it is worth, my earnest testimony to the high scientific merit and substantial excellence of Mr. Faxon's volume.

THOMAS R. R. STEBBING.

CONTRASTS FROM CAMBRIDGE.

PERIPATUS. By Adam Sedgwick. MYRIAPODS. By F. G. Sinclair (formerly F. G. Heathcote). INSECTS. (Part I.) By D. Sharp. Being vol. v. of the "CAMBRIDGE NATURAL HISTORY," edited by S. F. Harmer and A. E. Shipley. 8vo. Pp. xi. and 584, 371 figures in text, and a map. London: Macmillan, 1895. Price 17s. nett.

THE third volume of the "Cambridge Natural History," dealing with the Mollusca and Brachiopoda, has been followed at no long interval by the present volume—the middle one of three to be devoted to the Arthropoda. It is a natural course that each volume should be issued as it is ready; and no objection could be taken to the irregularity of the order, if the editors of the series were but careful to fulfil the promise of the prospectus that each volume should be complete in itself. But the promise has not been kept. The "Cambridge Natural History" is said to be intended in the first place for the instruction of persons without a knowledge of scientific language. What amount of instruction is likely to be conveyed by the two opening paragraphs (in which Mr. Sedgwick sets forth the reasons for classing *Peripatus* with the Arthropoda) to readers who are not told what an arthropod is? It is to be presumed that they must await the appearance of the fourth volume for information on this point. Meanwhile, they will doubtless joyfully agree that *Peripatus* is an arthropod when they read that it possesses "a vascular body-cavity and pericardium (hæmo-cœlic body-cavity)." Similarly, Mr. Sinclair's opening paragraph tells that the Myriapoda are "Tracheata with separated head and numerous segments." But for a definition of "Tracheata," the volume may be searched in vain.

It was inevitable that the section on *Peripatus* should have been entrusted to the naturalist whose brilliant researches on the structure and development of that animal have helped to spread the fame of the Cambridge science school. The twenty pages which Mr. Sedgwick has contributed, illustrated with well-chosen figures, mostly from his own memoirs, and with a map showing the distribution of the animals, will prove of value to the zoological student, but will hardly tend to enlighten the general reader. Many of the paragraphs are taken word for word from Mr. Sedgwick's monograph in the *Quarterly Journal of Microscopical Science*; and the style of writing appropriate to the pages of that magazine is out of place in a book intended to instruct the intelligent layman in the facts of zoology. Technical terms are constantly used without explanation. There are people who want to be told what a gastrula is. Tracheæ and nephridia are described, but not a word is said about the use of either set of organs. The editors of the series should surely make it their business to see that each contributor at least attempts to fulfil both the functions—work of reference and popular exposition—claimed for the series. Mr. Sedgwick could not fail to succeed in the first; it is all the more to be regretted that the structural and developmental characters which make *Peripatus* a type of such high interest to the zoologist have not been set forth so as to appeal to the common man. The paragraph in which Mr. Sedgwick dwells on the external beauty of a living *Peripatus* with its "velvety skin," and "eyes sparkling like diamonds," shows that he could have told with equal plainness and enthusiasm, had he taken the trouble to do it, the internal history which he has so ably read.

To the account of *Peripatus* is appended a synopsis of the species. This can only be of use to the systematic naturalist. When this despised person studies it, he will marvel that three men of the scientific standing of Messrs. Shipley, Harmer, and Sedgwick could have sent forth such a piece of work. Not even a footnote calls attention to Mr. Pocock's opinion (published July, 1894) that the Neotropical, Ethiopian, and Australian sections of *Peripatus* are fully worthy of generic distinction. The names of all the authors of species are put in brackets; as if they had referred the forms they described to some other genus. Mr. W. L. Sclater is credited with a name (*P. demeraranus*) which Mr. Sedgwick himself needlessly coined to supersede Mr. Sclater's name for the Guiana species; while the name *P. chiliensis*, ascribed by Mr. Sedgwick to Gay, is another gratuitous synonym of his own for the species which Gay and Blanchard called *P. blainvillei*. Mr. Dendy's Victorian species, *P. insignis*, is not mentioned at all. *P. iuliformis*, Guilding, and the *Peripati* from Jamaica and Dominica are inserted among the "doubtful" species, though all three have been recently described in sufficient detail by Messrs. Grabham, Cockerell, Pollard, and Pocock. Lastly, *P. trinidadensis* is notified as a "n.sp."; it was described by Mr. Sedgwick himself in 1888. This last marvel gives the clue to the whole performance; the synopsis has been exactly reprinted from Mr. Sedgwick's monograph, now seven years old! To point out such slovenly compilation as this is condemnation enough.

Mr. Sinclair's chapter on the Myriapoda is a very uneven piece of work. It is written in a style well calculated to allure the reader to the study of those animals, often thought repulsive and uninteresting. In the introduction the author gives a general account of the aspect, habits, feeding, and breeding of the myriapods, incorporating many personal observations; he also discusses the popular names in use for the creatures. Then follows a section on the classification of myriapods, which can only be described as inexcusably antiquated, especially as Mr. Sinclair seems deliberately to have chosen to make it so. He implies that Koch and Latzel are the only writers who have treated of the myriapods as a whole; Messrs. Pocock and Bollman are presumably included among "the many authors who have done excellent work on different groups and families," work which Mr. Sinclair "does not wish for a moment to undervalue." Then why does he utterly ignore it, when both those writers—in English—have treated the group as a whole, and in a masterly way? But if Mr. Sinclair turns from Pocock and Bollman, surely he will consent to be guided by Latzel? No, "on the whole, he thinks it will be better to take the classification of Koch," though the works of that author are "comparatively old," one only thirty and the other fifty years. And so the reader is presented with a scheme the diagnostic statements of which bristle with errors. The genital ducts of millipedes are said to open on the seventh segment (instead of the third, as Mr. Sinclair correctly states in his anatomical section). The Callipodidæ and the lately rediscovered *Glomeridesmus* are not mentioned at all. The Polydesmidæ are said to have always nineteen body-segments; most of the genera have twenty. The Glomeridæ and Sphærotheriidæ are credited with eleven and twelve body-segments respectively; in each case one too few. Not a word directs attention to the peculiar suctorial mouth of *Polyzonium*; and the openings "near the lateral corners of the body-rings" in that animal are not stigmata but stink-holes. Turning to the centipedes, we are told that the Lithobiidæ have "many eyes"; *Henicops* has but one ocellus on each side. Clawed anal legs are given as a family character of the Geophilidæ; in several *Geophili* these limbs have no claws. The dorsal plates of *Scutigera* are said to be smaller than the ventrals; they are always larger, as Mr. Sinclair must surely know from his own studies on the animal. Haase's interesting genus *Cermatobius* (forming a distinct family) is, of course, not mentioned at all. If Mr. Sinclair had taken the trouble to find out the existence of this intermediate form between the Lithobiidæ and *Scutigera*, he would perhaps have hesitated to raise the latter genus to ordinal rank; equal in importance to the Chilopoda, Diplopoda, Symphyla, and Pauropoda. But it is really astounding that a chapter on Myriapoda, in a work professing to give the latest results of research, should contain no reference to the view—several years old, and independently advocated by Pocock and Kingsley—that the association of these groups in a single class is unnatural, and that the Chilopoda and their allies are closer to the Insecta than to the Diplopoda. Suppose this chapter had been entrusted to a classifier, who, considering it necessary to put in something about development, might have written that, "without desiring to undervalue the work of several recent investigators, he thought it better to summarise Newport and Metschnikoff's accounts of myriapod embryology": such treatment of the subject would appear incomplete and one-sided to Mr. Sinclair, yet he has treated the systematic aspect of the group in a manner precisely analogous. It is, of course, a mere truism that embryological and systematic work are alike necessary for the progress of zoology, and that the workers in either branch should feel the unity of aim underlying their diverse labours; but such a chapter as this shows that there may still be need of exhortation to naturalists to take an intelligent interest in each other's subjects.

The classificatory section is followed by an account of the structure of myriapods. This is well and clearly written, and the author evidently remembers that his task is to instruct the unlearned as well as to guide the serious student. Indeed, the latter might complain that from his point of view some features are passed over too briefly. Even here errors are not wanting: all millipedes, except the Polyxenidæ, are said to possess stink-glands; the Chordeumidæ have none. More space might have been devoted to such very interesting and problematical forms as *Scolopendrella* and *Pauropus* and figures of these should certainly have been given. The illustrations of entire animals are all from Koch, and the *Scutigera* wants several pairs of legs, though no comment is made as to its imperfection. The structural figures are after Latzel, copied from Mr. Sinclair's own papers, or original.

The only fault that might be found with the section on the development of myriapods is that it is drawn too exclusively from Mr. Sinclair's own researches. It consequently neglects the centipedes; but it is an excellent summary of diplopod development, and serves admirably the twofold purpose claimed for the book. Mr. Sinclair shows how embryology can be made attractive to the general reader, and how the fascinating problems presented by the facts of development can be set forth at once plainly and accurately. These pages are well illustrated from the author's own works. A section on fossil myriapods, with a few figures, is a welcome addition; but, here again, neglect of recent literature is to be deplored. Two important families of Carboniferous centipedes, the Eoscolopendridæ and Gerascutigeridæ, erected by Scudder in 1890, are not mentioned. The genus *Trichiulus* still figures among the Archipolypoda, though the fossil on which it was founded is truly referable to a fern-frond, as stated by Zittel. Among the fossil diplopods, amber specimens of *Craspeodosoma* are referred to the Lysiopetalidæ, a family name not to be found in Mr. Sinclair's Kochian classification of recent forms, where the family to which *Craspeodosoma* belongs is called Chordeumidæ. In conclusion, Mr. Sinclair sums up the light thrown by embryology and palæontology on the origin of the myriapods. But, here again, we are faced by the author's strange apparent ignorance of the fact that naturalists of high repute deny the homogeneity of the class. The failing common to Messrs. Sedgwick and Sinclair in their contributions to the present volume is their unaccountable neglect of the work of all recent authors—except themselves.

The first instalment of Dr. Sharp's work on the Insecta occupies six-sevenths of the volume. High expectations must have been formed by British entomologists of the character of this work. They will not be disappointed; for Dr. Sharp has given the naturalists of to-day such a gift as Westwood gave their fathers in his "Modern Classification." Dr. Sharp cannot claim to have done original research on the structure and development of insects comparable to Mr. Sedgwick's work on *Peripatus*, or Mr. Sinclair's on the diplopods. He belongs to the despised group of the systematists; but his contribution to the volume, in the excellent balance of its subject-matter and the fulness of its references to the literature, contrasts pleasantly —and painfully—with the chapters written by the two eminent morphologists. A perfect work on modern entomology is beyond the power of man; but Dr. Sharp has set before himself a high ideal, and has gone far towards realising it. Opening with some remarks on the immense success achieved by insects in the struggle for life, and the high interest of the social organisation displayed by many of them, he proceeds to an account of their external and internal structure, embryology, and subsequent development, illustrated by numerous figures, many of which are original. All technical terms are explained, and any general reader who will take a little pains can hardly fail to grasp the the author's meaning. To the student, these pages are a veritable store of information containing a judicious summary of the most reliable observations of numberless workers. And if any particular problem calls for an appeal to the original authorities, nearly every page is provided with several references in footnotes. In the embryological section it might have been well to devote more space to the problems presented by the segmentation of the head. The antennæ are stated to arise from the procephalic lobes, though there is a general agreement among recent workers (to some of whom reference is made) that these organs arise primitively behind the mouth and are serial with the limbs.

Dr. Sharp's chapter on classification opens with the alarming statement that the 250,000 known species of insects probably form but a tenth part of the insect population of the globe. It is a surprise to find that Dr. Sharp, though summarising the recent general classifications of Packard and Brauer, holds to a scheme differing but slightly from that of Linné. As he points out, the most serious difficulty in the arrangement of insects in orders is presented by the Linnean Neuroptera. This "order" he prefers, though provisionally, to keep intact, in spite of the vast difference in metamorphosis shown by the groups composing it. It cannot be denied that such conservatism is convenient, but it might have been well at least to have separated the mayflies from other "Neuroptera" (as well as the earwigs from the Orthoptera), the paired genital openings in these groups being surely an archaic character of high import. It is hard to accept Dr. Sharp's objection to the use of such characters on the ground that but few insects have been examined for them. Zoology can only proceed on the assumption that the correlation of certain external structures with certain internal structures will be found to hold throughout a natural group. A museum ornithologist will not hesitate to class a new skin with feathers and beak as an egg-laying bird, though it is but a presumption that the living creature did lay eggs. The peculiar structure of the mouth-organs in caddis-flies, also, seems to warrant ordinal rank for them. Dr. Sharp, though restoring the Linnean name of Aptera for the Collembola and Thysanura objects to Brauer's grand division of insects into winged and wingless. Many of the "winged" insects, he points out, have no wings. But surely the idea of the division is that in the one group the absence of wings is a primitive character—in the other secondary.

The orders of Insecta described in detail in this first part of the work are the Aptera, Orthoptera, Neuroptera, and Hymenoptera, as far as the Trigonalidæ. This arrangement is certainly open to criticism, for if any two orders of insects should be brought closely together, the Lepidoptera should follow the caddis-flies. And Dr. Sharp admits that the Hymenoptera have good claim to stand at the head of the insect-world—therefore to come last, if the Aptera begin the series.

But the way in which Dr. Sharp treats the details of his subject is, as in the introductory chapters, admirable. One is especially struck by the balance which is maintained all through between various branches. In the account of each family, external form, morphology, development, habits are all adequately dealt with and excellently illustrated; while the more solid matter is diversified by discussions on such points as the power of the book-louse *Atropos* to produce "death-tickings," and the hypocritical devotions of the Mantids. On every subject, while old authors are not neglected, references to the latest work are given. The anatomist will find a summary of Grassi's recent researches on the Thysanura; the lover of insect habits, the same naturalist's observations on the Termites; the systematist, descriptions of Hansen's *Hemimerus* and Simon's blind cockroaches from the Philippine caves; the lover of controversy, a notice of Spencer and Weismann on the sexes of ants; while foot-notes on every page will send off the industrious student to consult the original monographs.

In his treatment of families, Dr. Sharp is rather inclined to "lump." For him all dragon-flies are but one family, all caddis-flies but one. These views do not seem to be at present those of naturalists who have specially studied the groups. It is remarkable, however, that in many orders, after a period of splitting into numerous families, has come a time of reunion. This has been the case with moths, beetles, and bugs, and it is possible that Dr. Sharp's views of the true value of family groups in other orders to-day may become those of the specialists in a few years' time. The old division of the Hymenoptera into terebrant and aculeate sub-orders is abandoned for the more natural division into groups with sessile and petiolate abdomens.

The remarks on fossil insects might have been somewhat fuller, and no figures are given of the primæval forms which are classed by Scudder as Palæodictyoptera. However, Dr. Sharp mentions the difficulties of interpreting these insect remains, as well as the views of Brogniart and others that they are better classed in distinct families distributed among certain of our existing orders. Altogether, Dr. Sharp has produced a book to which the British worker at entomology will, in the first place, turn for information; in which the intelligent reader will find justification for the deep saying of Augustine[1]—comparing "grubs" with "angels"—which has been chosen as the motto of the volume.

Geo. H. Carpenter.

Burmese Spiders.

Descriptive Catalogue of the Spiders of Burma, based upon the collection made by Eugene W. Oates, and preserved in the British Museum. By T. Thorell. Pp. xxxvi., 406. London, 1895. Printed by order of the Trustees. Price 10s. 6d.

Any publication on Arachnida from the pen of Professor T. Thorell will be hailed as a valuable contribution to arachnological science, especially as in the work now under notice the productions of a region like that of Burma are not only for the first time systematically collated, but the number of known species in the Order (Araneidea) treated upon increased from 175 to 381. Of Mr. Oates's collection, numbering 310 species, 153 are described as new to science and 206 new to Burma, 19 new genera being also characterised. The collection was chiefly made at Tharrawaddy, about 70 miles north of Rangoon, in what used to be called British Burma, but now, since the annexation of the whole country, is termed Lower Burma. With the exception of a short introduction, in which Dr. Thorell explains the classification he has followed in the present work, some remarks on zoological nomenclature, a reference to the literature already published on Burmese spiders, and a note on the general character of the Burmese spider-fauna, the volume before us consists simply of a series of scientific descriptions, drawn up in Latin and detailed with the author's well-known minuteness and accuracy; it is therefore pre-eminently a work for the working araneologist. It is maintained by some zoologists that illustrations are quite unnecessary where natural objects are fully and properly described; but, unquestionably, well-executed drawings are of incalculable assistance, and not only save the scientific worker much valuable time, but are a great attraction to others, and may often be the means of inducing those who may chance to have the opportunity, to turn their attention to the observation and collection of the objects delineated. It seems strange, therefore, that the Trustees of the British Museum, having the materials in their own hands, should have permitted a work like the present to be issued without a single illustration of any kind.

With respect to the character of the Burmese spider-fauna as at present known, out of the 381 species described, 106, or rather over

[1] "Creavit in cœlo Angelos, in terra vermiculos: non superior in illis, non inferior in istis. Sicut enim nulla manus Angelum ita nulla posset creare vermiculum."

one-third, belong to the group "Orbitelariæ" (*i.e.*, those spiders whose snares are of an orbicular or wheel-shape). Four other groups, the "Retitelariæ," "Citigradæ," "Laterigradæ," and "Saltigradæ," number 218 species, in about equal proportions; this at once indicates the nature of the collecting-work as yet effected in the region in question. The spiders of all the five groups named are those which obtrude themselves at every step upon the most casual observer. By far the greater number of species have to be searched for with diligence and the expenditure of much time and labour, and the results would probably be, in general, found to represent largely the groups so very scantily, as yet, recorded from Burma. Three hundred and eighty-one species, though a very respectable and valuable total, can scarcely be a fourth part of what Burma possesses and would probably yield to a careful and systematic search. It is to be hoped, therefore, that Mr. Oates will renew his researches, especially keeping in view those species that require to be searched for in the most uninviting places, and that we may have another volume upon the results from Dr. Thorell's pen, and well illustrated; under such conditions, the history of the Burmese spiders would be very complete and valuable—more so, perhaps, than that of any country whose spider-fauna has as yet been separately published. O. PICKARD-CAMBRIDGE.

BIRDS'-NESTING WITH THE CAMERA.

BRITISH BIRDS' NESTS; How, Where, and When to Find Them. By R. Kearton. Illustrated from photographs by C. Kearton. Crown 8vo. Pp. i.–xx., 1–368. London: Cassell & Co. Price 21s.

THE romance of birds'-nesting exercises a magnetic attraction over many minds. We have clambered along the crags of beetling precipices, creeping on hands and feet where it was impossible to walk; have waded breast-high through swollen torrents; and have spent our nights under the open sky, in order to gratify our passion for gazing on nests that were new to us. Our small share of success affords the happiest reminiscences. So it is with hundreds of enthusiastic ornithologists. Most of them have since regretted that they had no opportunity of photographing the eggs and nests which rewarded their rambles over lonely islets or mist-wrapped hills. It was therefore an excellent idea of Messrs. Kearton to present the public with a series of about one hundred full-page plates from nature. The book is professedly intended as a guide to finding the nests of British birds. We should feel sorry if, by any chance, it gave a new impetus to the destructive custom of forming private collections of the eggs of our native birds. But though we look in vain for any protest against egg-grabbing from our author, Mr. R. Kearton, he has given us a pleasant running commentary on the plumage and habits of many familiar species. His text has the merit of being arranged with lucidity. At the same time, we feel a little regret that the proof-sheets were not corrected by some well known and accurate ornithologist. We should then have been spared the ungrateful task of pointing out that the letterpress requires further revision. For example, if Mr. Kearton was not aware that the female of the dotterel is the brighter of the two sexes, he should have consulted some recent authority instead of stating the exact contrary. Similarly, if he did not know much about the plumage of the partridge, he might have consulted Mr. Ogilvie-Grant's papers on the subject, instead of volunteering the mistaken dictum that the female of this common bird does not assume the dark horseshoe until

MERLIN.

From a photograph by C. Kearton, in "British Birds' Nests," by R. Kearton.
Kindly lent by Messrs. Cassell & Co.

the second year. If a writer chooses to adopt the *rôle* of a popular teacher, it is not too much to expect that he will first consult the literature of his subject; but we would prefer to leave the task of fault-finding to somebody else. The real, transcendent merit of the work lies in the splendid plates with which it is adorned, two of which we are enabled to reproduce through the kindness of the publishers (*see* Pls. III. and IV.). It is easy to take photographs of birds' nests. It is most difficult to secure satisfactory results. Only those of us who have plodded up and down the mountain sides, with camera and tripod on the shoulder, can comprehend the vast amount of trouble needed to obtain such a noble series of negatives as those which Mr. C. Kearton has actually developed. Not only so, but our authors have set to work with a fine, artistic perception of the beautiful. No one can turn over the pages of this volume without feeling grateful to these spirited nest-hunters for the delicious insight into the habits of wild birds which their pictures afford.

H. A. MACPHERSON.

DUBOIS ON PAST CLIMATES.

THE CLIMATES OF THE GEOLOGICAL PAST, AND THEIR RELATION TO THE EVOLUTION OF THE SUN. By Eug. Dubois. 8vo. Pp. viii., 167. London: Swan Sonnenschein & Co., 1895. Price 3s. 6d.

THE author tells us in the preface that "The present essay is an attempt to explain by changes of the solar heat the great climatic changes of the Geological Past." It is a translation, with some small alterations, of a treatise in German, "Die Klimate der geologischen Vergangenheit, und ihre Beziehung zur Entwickelungsgeschichte der Sonne," which appeared in the beginning of 1893 (Nijmegen: H. C. A. Thieme). In the first part of the book we have a general account of the climates of the past; in the second, a discussion of the "changes in the solar heat as the agency by which the geological climatic changes were brought about." At the outset the author discusses the difficult question of fossil plants and animals as indices of climatic changes in past time; the subject-matter of this part of the essay is practically the same as that treated of in the Sedgwick Essay of 1892.[1] Dubois wisely points out the danger of relying too closely on organisms as safe guides in questions of climate. He writes: "A fixed relation between the climate and the character of the organic world does not exist." After speaking of the spreading of northern forms towards the south, and their gradual acclimatisation to new conditions, he adds: "In this way southern types will always display a certain relationship to the older forms of the northern regions, the cause of which is thus not to be found in a change of temperature in their respective stations." The arctic floras are briefly dealt with, and the familiar conclusions drawn as to Tertiary climates. In speaking of the Carboniferous vegetation, the author refers to the preponderance of marattiaceous ferns among the Coal period Filicinæ; it should be borne in mind, however, that the Marattiaceæ at the present day are very few in number, and confined to tropical regions. It is hardly safe, therefore, to compare the living remnants of this once vigorous and widespread family with the Marattiaceæ of the Carboniferous forests as regards climatic conditions of growth.

Other authors have suggested that the *Glossopteris* flora of the Southern Hemisphere, which appears to have replaced the characteristic Coal flora towards the close of the Palæozoic period, owes its

[1] "Fossil Plants as Tests of Climate." A. C. Seward. London: 1892.

origin to the fall of temperature, of which we have evidence in the widespread glacial deposits of India, Australia, and Africa. Dubois accepts this view, but does not attempt to discuss the probability of this southern flora being the product of a cold climate. It is difficult to recognise in the plants of this period any characters suggestive of arctic or arctic-alpine conditions. A displacement of the poles is given up as untenable. "Should astronomers and physicists raise no objections to a considerable displacement of the poles, the facts observed with regard to arctic vegetation of the Tertiary period still offer sufficient arguments against such a supposition."

To discuss the numerous debatable points touched on in this interesting essay would take us far beyond the limits of the space at our disposal. It is satisfactory to find that no very considerable reduction of temperature is demanded for the Glacial period. The author quotes, and apparently accepts, the opinion of Penck: "A general reduction of temperature of 4°–5° C.—and for a climate damper than the present, of even less—suffices to account for the whole Glacial phenomenon." Assuming suitable geographical conditions, we need not have recourse to such a serious lowering of temperature as is frequently deemed necessary. In the second part, the causes of climatal changes are dealt with at some length, and it is urged that we must look to changes of the solar heat for the cause of the geological changes of climate. An attempt is made to examine the sun's history in detail. "The sun is a star like the thousands which appear at night as luminous specks in the celestial vault, even of relatively small dimensions, and differing from the others merely by its closer proximity to the earth. The substances of which it consists are entirely the same as those of which many other stars are composed." The past history of the sun, its gradual change from a star of the first class to a star of the second class, is compared with the history of geological climates. With the sun in the condition of a white star, says Dubois, organic evolution may have progressed faster than in the Tertiary period, when the light and heat of the sun were already diminishing. This part of the essay contains much that is highly suggestive, and is well worthy of attention by those qualified to estimate the value of the evidence and the author's deductions.

On page 11 we find the not unusual mistake of applying the common name of mares' tails to the Equisetums, and on page 16 *Salisburia* is written *Salisburea*. The statement that Dicotyledons make their first appearance in Jurassic times is not supported by trustworthy evidence; we have no traces of these plants prior to Lower Cretaceous times. The essay may be recommended both as a careful compilation of previously-recorded facts, and as an original contribution towards the causes of climatic changes during the past history of the earth.

A Physical Mantell.

Open-Air Studies: An Introduction to Geology Out-of-doors. By Professor Grenville A. J. Cole, M.R.I.A., F.G.S. 8vo. Pp. xii., 322, with 12 plates and 33 other illustrations. London: Charles Griffin & Co., 1895. Price 8s. 6d.

In spite of the multiplicity of text-books of geology, there has always been room for one which would do for the physical branch of the science what Mantell did for palæontology. A book was wanted that would take the student out-of-doors, and there teach him to observe and reason on the problems of physical geology, just as

Mantell taught the learners of his day where and how to collect fossils. The existing manuals on field-geology are addressed rather to those who know a good deal already, and wish to apply their knowledge in mapping, or else who have to attempt the unravelling of the structure of unexplored regions. These are therefore too dull and concise for most beginners. The elementary text-books are written too much in the form of digests of known facts and current theories to be sufficiently suggestive of observation and thought to the class of students that we have in mind. The present treatises on palæontology are admirable summaries of existing knowledge or popular sketches of life groups; but they have not Mantell's stimulating enthusiasm, and do not send men forth to collect with the same energy as did that author's "Medals of Creation."

Professor Cole's new work admirably supplies this want. It is not a formal systematic text-book, but the student who has travelled across England with it will be more likely to become a useful geologist than one who has read a volume of three times the size. It begins with a chapter on the "Materials of the Earth," which is necessary, and is necessarily dull; but it is the only dry chapter in the book. After having learnt from this the simple properties of rocks and minerals, and how to identify them, the student is recommended to go into some hill country and study "A Mountain Hollow," which is the subject of the second chapter. Here he learns how to examine a section, to study erosion and wind and water, to distinguish between talus, drift, and bed rocks, to watch the formation of clouds, their descent as rain and snow, and to see glaciers at work, or to trace the signs of their former existence. Thus a mountain hollow is made to serve as an object lesson to illustrate many important geological phenomena. In the same way the student is directed to the valley, along the sea-shore, across the plains, to the craters of dead volcanoes, and over granitic highlands. The three final chapters tell him how to read the annals of the earth, narrate how the stratigraphical succession was first determined, and guide him across the stratified "Surrey Hills" and over the contorted Alpine Mountains.

The book is elementary, but contains much which will repay perusal by advanced workers, for it has a charming combination of antiquarian references with the latest results of modern work. Papers are abstracted of which the ink could hardly have been dry when the proofs of this work passed through Professor Cole's hands. And side by side with these are stories of last century speculations and scientific hoaxes. Occasionally, the author has accepted results which are of startling significance, but which are nevertheless hardly likely to be verified. Thus he retains life in the Archæan series, replacing Dawson's *Eozoon* by Cayeux's Radiolaria, though the latter are almost certainly as inorganic as the former. He accepts man as Lower Pliocene in age (p. 241) on the strength of Noetling's testimony. Occasionally, the conclusions of physical evidence have been adopted without reference to the teaching of palæontology or neontology as, *e.g.*, in reference to the formation of the Caspian Sea (p. 145). But these are details; in his use of recent references the author usually shows great discrimination and caution. The illustrations of geological phenomena quoted are always apt and refreshingly original; for the book is the work of a man who loves the open air and has travelled far and wide with his eyes open, and he has thus been able to draw his examples from all sorts of odd corners scattered over the north-western quarter of Europe.

There is one further feature in the book which would alone make its perusal pleasurable and profitable, and that is the elegance of its English. Professor Cole's papers have always been characterised by their accuracy and ease of expression. Throughout the present volume we come on picturesque touches which are most welcome to the student in a town. They bring back reminiscences of countries where "the granite hills flush rose-red in the glow of evening," of passes "where there is still a chance of startling an eagle in some hollow filled with the sea-mist," of "clouds creeping across the wind-swept *cols*," and of "the soft sheets of mist stealing across the hollows of the fen."

The book is worthy of its title; from cover to cover it is strong with bracing freshness of the air of the mountain and the field, while its accuracy and thoroughness show that it is the work of an earnest and conscientious student.

Fungi in General.

Introduction to the Study of Fungi. By M. C. Cooke. Pp., x., 360; 148 figs. London: A. & C. Black, 1895. Price 14s.

This veteran writer on Fungi has given to the world such a number of books on this subject, and on so many others, that he probably does not claim at this stage of affairs any extraordinary degree of accuracy or enlightenment. If the present volume be judged by the standard of an ideal book on Fungi—the nearest approach to which for its time is De Bary's famous "Comparative Morphology," now getting out of date; if it be judged by what a great writer might have done, or an ordinary well-informed mycologist might have written, one would say it is not a particularly good book. If it be judged by its author's previous performances, such as "Fungi: their Nature, Influence, and Uses," in the International Scientific Series, one would say it is comparatively a good book. It marks an advance in the author's views. Time has mellowed his violent feelings towards some burning questions of the last twenty years, and he no longer employs his fine talent in abuse of most things new. Far be it from us to do other than praise him for his repentance in some matters, late though it be, and carefully modified and guarded as well. He has always fought a good fight, observed the rules of the game in all his contests, and the present writer, who is also growing older, is glad to welcome this approach of an old friend and antagonist.

The great merit of this book is not a new one. Dr. M. C. Cooke has always written well, and he writes this book well. It is not dry. It is well printed and indifferently well illustrated—there is considerable inequality in the style of the cuts. The author has read a good deal in the way of recent morphological literature—though manifestly not enough, nor carefully enough. Still, it is a great advance on his previous books, and may be recommended to the large class of readers who shrink from harder reading in English or German.

G. M.

Fungi in Brazil.

Protobasidiomyceten. Untersuchungen aus Brasilien. By Alfred Möller. 8vo. Pp. xiv., 179, 6 plates. Jena: Gustav Fischer, 1895. Price 12s.

Dr. Möller's account of his researches on fungi in the Tropics has now reached the third volume, and, if possible, the interest of the record increases. During the three years of his residence in Brazil he made 9,000 microscopic cultures in his laboratory, and such indefatigable work has been amply rewarded. His attention all along was specially directed to the Protobasidiomycetes, under which Brefeld has classified all those lower forms of the Basidiomycetes that have divided basidia. The Autobasidiomycetes with undivided basidia include nearly all the larger fungi, the mushrooms, toadstools, etc., and are to form the subject of another paper.

The Protobasidiomycetes have been further subdivided by Brefeld into two groups, distinguished by the form of the basidium. The Auriculariaceæ, brown, leathery, wrinkled fungi, popularly known as "Jew's ears," represent one type: they have long upright basidia divided by transverse walls into four cells, and each cell gives rise to one spore. In the other group, the basidium is more round or egg-shaped, and it is divided lengthwise, like the quarters of an orange. This type prevails in the Tremellineæ, very slimy, gelatinous fungi that grow mostly on decaying wood; there is a long outgrowth or sterigma from the apex of each cell, on the top of which the spore is borne. The reason for this form of fruiting is very apparent, as the spores are thus lifted above the gelatinous covering and their dissemination is secured.

One of Möller's most interesting discoveries was that of *Sirobasidium brefeldianum*, which forms a transition from one to the other of these types. The fungus occurs on dead branches, and looks like little white pearls or drops of water. The basidium is an oval-shaped cell, which has only one somewhat slanting division and two spores without sterigmata, one borne near the apex of the basidium, the other lower down. After the spores are ripe, the basidium shrivels up and the cell immediately beneath develops in turn as a basidium, and thus a row of such shrivelled, empty cells could often be seen surmounting a spore-bearing basidium. A very similar fungus had been found in Ecuador by Lagerheim, and was described by Patouillard in the *Journal de Botanique* for 1892, under the generic name *Sirobasidium*. In the Ecuador plant, the basidium was divided into four cells by longitudinal walls, and the four spores were borne at the apex, also without sterigmata. Here, too, the succession of basidia in a long row was similar to that of *Sirobasidium brefeldianum*, the Brazilian species.

In the preface to this volume, Dr. Möller quotes, with entire approval, Brefeld's statement that to classify and name fungi belonging to the Protobasidiomycetes, it is necessary to rely chiefly, if not alone, on spore culture and development. It was surely rash, then, on Möller's part, to accept the work of Patouillard, who merely described the fungus as he found it. Life is scarcely long enough to watch how the spores grow in every fungus that we may desire to classify. Möller himself has not found such knowledge essential, or he would have laid aside Patouillard's *Sirobasidium* with a query.

The researches of Van Tieghem, and subsequently of Brefeld, have resulted in placing the Uredineæ among the Basidiomycetes near to the Auriculariaceæ, and therefore among the Protobasidiomycetes. The Uredineæ are all parasites, and form the "rusts" that work such havoc among cereal crops. The brown and black streaks and patches that cover the grasses in autumn are formed of innumerable little two-celled brown spores, which are scattered by the wind, and are capable of resisting extreme cold. In spring, they germinate and reproduce the fungus. It is at the stage of germination that the fungus harks back to its kindred, and the germinating filament is a true basidium exactly like that of *Auricularia*. It is divided into four cells which produce the spores, and these in turn grow out into the filaments of the new plant. Dr. Möller does not delay long over this group, but he describes a new genus, *Saccoblastion*, which he considers a closely allied form. It was found, in moist weather, a thin tangle of hyphæ, on decaying wood and bark. The parent cell of the basidium in this fungus forms a large, drooping, pear-like outgrowth, whence the name *Saccoblastion*. Möller considers this outgrowth to be the equivalent of the two-celled brown spores in the Uredineæ. In the one case there is a mere thin-walled protrusion from the vegetative cell, in the other there is a spore which separates from the parent plant and reproduces it. The homology is, to say the least, very startling and far-fetched.

Two curious genera have been added to the Tremellineæ, viz., *Protomerulius* and *Protohydnum*. The first-named bears a striking resemblance to *Merulius*, the well-known "dry-rot"; *Protohydnum* grows exactly like a *Hydnum*, the under-side being studded with tooth-like projections nearly a quarter of an inch in length. Both these fungi have, however, the characteristic, longitudinally-divided basidium of the Tremellineæ, and only in outward form simulate plants of the more advanced type of the Autobasidiomycetes.

Dr. Möller has added six new genera and twenty-eight new species to the Protobasidiomycetes; and in the forms which he has found he has happily been able to trace a gradual development in the formation of the hymenium, from plants with scattered isolated basidia to those in which the basidia grow in a definite fruiting layer. The thanks of all students of fungi are due to him for this most interesting account of his labours. A. L. S.

Mosses and Ferns.

The Structure and Development of the Mosses and Ferns. By Prof. Douglas H. Campbell. Pp. viii., 544. London: Macmillan & Co., 1895. Price 14s.

Professor Campbell is well-known as the author of a number of important papers which are concerned, for the most part, with plants and problems connected with the Archegoniatæ; thus a work from his pen dealing with the cryptogamic department of this great series of plants at once arrests attention and arouses interest. And it is not too much to say, at the outset, that it forms probably the most important treatise of its kind since the publication of the magnificent and fundamental researches of Hofmeister some forty years ago.

The too often neglected group of Muscineæ, and especially the section of the Hepaticæ, meet here with far more adequate recognition than has, unfortunately, become customary. Representatives of the various orders of Liverworts have been investigated by the author; but it must not be imagined that a general and comparative treatment has been lost sight of because some forms are selected as special types. We notice with satisfaction that to *Targionia* is given a due prominence among the Marchantiaceæ. Its comparative simplicity well fits it to serve as a key to the extremely complex structure exhibited by the more familiar genera.

The somewhat detailed treatment of the Anthoceroteæ is a good feature of this part of the book. The group has acquired a position of considerable importance, inasmuch as it not improbably indicates the sort of phylogenetic path along which the ancestors of the vascular cryptogams have travelled.

With the chapter on the mosses proper we confess we are not quite so well pleased. Our old friend *Funaria* is exhaustively studied, but we should have liked to see interesting forms like *Buxbaumia*, *Diphyscium*, *Splachnum*, or *Fissidens* receive far more attention than they have actually met with. In this, as in other parts of the book, we think the following-up of cell lineage has been too exclusively pursued, at the expense of a wider morphological survey of the mature forms and of the numerous adaptations to circumstances of the environment so fully illustrated by these plants.

Naturally, the vascular cryptogams occupy the largest share of the book. Here Professor Campbell works out the views, which he was the first to propound, and which have been largely accepted by many other botanists, especially in this country, viz., that the eusporangiate ferns are older, phylogenetically speaking, than the leptosporangiate forms. The author also insists that it is among the Hepaticæ, rather than the Musci, that their lower affinities are most naturally to be discerned.

The Ophioglossaceæ are regarded as the most primitive type, and as being most nearly related to such a form as indicated by *Anthoceros*. The author works out this point, so far as the evidence goes, both in the sporophyte and the gametophyte, and he lays considerable weight on the results of comparisons between the antheridia and archegonia of the two groups respectively. We confess that, as regards the antheridia, we do not think that a very good case has been made out, nor indeed does Professor Campbell express himself on this point without reserve. The antheridia of the Anthoceroteæ are very peculiar, and need some manipulation in order to be forced into line with those of the ferns. However, it must, of course, be remembered that, in any case, it is not *Anthoceros* itself which is contemplated as lying in the line of direct descent; it only serves to give the idea of a generalised type to which the ancestors of the present higher plants may have roughly conformed. The argument drawn from the comparative study of the archegonium is much more convincing, and the author's suggestion that the whole archegonium of a vascular cryptogam corresponds only to the axile series of the analogous body in liverworts we regard as a peculiarly happy one.

The leptosporangiate ferns, so far, at least, as concerns the homosporous members, form a well-defined group, their relationship with the eusporangiate series being indicated through the Osmundaceæ. As regards the heterosporous families, Professor Campbell considers the Salviniaceæ as a possible offshoot from the already divergent Hymenophyllaceæ, while the Marsiliaceæ are assumed to be derived from the Polypodiaceæ. We should ourselves, however, be disposed to remove the Marsiliaceæ much further from any existing homosporous type than Campbell has done; the very strongly-marked degree of reduction in their gametophyte and the great peculiarity of the sporophyte, both in structure and in position, seem to us to be facts which indicate that, if they are really related to the Polypodiaceæ at all, their affinity is at best but an extremely remote one. It is, we venture to think, not impossible that they may turn out, after all, to be more nearly allied with some eusporangiate prototype resembling the Ophioglossaceæ. It is not *à priori* impossible that the present character of their sporangia may well have been developed quite independently of any real descent from primitive leptosporangiate ancestors. Heterospory has appeared more than once in the alliance of vascular cryptogams, why not the leptosporangiate character also?

The general summary at the end of the book is a fine piece of work. The full discussion of the mutual relationships existing between the various subdivisions of the cryptogamic archegoniatæ, and between these and the higher spermophytes, is full of interest and suggestive thought from first to last. Professor Campbell regards the phanerogams as representing the outcome of at least two separate lines of descent, the gymnosperms, or at any rate the Coniferæ, being referable to a lycopodiaceous stock, while the source of the angiosperms is to be sought for among the eusporangiate ferns.

It is impossible, while respecting ordinary limitations of space, to do complete justice to an important work like that now under review; but enough has been said to show that no one who wishes to realise the present position of plant morphology can afford to neglect Campbell's book. On the other hand, we cannot blind ourselves to some of its more obvious defects. We have already referred to the almost entire lack of "bionomic" element, and we also think that a more extensive treatment of the variation that occurs within small circles of affinity would have been appreciated. But it is against the almost complete neglect of palæontology that our most serious complaint is directed. Quite the best and most important of the palæophytological work has been done in the department of the archegoniate plants, and we imagine there will be but few readers of Dr. Campbell's book who will not feel disappointed at the perfunctory manner in which this branch of the subject has been dismissed. This omission, we may hope, will be remedied in future editions; it constitutes at present a defect in what is otherwise a fine book. J. B. F.

New Serials.

The U.S. Weather Bureau has started a monthly entitled *Climate and Health*, edited by Dr. W. F. R. Phillips. By means of tables and charts it discusses the relations of disease and climatic conditions.

A quarterly, entitled the *Journal of Experimental Medicine*, is announced by Appleton & Co., New York. It is devoted to original investigations in physiology, pathology, bacteriology, pharmacology, physiological chemistry, hygiene, and medicine. The editor-in-chief, Professor H. Welch, of Johns Hopkins University, is assisted by twelve other well-known Americans. A similar journal has been begun in Russia, under the editorship of Professor W. W. Podevyssotzky, of Kieff. It is entitled *Russisches Archiv für Pathologie, Clinische Medezin und Bacteriologie.*

We note a monthly, entitled *Devonia*, edited by E. W. W. Bowell and E. H. Bazeley, price 1s. 6d. per quarter, post free. Communications may be addressed to the editors at Huntsham, Bampton, North Devon. The paper is at present reproduced from manuscript, apparently by the autocopyist. It contains natural history notes of local and general interest. The energy of the conductors is praiseworthy, though it might be directed with more utility towards the improvement and aid of existing journals such as *Science Gossip*, which, if not dead, is hibernating.

Literature Received.

Origin of Plant Structures, G. Henslow: Kegan Paul. Telescopic Astronomy, A. Fowler: Philip. De Gewervelde Dieren, T. C. Winkler: Haarlem. Faune de France; Coléopteres, A. Acloque: Baillière. N. American Fauna, no. 10: U.S. Dept. Agriculture.

Igneous Rocks of the Giridil Coal-field, Holland and Saise: *Rec. Geol. Survey India.* The Botanical Outlook, J. M. Coulter. Botanical Studies, xxiv.-xxviii.: Minnesota State Botanist. Surviving Refugees of Ancient Antarctic Life, C. Hedley: *Trans. Roy. Soc. N.S.W.* Perissodactyls of the Lower Miocene, Osborn and Wortman: *Bull. Am. Mus.* Some Factors in Evolution of Adaptations, G. Haviland. Natural History and Scientific Book Circular, including works from the Libraries of Sir G. B. Airy and A. C. Ranyard: Wesley & Son.

Knowledge, Dec. and Jan. Review of Reviews, Jan. Nature, Dec. 19, 26, Jan. 2, 9. Literary Digest, Dec. 14, 21, 28, Jan 4. Revue Scientifique, Dec. 21, 28, Jan. 4, 11. Irish Naturalist, Jan. Revue générale Sciences, Aug. 15, 30, Sept. 15. Feuille jeunes Naturalistes, Jan. American Journ. Science, Jan. Victorian Naturalist, Oct. Science, Dec. 13, 20. Scottish Geographical Mag., Jan. Westminster Review, Jan. Naturen, Nov. and Dec. Nature Notes, Jan. American Naturalist, Dec. and Jan. The Naturalist, Sept., Nov., and Jan. American Geologist, Nov., Dec., and Jan. Botanical Gazette, Dec. Biology Notes, Nov. and Dec. The Photogram, Jan. L'Anthropologie, Nov. and Dec. Naturæ Novitates, Dec.

OBITUARY.

WE regret to announce the death of Mr. HUGH MILLER, F.R.S.E., F.G.S., son of Hugh Miller (author of "The Old Red Sandstone," "The Testimony of the Rocks," etc.). Mr. Hugh Miller, who was born July 15, 1850, joined the Geological Survey in 1874, and was engaged at first in surveying portions of Northumberland. Later on he was transferred to the Survey in Scotland, and mapped some of the regions around Cromarty, rendered classic by the observations of his father. He then proceeded to Sutherlandshire, and was engaged in surveying the Eastern Schists, the Old Red Sandstone, and the Glacial Drifts. He was the author of a little work on "Landscape Geology," and of papers on the Glacial Phenomena of Northumberland. He died January 8, 1896.

IN our article on the Perthshire Museum of Natural History considerable mention was made of Colonel HENRY MAURICE DRUMMOND HAY, of Seggieden. Our readers will regret to hear that he died at his family residence on January 3, at the age of 82. He had one of the best private natural history collections in the country, it being especially rich in birds and their nests. While in Bermuda with his regiment, the 42nd Royal Highlanders, he made an exhaustive collection of fishes, and his reports and drawings were sent to the American Fishery Commission in 1860, and were highly commended. His loss will be greatly felt by the Perthshire Society of Natural Science.

THE *Victorian Naturalist* gives the following account of Mr. J. BRACEBRIDGE WILSON, M.A., F.L.S., who passed away at the age of 67 on October 22 last. "In his position as head master of the Church of England Grammar School, Geelong, for the past twenty-two years, he had made hosts of friends all over Australia, who will deeply feel his loss. Among biologists his name will long be remembered as an enthusiastic collector of the sponges and algæ of the vicinity of Port Phillip Heads, where he was accustomed to spend all his holidays dredging for fresh material to be forwarded for working out to such friends as the late Dr. Macgillivray, of Bendigo, Baron von Müller, Professor M'Coy, F.R.S., Melbourne University, or Dr. Dendy, now of Christchurch, New Zealand; or through them to the leading specialists of England or the Continent. He was for a number of years a member of the Field Naturalists' Club of Victoria, and took considerable interest in the work of the Geelong Field Naturalists' Club."

The Rev. J. G. Morris, whom the *American Naturalist* describes as one of the fathers of American entomology, died in Lutherville, near Baltimore, on October 10, aged 92. His catalogue of the lepidoptera, published in 1860 by the Smithsonian Institution, and his Synopsis of Diurnal and Crepuscular lepidoptera are the works by which he was best known to entomologists.

A full account and a bibliography of Johannes Frederik Johnstrup, of Copenhagen, whose death we announced in our last February number, p. 138, is contributed by Victor Madsen to vol. xvii. of the *Förhandlingar* of the Geological Society of Stockholm, pp. 85–96.

Other deaths recorded are those of: E. A Wünsch, a local geologist of note, who spent his earlier years in the neighbourhood of Glasgow, and his later ones in Cornwall, in December, 1895; Rev. W. Thompson, the author of "Florula Sedbergensis," who was born at Mallerstang in 1843, and died at Sedbergh on June 6, 1895; M. S. Bebb, of Rockford, Illinois, well-known for his work on the willows, in California, on December 5 last; Dr. F. P. Porcher, Professor of Materia Medica and Therapeutics in the Medical College of the State of South Carolina, and author of numerous works on pharmaceutical botany, at Charleston, S. C., on November 19; General O. v. Radoszkowski, the hymenopterologist, in Warsaw, last May; A. P. Kosticher, Director of Agriculture in Russia, who created the first laboratory in Russia for the study of soils and agricultural products, and wrote a large work on the black earth of Southern Russia; Dr. Peter S. Popow, extraordinary Professor of Physiology at Dorpat University; Dr. Teichmann, formerly Professor of Anatomy at Cracow; Dr. A. von Brunn, Professor of Anatomy at Rostock University, on December 10, aged 46; Dr. K. B. Schiedermayr, the botanist, in Kirchdorf, Austria, on October 29; Professor G. Krabbe, plant-physiologist, formerly of Berlin, at Wonsahl, near Ibbenbüren, in Westphalia, on November 3, aged 40; O. Borchert, African explorer, on November 13, in Ludwigslust; Dr. Paolo Galardi, Professor of Natural History in the Lyceum of Siena, on December 8, 1895; Dr. Achille Quadri, Professor of Zoology at Siena University, on December 17, 1895; the Polish botanist, Dr. F. Berdau, on November 27; and Antonio de Castilio, founder and director of the Geological Survey of Mexico, who died in the City of Mexico on October 27.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

The following appointments have been announced:—Colonel G. T. Plunkett, R.E., Secretary of the Royal College of Science for Ireland, to be Director of the Science and Art Institutions in Ireland; A. W. Rogers, of Christ's College, Cambridge, to be Assistant Geologist on the Geological Survey of Cape Colony; W. L. Sclater, to be Curator of the South African Museum, Cape Town; Dr. Hürthle, to be Extraordinary Professor of Physiology at Breslau; Dr. K. G. Hüfner, Professor of Organic and Physiological Chemistry at Tübingen, to succeed the late Professor Hoppe-Seyler at Strassburg; Dr. A. Froriep, to be Ordinary Professor of Anatomy at Tübingen; Dr. W. Roux, of Innsbruck, as Professor of Anatomy in Halle University; Dr. Karl Müller, of Berlin, as Professor of Technical Botany to the Technical School of Charlottenburg; Professor N. Kudnetzoff, as Director of the Botanic Garden of Dorpat University, with N. Busch as Assistant-Director; Dr. J. Ritzema Bos, as Professor of Plant-pathology at Amsterdam University; Dr. N. V. Ussing, as Professor of Mineralogy at Copenhagen University; Dr. Carlo Fornasini, to be Assistant in the Geological Museum of Bologna University; Professor Achille Russo, to be Lecturer in Natural History at the Technical Institute of Melfi; G. Nappi, to be Professor of Natural History at the Lyceum of Caltanisetta; F. Pierucci, to be Professor of Natural History at the Lyceum of Rieti; Dr. A. Bertino, to be Assistant in Zoology, Physiology, and Comparative Anatomy at Sassari University; Giuseppe Boccino, to be Assistant in Natural History and Agriculture at the Technical Institute of Udine; E. Ficalbi, of Cagliari, to be Professor of Zoology in Messina; Professor Gaetano Pittalunga, to be Instructor in Natural History at the Lyceum of Savona; Dr. Theobald Smith, late Chief of the Division of Animal Pathology in the U.S. Department of Agriculture, to be Lecturer at Harvard, and Bacteriologist to the Massachusetts State Board of Health; he is succeeded by Dr. V. A. Moore, who has for assistant Dr. P. A. Fish; Dr. Lucien M. Underwood, to be Professor of Botany in the Agricultural and Mechanical College at Auburn, Alabama; Mr. F. S. Earle, to be Assistant in the Division of Vegetable Physiology and Pathology in the U.S. Department of Agriculture, in place of J. F. James; F. L. Washburn, to be Professor of Zoology at Oregon State University; Dr. H. Nichols, to be Lecturer in Psychology, and Dr. James Ellis Humphrey, to be Instructor in Botany, at Johns Hopkins University; Dr. J. P. Lotsy, formerly of Johns Hopkins, to assist Dr. Treub at the Buitenzorg Gardens, Java.

Mr. C. A. Barber has been appointed temporary lecturer in botany at Cooper's Hill, in order to fill the vacancy caused by Professor Marshall Ward's transference to Cambridge. We understand that changes in the constitution of the college are contemplated, and, until the new scheme is settled, no permanent appointment will be made. We trust, however, that the position of botany in the curriculum will not be lowered in any way.

Mr. Harry Page Woodward has resigned the post of Government Geologist to West Australia, and has taken service with the well-known firm of Bewick, Moreing & Co., of Coolgardie and London.

On January 11, the Academy of Sciences at St. Petersburg elected Professor James Hall, of Albany, an Honorary Foreign Member, and Professor Ray Lankester and Mr. C. D. Walcott among its corresponding members.

On the occasion of Sir Henry Acland's retirement from the Regius Professorship of Medicine in the University of Oxford, a meeting was held in the hall of All Souls' College, when the Vice-Chancellor presented Sir Henry with an illuminated address, and with a list of 400 subscribers to a sum of some £3,000, which will be devoted to the enlargement of the Sarah Acland Home for Nurses. A bust of the professor is to be placed in the University museum, and "will remind present and future students that he was the chief mover in the creation of the museum and the developmeut of the Radcliffe Library as a centre of physical science in Oxford."

THE Fishmongers' Company has given to the City and Guilds Technical College, Finsbury, a scholarship of £60 per annum in memory of Professor Huxley. This is to be held three years by any scholar of the Finsbury College who has given evidence of high scientific attainments, to enable him to proceed to the Central College at Kensington

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THE million dollars demanded by Mr. J. D. Rockefeller, as a condition of his own gift of the same amount to Chicago University, has been produced by Miss Helen Culver. The sum is assigned to the biological department. It is probable that a school of medicine will be established.

WE learn from the *Manchester Guardian* that considerable improvements have recently been made in the museum and art galleries at Peel Park, Salford. We are not so much concerned with the additions to the picture galleries and those illustrating manufactures, as with gallery C, devoted to the ethnographical section, and rooms F and G, which have recently been handed over to the geological section. The ethnographical specimens have lately been arranged on a system such as will enable them to appeal more effectively to the public intelligence. Beginning with prehistoric man, and working up through palæanthropic and neanthropic ages into the early historic, mediæval, and recent eras, the specimens terminate at one place with flint-and-steel implements. The specimens following are grouped geographically, and illustrate the weapons and utensils, clothing, etc., used by different races all over the world. The geological rooms have been put in order by Herbert Bolton, of the Manchester Museum, Owens College. The classification of the specimens has brought out a large amount of material formerly stowed away and hardly recognised as existing. Consequently, two series of wall-cases, each about fifty feet in length by six feet high, have been added. These contain larger specimens which are not well adapted, on account of their size, for exhibition in the table cases. The Coal-measures, on account of their importance to the district, take a large amount of space for their illustration, but choice specimens are much needed of coal-plants, most of those formerly possessed by the museum having fallen to pieces. The general arrangement of the specimens is stratigraphical, and Sir Henry Howorth, whose influence, perhaps, is traceable here, will be glad to see that the last table-case, which contains specimens illustrative of the most recent phase of geological history, has been arranged in agreement with the contents of a special case in the anthropological gallery, the latter arranged by the curator as an introduction to the general anthropological collections. By this means, it is hoped the visitor will carry his studies from either of the sections to the other, while the arrangement emphasises the general continuity of prehistoric and historic time.

A special department of practical geology illustrates the chief coals of the Lancashire coalfield, and a small selection of other coals, together with a series showing the chief stages in the process of change from peat to coal. There is also a section of building-stones, which is intended to form a group more especially illustrative of those used in Salford and Manchester, and, whenever possible, two specimens of each will be shown, one fresh from the quarry, the other from some building where it has been exposed to the action of the weather for a number of years. In the latter case, the aspect of the building-stone will be indicated, the number of years it has been weathered, and the deterioration which has resulted. One feature of interest to the geologist is the extensive use of photographs. Most of these show the action of geological processes over large areas, as, for example, the destruction of cliffs, the formation of river valleys, and the appearance presented by eruptive rocks. The photographs, like the specimens, are mainly illustrative of British geology, although, for the sake of completeness, foreign specimens are being introduced to represent those periods which have left no traces in the British Isles. The work is being rapidly pushed forward, and it is hoped that the rooms may be thrown open again to the public in March.

A Museum of Anatomy and Surgery has been founded in St. Petersburg. For its use, a building on the banks of the Neva has been purchased by the Pirogoft Chirurgical Society, and this will be reconstructed with the aid of 60,000 roubles bequeathed to the Society by the late Countess Musin-Pushkin, and 30,000 provided by the Government. The museum is to be arranged on the lines of that of the Royal College of Surgeons.

The following is the list of awards of the medals and funds made by the Geological Society, London, for the present year:—Wollaston Medal, Professor E. Suess; Murchison Medal, Mr. T. Mellard Reade; Lyell Medal, Mr. A. Smith Woodward; Wollaston Fund, Mr. A. Harker; Murchison Fund, Mr. P. Lake; balance of the Lyell Fund, Dr. W. F. Hume and Mr. C. W. Andrews; Barlow-Jameson Fund, Mr. Joseph Wright, of Belfast, and Mr. Storrie, of Cardiff.

The Union of Irish Field Clubs is undertaking a Directory of Irish Naturalists. which will doubtless forward the good work being accomplished by the Union, and be useful to their English colleagues.

We learn from *Nature* that it is proposed to form a society to bring together more closely those who have taken up reptiles as their hobby, and it is hoped that by this means interest may be kept up and mutual help secured by all concerned, Dr. Arthur Stradling has consented to become President. In order that a working basis may be secured at once, those who intend to become members should communicate with the Secretary, Rand Rectory, Wragby, Lincolnshire.

The third International Congress of Psychology will be held at Munich from August 4 to August 7 in this year. The President Elect is Professor Stumpf, of Berlin; the Vice-President is Professor Lipps, who is also chairman of the reception-committee. All persons, whether male or female, who desire to further the progress of psychology are invited. The subscription is 15s., which entitles members to the daily journal and to a copy of the report. All who intend to read papers are requested to send their names and subjects to the Secretary, Dr. Freiherr von Schrenk-Notzing, Max Josephstrasse 2, Munich, before May 15.

A meeting of the Farmers Institute was held at the New Mexico College of Agriculture from January 2 to January 4, when various papers dealing with the practical and scientific aspects of agriculture were read. The chair was taken by Professor S. P. McCrea, Director of the New Mexico Agricultural Experiment Station.

A company has been formed in Paris in order to extend the methods of Pasteur in medicine. Messrs. Duclaux, W. Roux, J. B. Pasteur, and Radot form the executive council. A monument is to be erected at Melun, near Fontainebleau, to commemorate Pasteur's experiments in vaccinating sheep suffering from anthrax, which were first made in that district. It is also proposed to erect a statue of the deceased investigator in some public place in Paris.

According to the *Irish Naturalist*, Professor Sollas, of Dublin, will leave in March for Sydney, to take charge of an expedition that is being despatched to make deep borings in a coral atoll. The scheme, which is supported by a strong scientific committee, has been financed by the Royal Society to the extent of £800; and the Government are placing a gunboat at the disposal of the party, to convey them from Sydney to Funifuti, in the Central Pacific, which has been selected as the scene of operations.

By the kindness of Dr. Henry Woodward we are able to announce the safety of Dr. Forsyth Major and his companion Robert. They were at Antananarivo on December 1. Dr. Major states that the country is somewhat unsettled around Vakinanzaratra, but improvement is rapid. Both have enjoyed good health, and worked in the forest right through the rainy season of last year without harm.

A COPENHAGEN correspondent of the *Daily Chronicle* states that a Danish scientific expedition, which has for its object the exploration of the Pamir district and Kafiristan in Central Asia, will probably leave Copenhagen during the month of March. The expedition will have for its leader Lieutenant Olafsen, and its final equipment will be completed at Samarkand.

AT a meeting of the Royal Scottish Geographical Society held in Edinburgh on December 19, Mr. Borchgrevink lectured on his recent voyage to the Antarctic regions. Dr. John Murray, who occupied the chair, spoke of the interest connected with a scientific expedition to the South Polar Seas, and regretted that Mr. Goschen felt unable to recommend his colleagues to spend money or spare a vessel for such an undertaking while the East was in its present disturbed state. The Royal Geographical Society of London were considering the practicability of sending out an expedition, independently of the Government, at an early date. If the money necessary could not be collected, a party might perhaps be sent out with an expedition that was proposed for killing blue whales. With £5,000 the chairman believed that arrangements might be made to send out twelve men with a commercial expedition, who might be landed on the Antarctic continent and taken off in the following year.

MR. FRANK H. CUSHING, of Washington, is in charge of an expedition to St. Augustine, in Florida, for the purpose of exploring the islands of Florida Keys, and of studying the tumuli recently discovered there. These are characterised by numerous ornaments made from sea-shells.

PROFESSOR DYCHE, who was on the Peary Relief Expedition, has received such offer of support as enables him to project another journey along the west coast of Greenland in the direction of the North Pole.

WE are exceedingly glad to note a new departure by H.M. Stationery Office. This is the reproduction of coloured geological maps by printing instead of by hand as has hitherto been the case. We have received a copy of sheet 12 of the so-called Index Map of the Geological Survey of England and Wales, on the scale of four miles to the inch. It is the first colour-printed map ever issued by our Survey, which we should imagine was alone among Surveys in sticking to the old-fashioned process. This sheet, which includes the country round London, from Ipswich and Bedford on the north to Petersfield and Battle on the south, is sold for 2s. 6d., whereas the same coloured by hand costs 10s. 6d. The appearance of the map is far smoother, and the printing more legible, especially where it underlies the darker shades. To this must be added the advantage of greater accuracy, since hand-colourists are not immaculate. Doubtless the sale of this map will encourage the Stationery Office to proceed with the rest of the series, and even to extend the method to the ordinary one-inch scale maps.

PRINCE ALBERT of Monaco has rendered to the Paris Academy of Sciences an account of the last expedition of his yacht "Princesse Alice," which lasted from June 17 to August 12, and extended from Lisbon to the Azores and back again to Havre. Besides taking many deep soundings and dredgings, the yacht captured numerous animals at the surface by various means, the latter operation resulting in the discovery of many new species of animals of all orders. The most interesting part of the voyage was, however, the death of a sperm-whale on July 18. In its last convulsions the whale threw up a large number of cephalopods of great size and possessing many remarkable characters. One of these was particularly curious owing to the polygonal scales which clothed its upper and under surfaces, and were of a character hitherto unknown. The whale also furnished to the zoologists on board a large number of parasites, and served the photographers as a subject for numerous interesting plates.

CORRESPONDENCE.

Reply to Criticism upon "Notes from the Geological Laboratory" of the Johns Hopkins University.

The criticisms contained in your last number (p. 4) upon the methods of specific description employed in the "Notes from the Geological Laboratory," arise from an entirely erroneous conception of the character of the articles presented. These articles were intended simply as reviews of investigations carried on during the past year at the geological laboratory, and were not intended to give more than an outline of results. The full reports, and, to a large extent the plates also, have been already prepared for final publication and will shortly appear from the press. No pretence was made to give full diagnoses of the forms described, while it was distinctly stated that "The species referred to in the accompanying list have been largely figured, and the plates, together with the fuller descriptions of the forms, will be found in the forthcoming Government report."

Your stricture regarding the multiplication of new species, which is applicable to work in areas where a sufficient number of characteristic forms has been already described, does not fit a case like that of the Eocene of the Middle Atlantic slope, where the fauna is practically unknown, and where the amount of information has been wholly insufficient for stratigraphical purposes. The synonymy of the few species described by previous writers from this area has not been ignored, as an examination of the review will show.

The *Circulars* of the Johns Hopkins University have long afforded the scientific departments the means of bringing forward, in the form of preliminary notices and reviews, the investigations which are being conducted in the laboratories and have never been regarded as a permanent medium of publication.

Johns Hopkins University. William B. Clark.

[We welcome Professor Clark's letter, as it affords additional argument in support of our remarks on "The Preliminary Notice" (*see antea*, p. 73).—Editor, Nat. Sci.]

Reducing Divisions in the Formation of the Polar Bodies.—A Correction.

The review of my "Atlas of Fertilisation," published in Natural Science for December, 1895, contains a misinterpretation of my views regarding the phenomena of maturation that I trust you will allow me to correct. The passage reads:—

"It is clear that the distinction between reducing divisions and ordinary divisions suggested by Professor Weismann cannot be applied to the formation of the polar bodies as interpreted by Professor Wilson" (p. 378).

There is nothing, I think, in the brief account of maturation given at pp. 9, 10 of the Atlas, or in the accompanying figures, to bear out this statement. The ultimate problem of reduction, as Boveri long since pointed out, lies in *the mode of origin of the tetrads*, of which nothing is said in the Atlas, since my purpose was only to give an outline of the broader features of maturation. The work of Häcker and Rückert seems to leave no doubt that in the copepods the origin of the tetrads is such that the division of the dyads during the formation of the second polar body must be interpreted as a "reducing division" in accordance with Weismann's earlier views. This result is diametrically opposed to the conclusions of Boveri, Hertwig, and Brauer in the case of *Ascaris*, and cannot at present be reconciled with them. It was on account of this contradiction that the origin of the tetrads was not critically considered in the Atlas. The account there given, which considers only the later stages of maturation, is consistent with either Brauer's or Rückert's view, and I did not wish to complicate the subject by the introduction of theoretical considerations relating to bivalent chromosomes, reducing divisions, and the like.

Columbia College, EDMUND B. WILSON.
December 9, 1895.

"THE GLACIALISTS' MAGAZINE."

IN the January number of NATURAL SCIENCE references are made to this magazine and myself, upon which I would make the following remarks.

Overwork and ill-health at the close of 1894 and beginning of 1895 brought my work on the magazine into arrear, and when my health broke down completely, last March, a committee was appointed to relieve me of every task that could be deputed. Unfortunately, that committee made a grievous mistake in regard to the distribution of the magazine, and it was not until my return home, after an absence of more than three months, that I learned that, though copies had been sent to the members of the Glacialists' Association in June or early in July, up to and including the first part of vol. iii., none was sent to the publisher. This defect was immediately rectified, and the September part was also sent, which seems to have in some way escaped your notice. [Not at all; see p. 62.—ED., NAT. SCI.]

The *Glacialists' Magazine* is now published quarterly at Lady-day, Midsummer, Michaelmas, and Christmas. The Christmas number was issued on December 31.

Chapel Allerton, PERCY F. KENDALL.
January 13, 1896.

[We have already announced the change in period of publication of this valuable magazine, and we sincerely hope that the easier labours of a quarterly may spare Mr. Kendall's health; but should the influence of erratics again prove too much, it would not take him half an hour to stamp an issue of his magazine with its correct date of publication.—ED., NAT. SCI.]

NORTH SEA FISHERIES.

IN our review of Mr. Holt's "Examination of the Present State of the Grimsby Trawl Fishery" (vol. viii., p. 52), we correctly quoted the price as 3s. 6d. We are, however, glad to learn from the Director of the Marine Biological Laboratory at Plymouth that reprints of this paper can now be had at 1s. each, either from Messrs. Dulau & Co. or from himself.

A CARD CATALOGUE TO ZOOLOGICAL LITERATURE.

DR. H. H. FIELD writes to us that this scheme is now in full operation, and states that "after February 15, the number of copies printed will be reduced so as to be but slightly in excess of the subscription list. Persons ordering much after that date run the risk of finding a part of the catalogue already out of print." Further information may be obtained from the Bibliographical Bureau, Universitätsstr. 8, Zurich-Oberstrass, Switzerland.

NOTICE.

TO CONTRIBUTORS.—*All communications to be addressed to the* EDITOR *of* NATURAL SCIENCE, *at* 22, ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

TO THE TRADE.—NATURAL SCIENCE *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

THE "CHALLENGER" NUMBER.—*In reply to enquiries, we remind our readers that, although the* FIRST *edition of this ran out of print immediately, there are still some copies of the* SECOND *edition to be obtained at the usual price*—ONE SHILLING. *No more will now be printed, so orders should be sent at once.*

NATURAL SCIENCE:

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NOTES AND COMMENTS.

The University for London.

SLOWLY, slowly, but still sensibly, the lumbering movement for the institution of a real University for London proceeds. All the great bodies that are interested, even the existing London University, have now intimated their acceptance of the broad principles involved in the scheme of the most recent Commission. The agitation in favour of the existing condition of things is now confined to a flickering, though sometimes brilliant, series of attacks by interested irreconcilables. So long as the great corporations differed on questions of principle, not of detail, action could not be expected from a Government which has to face trouble in all parts of the world, and which has burdened its shoulders with a question of elementary education that will raise the keenest conflict of opinion and prejudice. Now, fearing no one that matters, the Cabinet may place London in a position that is equal, say, to that of St. Andrews or of Jena.

It has been pointed out, by some who are timid and by others who are designing, that the Commission did not arrange that an adult University, equipped with every provision for research and graced by the historic dignity of Oxford and Cambridge, should be born of their labours. It should be unnecessary to say that such a prodigy is to be expected from no Commission. What we want, and what can be given us, is unity in place of distraction, a real University in the place of an examining board. When we have got that, time will add all other things to us. In the present University there is nothing to attract the pious founder and the living benefactor. We believe that the rich men of England are as ready to assist the highest purposes of a University as are the rich men of Australia and America. But there must be a body-corporate, representing by its teachers and professors the best workers in all branches of knowledge, attracting as its students—graduate and undergraduate—the most promising of the youth of our empire.

PROFESSOR MARSHALL WARD ON "MODERN BOTANY."

IN the first lecture of his course on "Some Aspects of Modern Botany" (Royal Institution, February 13), Professor Marshall Ward mentioned that mediæval botany consisted in the collection of native plants, and the attempted identification of these with medicinal and economic plants, described by the ancients, or known from distant countries. Difficulties in identification led to discovery of the fact that different countries had different plants, and thus was laid the foundation of the science of geographical distribution. The careful study of large numbers of specimens led to the evolution of the idea of natural affinities. Efforts at classification were at first vague; men had to learn what parts were comparable. For a time they were like children, distinguishing an oak from a buttercup by the acorn and the flower. Their belief in the existence of sharp lines, which could be brought out if plants were repeatedly and elaborately described, contrasted somewhat with the exaggerated importance which is to-day ascribed to points of resemblance as opposed to points of difference.

Systematists have not yet reached the end of all things. The broader divisions of plant classification may be settled; it may be possible for an expert to indicate, almost at a glance, the exact position of a new species; but the work will not be complete till the list includes all existing and fossil species from all parts of the world. Then the ultimate aim may be achieved, namely, the construction of a genealogical tree showing the true affinities of all known plants. The lecturer went on to emphasise the value of a good Flora, instancing the "Flora of British India," "which, we are all so glad to know, is now nearly complete." It is not merely a list of the plants growing in a certain country, but it tells much about character and localities, range in altitude and distribution in other parts of the world.

The remainder of the lecture was occupied by discussion of some questions of variation and adaptation. First, Professor Ward remarked as to the "purpose" of a hairy covering, of which the Alpine edelweiss supplied an illustration. Consideration showed that this was a concomitant, not of cold, but of dry situations, and was one of several means adopted by the plant for lessening the loss of water by transpiration. The danger of using such adaptive characters for systematic purposes was effectively illustrated by a slide showing a Mexican *Echidnopsis*, a member of the Cactus family, and an African *Euphorbia*, two fleshy-stemmed plants which could scarcely be distinguished except by careful examination. The red colour often assumed by parts of plants other than flowers, especially young leaves, afforded an instance of the danger of pushing an explanation too far. In many instances it doubtless served to absorb some of the sunlight and so protect the chlorophyll of young organs, but such a case as the red colour in the lower layers of the floating leaf of a water-lily demanded some other explanation. It had been suggested that the light absorbed by the colouring matter might be converted into heat, and that the slight rise of temperature thus effected might perhaps be of importance to the leaf. The genus *Senecio*, of world-wide distribution, and varying from a small herb, like our wayside groundsel, to the tree-like forms occurring on the several mountains of tropical Africa, formed a good subject for the study of the adaptive variations occurring among plants that were shown by the structure of the flowers to be closely allied. Examination of the Indian Senecios threw some light on the meaning of the hairy covering. Of the forty-two species which might be classed as Himalayan, the great majority were glabrous, while those found in the drier climate of the western side of the peninsula were hairy, or showed some form of structure generally associated with dry-growing plants.

The lecturer finished by expressing a strong opinion on the great value of descriptive botany for teaching purposes, and contrasting the present position of students with that in which "the greatest of our living systematic botanists" found himself in his own college days.

The Fertilisation of an Australian Wild-Flower.

In his presidential address to the Philosophical Institute of Canterbury, New Zealand, Professor Dendy, speaking of "Fertilisation of Flowers," refers to a common Australian wild-flower which is somewhat remarkable in this respect. *Stylidium* is the largest genus of a small family, almost exclusively Australian, to which it gives the name Stylidieæ. The species referred to is evidently *Stylidium graminifolium*. The flowers are rather small and are borne on a stem which springs from the midst of a tuft of grass-like leaves. Of the five petals, four spread out in the form of a cross round the tube in which the honey is secreted, while the fifth forms a small lip upon which rests the slender column formed by the union of the stamens and styles, and bearing at the end the anthers and stigma. Near the tip, the column is bent upwards at a sharp angle. The anthers shed their pollen before the stigma is fully developed, the flower thus guarding against self-fertilisation. The bent portion near the tip of the column is sensitive and is the part first touched by an insect, which, visiting the flower in search of honey, pokes its proboscis down the tube. No sooner is this spot touched than the column, which, owing to a sharp bend at its base, is hanging out at one side of the flower, springs over to the other side and brings the anther or stigma down on the back of the insect, thereby attaching pollen to it, or removing some which has been brought from another flower. When the insect has departed, the column resumes its original position and awaits the next visitor, but when the flower has been fertilised it soon loses its power of movement.

This description recalls what may be seen in this country in the common sage, where a similar result is attained by a different mechanical contrivance. As many of our readers will remember, half of each of the two anthers is barren and forms the short arm of a lever, the other half being borne at the end of the longer arm. In its search for honey the insect butts against the short arm, thereby bringing the long arm down on its back, and carrying off some of the pollen.

The Teaching of Marine Biology.

The greater facilities which have recently been offered to students of biology by the Plymouth Laboratory of the Marine Biological Association, have met with such success that it is proposed to hold a vacation course in marine biology during the Easter vacation, in other words, between March 23 and April 24. The course, which will be conducted by Mr. Walter Garstang, who was formerly a naturalist to the association, will be supplementary to the ordinary laboratory courses of our teaching institutions. Students will be given all the requisite facilities, will be allowed to make collecting excursions on the shore and from the laboratory boats, will have all their material and reagents supplied them, and will have the advantage of daily demonstrations and constant assistance from a practised marine naturalist. The director of the laboratory is fitting up a special room for this purpose, and we are informed that a fair number of students have already intimated their intention of joining. This is hardly to be wondered at, since the fee is not more than that at which a table at this laboratory is let for the purpose of research only, namely, £5 per month. It should be pointed out that this vacation course, which it is hoped will attract numerous students from our universities, is purely voluntary and carried on by private effort. We venture to repeat the hope which we have more than once expressed, namely, that the great universities of our country may come to understand that such a course should be an essential element in the education of every student of zoology, and that they will without much delay institute a similar vacation course upon their own account, and insist on its being attended by all who apply to them for a degree in that subject.

The Association of Species.

The ninth *Annual Report* of the Liverpool Marine Biological Committee, drawn up by Professor W. A. Herdman, has just been sent to us. As is usual with these reports, it is full of a large number of interesting observations. One of the subjects to which the Committee has recently paid special attention is the association of numbers of individuals of different species and genera occurring at various localities on the sea-floor. Several complete lists of different hauls are published, and from them various conclusions are deduced.

In the first place, it is clear that, whether it be a question of mere *mass* of life or of *variety* of life, haul for haul, the shallow waters hold their own against the deep sea, and form, in all probability, the most prolific zone of life on this globe. From the lists which are given it is seen that the species included in each haul belong in each case to a relatively large number of genera. Thus, in one case, the 112 species found were referred to 103 genera, while in a smaller haul thirty-nine species belonged to thirty-four genera, and so on. "These figures," says Professor Herdman, "are particularly interesting in their bearing on the Darwinian principle, that an animal's most potent enemies are its own close allies. Is it then the case, as the above-cited instances suggest, that the species of a genus rarely live together; that if in a haul you get half-a-dozen species of lamellibranchs, amphipods, or annelids, they will probably belong to as many genera, and if these genera contain other British species these will probably occur in some other locality, perhaps on a different bottom, or at a greater depth? It is obviously necessary to count the total number of genera and species of the groups in the local fauna, as known, and compare these with the numbers obtained in particular hauls. That has been done to some extent with the 'Fauna' of Liverpool Bay." The conclusion thus obtained is that a disproportionately large number is represented by the assemblage of species at any one spot, which means that closely-allied species are, as a rule, not found in association: birds of a feather do *not* flock together. Is it not, however, possible that this fact is a necessary consequence of association or absence of isolation? Allied species of Invertebrata would, if in association, tend to merge into one species through inter-crossing. There are, of course, a few cases of allied species occurring together. Sometimes this may be due to some special habit which, although the species are allied forms, prevents them from being severe competitors. Even sessile animals, such as hydroids and bryozoans, appear to be subject to the same rule, although Professor Herdman suggests that this may act to a less extent in their cases.

In connection with this subject, it would be very interesting if palæontologists would enquire whether the assemblages of fossils found in various deposits, such, for example, as the well-known slabs of the Wenlock Limestone, showed a similar admixture of genera. It is certainly a curious fact that the beautiful slabs from the Wenlock Limestone of Dudley, containing fossil crinoids, which are now exhibited in the Geological Department at the British Museum, contain almost as many genera as species. One slab, for instance, little larger than a man's hand, contains portions of eight crinoid individuals, belonging to eight species and seven genera. Another small slab from the Kinderhook beds of Iowa contains nine individuals, distributed among six species and four genera. This is very different to the crinoid slabs of Secondary age exhibited in the museum galleries, for in their case there is rarely more than one species of crinoid contained on a single slab. We may infer from this, and from the facts of the distribution of the crinoids of the present day, that the later crinoids were more apt to live together in large assemblages of a single species than were the earlier. The results which this habit has had on their evolution are well-known; one result, for instance, was the extreme length of stem attained by certain species of Liassic *Extracrinus*.

Modern Shallow-water Deposits.

We have previously alluded to the efforts of the Liverpool Marine Biological Committee in investigating the deposits now being formed on the floor of the Irish Sea (vol. vii., p. 229). Further details are given in the *Report* to which we have just referred. We here meet again with Professor Herdman's criticism of Dr. Murray's classification of submarine deposits into terrigenous and pelagic, terms which were fully explained in Natural Science (vol. vii., p. 22 and p. 395; 1895). "In our dredgings in the Irish Sea," says the *Report*, "where the deposits ought all, from their position, to be purely terrigenous, we meet with several distinct varieties of sea-bottom which are not formed mostly from the waste of the land, and do not contain anything like 68 per cent. of silica, but, on the contrary, are formed very largely of the remains of bottom-haunting plants and animals, and may contain as little as 17 per cent. of silica. Such are the nullipore bottoms, and the shell-sand and shell-gravel met with in some places, and the sand formed of comminuted spines and plates of echinoids which we have found off the Calf Island. These deposits are really much more nearly allied in their nature, and in respect of the kind of rock which they would probably form if consolidated, to the calcareous oozes among pelagic deposits, than they are to terrigenous deposits, and yet they are formed on a continental area close to land in shallow water. Moreover, although agreeing with the pelagic deposits in being largely organic in origin, they differ in being derived not from surface organisms, but from plants (the nullipores) and animals which lived on the bottom." Professor Herdman considers, therefore, that the terrigenous group of Murray is an unnatural assemblage, containing many deposits which have very little to do with the waste land. This leads him to propose the following classification:—

1. *Terrigenous* (Murray's term, restricted).—Where the deposit is formed chiefly (say, at least two-thirds, 66 per cent.) of mineral particles derived from the waste of the land.
2. *Neritic.*—Where the deposit is largely of organic origin, its calcareous matter being derived from the shells and other hard parts of the animals and plants living on the bottom.
3. *Planktonic* (Murray's pelagic).—Where the greater part of the deposit is formed of the remains of free-swimming animals and plants which lived in the sea above the deposit.

Another feature of this investigation is, as we have formerly insisted, the important aid it lends to geologists. Some remarks by Mr. Clement Reid, which are here published, are sufficient evidence of this. "One is again struck," says Mr. Reid, "by the common occurrence of loose angular stones at places and depths apparently well beyond the reach of any bottom drift—at least beyond the reach of currents likely to move such coarse material. This stony sea-bed is in all probability the result of submarine erosion of glacial deposits. Its occurrence renders comparison between recent marine deposits of these latitudes and Tertiary deposits a task of peculiar difficulty; for not only is the nature of the true marine sediments masked, but the fauna also must be greatly altered. It is evident that numerous species which need a firm base on which to affix themselves will be encouraged by a stony bottom; while in a Tertiary deposit, formed under identical conditions, except for the absence of stones, they may be entirely missing, having nothing but dead shells to which to attach themselves. Notwithstanding this peculiarity of most of the dredgings, a few samples may well be compared with our Older Pliocene (Coralline Crag). I would particularly draw attention to certain localities where material almost entirely of organic origin has been obtained. Of these perhaps the most interesting are some samples full of *Cellaria fistulosa* (found to the south-east of the Calf Sound, twenty fathoms). They are in many respects strikingly like certain parts of the Coralline Crag."

THE ATTACHMENT OF LARVÆ.

ANOTHER line of investigation started by the Liverpool Committee during 1895, is inquiry into the times and modes of attachment of the larvæ of various species, and also as to the most suitable substances for particular kinds of larvæ to settle down upon. This has been carried out by sinking in various parts of the bay an apparatus composed of a rope weighted at one end and buoyed at the other, and having a number of slips of glass, slate, wood, etc., attached at equal distances along its length. These ropes are hauled up and examined periodically. "So far, glass seemed in the early spring (February and March) to be the favourite substance. A surprisingly large number of algæ, compared with the animals, appeared, and nearly all were on the glass slips. Later on, in the summer, barnacles (*Balanus*) made their appearance in great numbers on the slips of wood and on the wooden buoy at the top of the apparatus, while all the upper part of the rope within a few feet of the surface became covered with algæ. A number of ascidians (*Ascidiella virginea*) were also found, in August, to have attached themselves to the rope, and seemed to have got as far as possible in between the strands and into the coils of the knots. On the upper pieces of slate, and, in one instance, on a piece of glass, there were young specimens of the tubicolous Annelid, *Pomatoceros triqueter*, in no case more than a $\frac{1}{2}$ to

$\frac{3}{4}$ inch in length." This inquiry is, of course, not without its practical bearings, and is sure, ultimately, to prove of value to those who desire a more scientific cultivation of the harvest of the sea.

Fish-Culture.

The importance of that scientific intervention with nature in connection with the increase of our marine food-supply, to which we have just alluded, was well brought out by Mr. J. J. Armistead in his recent discourse at the Royal Institution. It was the opinion of Frank Buckland that, in nature, not one egg per thousand produced a mature fish. By fish-culture, on the contrary, 95 per cent. of the eggs laid down are hatched, while of these one-half can, under favourable conditions, be brought to maturity. Roughly speaking, the yield is increased five-hundred-fold. The methods employed must in the first place simulate nature, as, for instance, when the boxes containing pelagic ova are moved up and down so as to produce the effect of wave-motion. Secondly, they must enhance all the favourable conditions, such as the supply of oxygen, the absence of light, the furnishing of sufficiently small and nourishing food; fish get indigestion from artificial foods, and it is to be noted that they travel better on an empty stomach. Thirdly, it is necessary to counteract the numerous adverse influences that are so common in a state of nature, and this applies, not merely to the artificial rearing of fish, but to their preservation generally. No less than thirty diseases are known and diagnosed, and for many of them cures have been found. Accidents of deficiency of water or food in running streams should be guarded against with the help of dams and reservoirs. At the present time our salmon are much neglected in this respect. Whether from lack of food, irregularity of water-supply, differences of specific gravity or temperature, the herring deserted the Firth of Forth some forty years ago and have not yet come back.

The great advance made in this subject during the last thirty years, and the success that meets the attention paid to it by the Governments of Germany and the United States, suggest that we have here a source of national wealth that might well receive more direct care from our own Government.

Preservation of Marine Mollusca.

Those who were interested in Mr. Hornell's paper on Formalin (Nat. Sci., vol. vii., p. 416), may like to learn that this fluid has been tried for the preservation of *Aplysia* and *Pleurobranchus*. In both cases, however, a considerable amount of colouring matter was dissolved out of the integument. Dr. J. D. F. Gilchrist, who contributes this observation to Professor Herdman's *Report*, also records a method of killing *Aplysia* in an expanded condition, which he says is the only one that can be depended upon with certainty. "A few drops of a 5 per cent. solution of cocain were mixed with the water in which the Aplysias were. After a time they expanded fully. They were then left in the solution (twelve hours or more) till no contraction took place when removed and put into weak alcohol. If contraction took place, they would be put back into the cocain solution when they again expanded. This was repeated till no contraction took place, when they could, after a time, be put into stronger alcohol."

The Hinge of Bivalve Shells.

The development and morphology of the hinge in bivalve Mollusca is a subject that needs much further elucidation, since it is sure to lead to a better understanding of the inter-relationships of the various members of the class Pelecypoda, and so possibly to a more satisfactory system of classification. A first step in this direction has been taken by Dr. Felix Bernard, of whose valuable work a first instalment appears in the *Bulletin de la Société Géologique de France* (3[e] ser., tom. xxiii., pp. 104–154). We hope to be able to lay before our readers a full account of Dr. Bernard's researches at some later period when the rest of his paper shall see the light. Meantime, one or two of his results are worthy of special attention. He passes over the embryonic or prodissoconch stage, and taking up his researches from that point, finds, so far as he has gone, that there are two typical forms of embryonic shell. In the second place, he finds that the ligament always arises *internally* in a triangular pit that slants obliquely backwards. Hitherto it has generally been believed that the external ligament was the phylogenetic predecessor. The growth of the ligament affects the curvature of the umbones. He proposes a new notation for the teeth, using odd numbers for those in the right valve and even numbers for those in the left. Dr. Bernard then describes the development of the hinge as shown in a series of stages from the young to the adult individual, and illustrates them with simple but excellent figures. Any conclusions at which he may have arrived concerning the possible connections between the different forms of hinge are reserved for his further communication, when other genera shall have been studied.

Concerning Snails.

Under Mr. Pilsbry's fostering care, the Pulmonata are being brought into better order than they have been for many a long day. He has just (*Nautilus*, February, 1896) established two new "super-families," or, as we should say, sub-orders. The one, Aulacopoda, is to include the Zonitidæ, Limacidæ, Endodontidæ, Arionidæ, and Philomycidæ, the characteristic of the group being the presence of grooves that run one on each side the whole length of the foot, a short distance above and parallel to its edges. These *pedal grooves* rise slightly at the tail and meet above it, the point of their junction being often marked by a local deepening of the groove, the "caudal mucous pore." This last has frequently been used as an important factor in classification, whereas it is merely an occasional extra development.

The Aulacopoda will thus form a group equivalent to the Agnatha (so-called, including the Selenitidæ), or to the group composed of the Helicidæ, Bulimulidæ, Cylindrelidæ, Pupidæ, and Achatinidæ, for which last Pilsbry proposes the name HOLOPODA.

THE NEW PHOTOGRAPHY.

So much has appeared already in the daily and weekly Press that we have little more to do than to call attention to the specimen of the new photography which, by the kindness of Mr. Campbell

PHOTOGRAPH OF THE SKELETON OF A LIVING FROG.
(Taken by A. A. Campbell Swinton, and reproduced from *The New Light*, published for *The Photogram*, by Dawbarn & Ward).

Swinton and the editors of the *Photogram*, we are able to reproduce in these columns. The exact nature of the rays which Professor Roentgen has discovered to be capable of passing through substances that are opaque to ordinary light is still far from certain. It seems as yet to be more probable that they are undulations of some kind, and not, as has been cleverly suggested, a material emanation of small particles. At present, the great difficulty in employing the new process is the absence of a means of focussing the rays. The actual photographs are no more than the shadows thrown by the substances which are opaque to the rays. To secure clearness of outline, it is therefore necessary that the photographic plate should be very close to the object from which shadows are desired. For instance, it would be very desirable to obtain magnified shadow-pictures of the small bones in the wrist and ancle of many animals, before these had been disturbed by disarticulation. But lenses of all substances that have been employed fail to focus the rays. As usual with a new discovery, the newspapers swallow with avidity a number of extraordinary suggestions and additional applications. It is telegraphed from Rome that one Professor Salvioni, of Perugia, has invented an instrument, the application of which to the eye "enables the vision by means of the Roentgen rays to penetrate opaque bodies. The retina of the eye is impressed by means of this 'cryptoscope' exactly in the same way as a photographic plate." Of course the newspapers may be maligning Professor Salvioni, but it is needless to say that, as the photographs taken by the new method are the result of transmitted—not reflected—light, it would be a wonderful instrument indeed that enabled the eye to penetrate opaque bodies. Professor Edison, too, is well to the fore. Apparently he has abandoned his designs for destroying the British navy by electrified water, and is now turning his attention to photographing the living brain by means of the new rays. In this invention he will have to produce a newer kind of ray. For the living human brain is enclosed in a bony box, and Professor Roentgen's rays have achieved their celebrity by failing to penetrate bone. But the suggestion we like best is that of a French lady, writing to a French journal. She has realised that the new rays penetrate clothing, and she proposes that women should combine against the immorality of modern photography.

Danish and German Science.

We have had on our table for some time three publications with titles that are somewhat formidable to English readers. These are: (1) Forelöbig Meddelelse om Spiraclerne hos Insecterne i Almindelighed og hos Scarabæerne i Særdeleshed m. m. til Paaviisning af hvad dermed tilstrækkelig Dristighed kan udgives for Naturvidenskab. En literair og zoologisk Undersögelse ved William Sörensen, Kjöbenhavn i Juli 1895. (2) I Anledning af Dr. W. Sörensens "Forelöbig Meddelelse om Spiraclerne hos Insecterne" o.s.v. Af J. E. V. Boas, Köbenhavn, 1895. (3) Germanisering af Dansk Videnskab. Ved Dr. H. J. Hansen, Kjöbenhavn, 1895.

These three essays contain the attack, reply, and rejoinder in a sharp personal controversy. The names of the authors are a guarantee that the reader will neither find the subject-matter unimportant nor the handling of it trivial. We do not propose here to enter into the merits of the principal question. They need to be studied in detail. We shall only make reference to one or two of the incidental discussions which seem especially worthy of attention. The division of the Decapod Crustacea by Dr. Boas into two suborders, the Natantia and the Reptantia, is subjected to a searching analysis by Dr. Hansen, with the result, as it seems, that the proposed division must be regarded as thoroughly untenable. But that against which Dr. Hansen fights most strenuously is, not any particular error or any individual author, but, as the title of his essay implies, against a modern tendency to "germanise" Danish science. While owning the services to science rendered by Germany through her numerous men of genius, he considers that Denmark has a scientific character and spirit of her own distinct from that of Germany. The larger country delights in hypothesis and theory, the smaller in thoroughgoing accuracy of investigation. He rightly considers that it would be a loss to the world to have that national characteristic overborne by the predominating influence of Denmark's powerful neighbour. He views with alarm the introduction of German books of education, German modes of thought, the ambition of the rising generation to study in Germany, to write in German, to win acceptance and commendation in German periodicals. To counteract all this, he is extremely desirous that in the scientific journals of his own country, as an alternative to the vernacular or Latin, the accepted language should be neither German nor French, but only and exclusively English. He urges that English ought to be thoroughly taught in Danish schools, that though not in words, yet in construction, it is far nearer to Danish than is the German language, and that both in England and the English tongue Danish science would find a genial welcome that could not be fraught with any mischievous consequences.

THE GIANT BIRDS.

THE difficulties that beset the study of fossil vertebrates are nowhere better illustrated than in the case of the Dinornithidæ. The remains of these extinct birds have been found in immense numbers, scattered in the superficial deposits of New Zealand. Only in rare instances is it possible to say that any two bones belonged to the same individual, while the number of even moderately complete skeletons is exceedingly small. As names have been founded upon single bones, the greatest confusion has arisen in the nomenclature of the family, owing to there being no means of correlating these bones with one another or with the rest of the skeleton. The difficulties have been further increased by the great individual variation to which these birds were subject, and also by the reconstruction of skeletons from odd bones which may belong to several species.

Several attempts have been made to evolve order out of this chaos, and perhaps the most successful is that of Mr. Lydekker in the British Museum Catalogue of Fossil Birds. The only way, however, of finally clearing the matter, will be to take some characteristic portion of the skeleton as the standard of reference, even at the risk of displacing some older names that have been applied to other parts. An important advance in this direction is made in a valuable paper by Professor Jeffery Parker "On the Cranial Osteology, Classification, and Phylogeny of the Dinornithidæ" (*Trans. Zool. Soc. London*, vol. xiii., part 2; 1895). In this, detailed descriptions are given of the various types of dinornithine skulls, and an attempt is made to determine the number of genera and species into which the family may be divided, taking this portion of the skeleton as the criterion. The results obtained agree in the main with those of Mr. Lydekker, the only important difference being that some of the species referred by him to *Anomalopteryx* are placed under the genus *Mesopteryx* of Hutton. It would be a great advantage if this nomenclature could be adopted, for this is one of the instances in which a pedantic application of the law of strict priority would only make confusion worse confounded.

In the last part of his paper the author enters into a very interesting discussion on the relations of the genera to one another, and of the Dinornithidæ as a whole to the other Ratite birds, in so far as those relations can be determined from the structure of the skull. He considers *Mesopteryx*, with its lightly-built skull and slender beak, the least specialised form; while he suggests that *Dinornis* and *Emeus* are the most highly modified, the former having probably arisen from the primitive stock independently of the other genera, while the latter is derived from the ancestor of *Mesopteryx*. As to the relations of the family to other Ratites, he considers that its nearest ally is *Apteryx*, and that they are both connected with the primitive stock which also gave rise to the Australian Ratites, the emu and the cassowary. The ostrich and rhea are regarded as having arisen independently from the "Proto-carinatæ." This view harmonises with what might be expected from the geographical distribution of the Ratitæ, and is further supported by many structural differences other than those found in the skull.

The Kea.

In our number for November, 1895, vol. vii., p. 304, we quoted from the *Zoologist* some remarks by Mr. Taylor White anent the Kea of New Zealand. The *Otago Daily Times* for December 14 has criticised both the facts and opinions of Mr. White somewhat severely, and since its editorial note on the subject appears to be written by one speaking with authority and not as the scribes of the daily Press, we think it advisable to show our readers what the New Zealanders themselves think of Mr. White's views. "His facts," says the *Daily Times*, "appear to be the more interesting features. We have Mark Twain's authority for the statement that there is nothing quite so humorous as facts, and here we have something to support the assertion. We observe *imprimis* that Mr. White does not live in the kea country, but probably 400 miles from it. He quitted the desolate mountains of the South Island many years ago. To judge by the extract before us, the original food of the kea was not berries, but 'lichens on stones,' that it took to tearing these off, and then, mistaking a dead sheep for a lichen on a stone, tasted that and found it beaksome. It lived on the mountains far above the region of berries. Now, there is a well-known idea among shepherds that the strange habit of the kea did arise somewhat in this way, but not from a taste for lichens. There is, in the alpine regions of the South Island, a plant popularly called the 'vegetable sheep,' botanically named *Raoulia*. From the distance of even a few yards it looks like a sheep. It grows in great masses, and consists of a woolly vegetation. A large specimen of this singular plant was exhibited in the Colonial and Indian Exhibition.[1] It is said that the kea was in the habit of tearing it up to get at the grubs which harbour within the mass, and that mistaking dead sheep for vegetable sheep it learned the taste of mutton. A more enterprising generation preferred its mutton rather fresher. Lichens do not come in here. As for the kea living above the region of trees, that is simple nonsense. It is an alpine bird which descends to comparatively low levels at times. It is well known in the region of shrubs about the Mount Cook Hermitage. It is said not to have learned to attack sheep in that district yet—unless during the last few years. We have it on the best authority that when specimens are shot their mouths contain seeds and berries, and we see no reason to doubt that these were once their regular food. The forest level in this province is up to, say, 3,000 feet, but shrubs bearing berries are found much higher, and in Canterbury higher still."

DR. CHARLES JANET ON THE HORNET.

WE have received a number of Dr. Janet's interesting studies on wasps, hornets, and their allies. In one of these, a note on *Vespa crabro* (*Mem. Soc. Zool. de France*, 1895), he gives a detailed account of the construction of the hornet's nest, with many notes on the habits of the insect. It seems that hornets do great damage to trees by nibbling the young shoots, so as to get their juices. Dr. Janet gives an ingenious explanation of the peculiar folding of hornets' anterior wings. The hind margin of the fore-wing, he says, becomes engaged in the front margin of the hind-wing, and is compelled to fold longitudinally, since otherwise it would force the hind-wing over the dorsal surface of the abdomen, as, indeed, occasionally happens in young individuals. If the wings came to lie dorsal to the abdomen, they would become frayed and torn in the narrow passages of the

[1] And may now be seen at the Natural History Museum.—Ed. NAT. SCI.

nest. The dorsal surface of the abdomen itself not infrequently shows signs of rubbing. We doubt, however, if this explanation is of universal application, for in solitary wasps the fore-wing is similarly folded, although these build, not nests, but mud-cells, in which there is plenty of room to turn about.

The Archæology of Yucatan.

The arid peninsula which lies between the Gulf of Honduras and the Gulf of Mexico has recently afforded a rich harvest to the archæologist. The numerous ruined cities of the Mayas have been described, first, in *Globus* for October last, by Theobert Maler, and, secondly, in an essay by Professor W. H. Holmes, of the Columbian Museum, Chicago. A map of Yucatan and Tabasco appears in the atlas to A. P. Maudslay's fifth contribution to the "Biologia Centrali-Americana," together with numerous views of buildings and architectural details. More within our scope, however, is the well-illustrated volume on the Hill-Caves of Yucatan recently published for Henry C. Mercer by Lippincott & Co., of Philadelphia. This records a praiseworthy attempt to establish the relative antiquity of man in Yucatan by means of a systematic investigation of the caverns in the Sierra. The exploration was originally suggested by Professor Heilprin, who had noticed the existence of a series of caves hitherto undescribed, containing aboriginal carvings on their walls and showing signs of human habitation. The expedition was financed by John White Corwith, of Chicago, and its members spent two months of last year in the country, mostly underground, visiting twenty-nine caves. All these occurred within an area of 100 miles in length by ten in breadth. Ten caves were excavated, of which six yielded valuable, and three decisive, results, chiefly of a negative character. "We had found no copper, gold, or silver, no jade, no gums, no preserved grains, no apparatus for weaving, and had discovered no pipe and learned nothing of pre-Columbian smoking or tobacco." The animal remains found belonged either to recent or late Pleistocene species, and were determined by Professor Cope. None were extinct. The shells examined by Mr. Pilsbry yielded like results. "Pottery grew rarer, or disappeared altogether towards the bottom of the ash films, yet there was no evolution in the ware. We found no Palæolithic man, no *Homo neanderthalensis*, no *Pithecanthropus erectus*, but a builder of cities inferably the superior of most North American tribes when he appeared upon the scene." The primitive immigrants must have visited the hill-caves for water; they were but temporarily occupied by a race of agriculturists rather than hunters. Some practised cannibalism, possibly a ritual form. Split human marrow-bones were found at Coyok, Loltun, and Actun Sabaka.

All the evidence obtained from a series of trench-diggings down to bedrock in various caves, revealing ashes, bones, and potsherds, was purely of a negative character, and led Mr. Mercer to conclude, like that prince among pioneers, Stephens, "that no earlier inhabitant had preceded the builders of the ruined cities of Yucatan. That the people revealed in the caves had reached the country in geologically recent times. That these people, substantially the ancestors of the present Maya Indians, had not developed their culture in Yucatan, but had brought it with them from somewhere else."

Therefore, despite the energy of Mr. Mercer and his colleagues, this straightforward and detailed account of their investigations leaves unanswered the burning question of American archæology: Whence came the Aztecs and Mayas?

The Bohemian Museum.

We have very great pleasure in publishing in this number the interesting description, with which Professor Anton Fritsch has favoured us, of the arrangement that has been introduced in the New Museum of Natural History at Prague. We, who have always been advocates of the intelligent method of museum exposition, are especially pleased to see that the important and classical collections contained in this museum have been arranged on such a truly scientific plan. All who have engaged themselves in practical museum-work know well enough how difficult it is to combine the two very different aims of general instruction on the one hand, and the illustration of the natural history of a limited district on the other. In a metropolitan museum, such as that at Prague, it is, of course, necessary to pay considerable attention to the large general public that supports the museum. But when we consider the extreme scientific interest of the collections, notably those that illustrate the great "Système silurien" of Barrande, we must admit that a far larger number of specimens ought to be exhibited than such a one as, say, Sir Henry Howorth would consider absolutely necessary. But, by the juxtaposition of drawings and references to literature along with the specimens, as represented in Fig. 1 (p. 169), the systematic collections themselves subserve the purpose of more general instruction. Those who have recently visited the Bohemian Museum can substantiate the claim of Dr. Fritsch that the problems to which we have alluded are adequately solved.

I.

Professor Huxley: from the Point of View of a Disciple.

AMONG the various estimates of Mr. Huxley's life and work that will have appeared before the present article can possibly see the light, I venture to hope that there is still room for a brief account of him as he appears to a disciple. For the pupil and assistant of a great teacher has, within a certain limited field, the best possible opportunities of judging of his master's work and character, especially when, as in the present instance, a considerable lapse of time has served to furnish something like the due perspective.

To the general public who think of Huxley chiefly as a merciless iconoclast, a keen controversialist, an incomparable popular exponent of science, the fact that he contributed certain papers to learned societies, wrote such and such text-books, and for thirty years lectured on the elements of Biology to a handful of students at the Royal School of Mines, are matters of little interest or moment. Nevertheless, it is obviously upon his technical and non-popular writings and upon the character of his teaching that his reputation as a man of science must stand or fall.

Judged by his original contributions to science, there can be no doubt that Huxley's performance falls far short of his capabilities, and that there is hardly a man of first-class ability among his contemporaries who has not produced more. Leuckart, Koelliker, Haeckel, Gegenbaur, are the names one naturally connects with his, and it must be frankly conceded that there is not one among them who has not left a deeper mark upon Zoology than he, or whose works are not more frequently referred to by the professional zoologist. Three of his researches may fairly be called classical: that on the Hydrozoa, in which he propounded the wide-reaching generalisation that the ectoderm and endoderm of polypes and sea-anemones correspond with the two primary germ-layers in the embryos of the higher animals; that on the fossil Ganoids; and that on the morphology of the vertebrate skull, in which he demolished the fanciful "vertebral theory," which, however fruitful in its first conception, had become a positive hindrance to the progress of philosophical anatomy. Of less magnitude are his papers on the classification of birds, on the crayfishes, on the anatomy of the Australian mud-fish, and on the Canidæ, while the rest of his strictly original contributions to zoology are, for a man of his intellectual calibre, hardly more than opuscula.

But what opuscula! There is not one of them but contains some brilliant generalisation, some new and fruitful way of looking at the facts of the science. The keenest morphological insight and inductive power are everywhere apparent; but the imagination is always kept well in hand, and there are none of those airy speculations—a liberal pound of theory to a bare ounce of fact—by which so many reputations have been made. As examples of scientific method, his papers are always valuable, and none more so than the Croonian Lecture on the theory of the vertebrate skull. I admit that vertebrate morphology has advanced so much since 1858 that it requires almost an antiquarian taste to go back so far, but the modest little pamphlet is still capable of furnishing some excellent lessons even to the youngest and most infallible of modern morphologists.

Looking at the matter from rather a narrow and professional standpoint, I am inclined to think that modern biology owes a larger debt to Huxley the teacher than to Huxley the investigator. His lectures were like his writings, luminously clear, without the faintest disposition to descend to the level of his audience; eloquent, but with no trace of the empty rhetoric which so often does duty for that quality; full of a high seriousness, but with no suspicion of pedantry; lightened by occasional epigrams or flashes of caustic humour, but with none of the small jocularity in which it is such a temptation to a lecturer to indulge. As one listened to him one felt that comparative anatomy was indeed worthy of the devotion of a life, and that to solve a morphological problem was as fine a thing as to win a battle. He was an admirable draughtsman, and his blackboard illustrations were always a great feature of his lectures, especially when, to show the relations of two animal types, he would, by a few rapid strokes and smudges, evolve the one into the other before our eyes. He seemed to have a real affection for certain of the specimens illustrating his lectures, and would handle them in a peculiarly loving manner; when he was lecturing on man, for instance, he would sometimes throw his arm over the shoulder of the skeleton beside him and take its hand, as if its silent companionship were an inspiration. To me the lectures before his small class at Jermyn Street or South Kensington, with the skeletons and "pickles" on the table before him, were almost more impressive than the discourses at the Royal Institution, where for an hour and a half he poured forth a stream of dignified, earnest, sincere words in perfect literary form, and without the assistance of a note.

Occasionally, but very rarely, his iconoclastic tendencies peeped out in his lectures. On one occasion he was describing the heart, and came in due course to the mitral valve. "This valve," he said, "is so called from a supposed resemblance to a bishop's mitre. You know the thing I mean—a sort of cross between a fool's cap and a crown." The same subject served for another epigram. At a meeting of examiners we were talking of the difficulty students experienced in remembering whether the mitral valve was on the left side or the right. Huxley told us that when he was a student he always remembered by saying to himself "a bishop's never in the right."

In the promotion of the practical teaching of biology, Huxley's services can hardly be over-estimated. Botanists had always been in the habit of distributing flowers to their students, which they could dissect or not as they chose; animal histology was taught in many colleges under the name of practical physiology; and at Oxford an excellent system of zoological work had been established by the late Professor Rolleston. But the biological laboratory, as it is now understood, may be said to date from about 1870, when Huxley, with the co-operation of Professors Foster, Rutherford, Lankester, Martin, and others, held short summer classes for science teachers at South Kensington, the daily work consisting of an hour's lecture followed by four hours' laboratory work in which the students verified for themselves facts which they had hitherto heard about and taught to their unfortunate pupils from books alone. The naïve astonishment and delight of the more intelligent among them was sometimes almost pathetic. One clergyman, who had for years conducted classes in physiology under the Science and Art Department, was shown a drop of his own blood under the microscope. "Dear me!" he exclaimed; "it's just like the picture in Huxley's 'Physiology.'"

In 1872, when the biological department of the Royal School of Mines was transferred to South Kensington, the same method was adopted as part of the regular curriculum of the school, and from that time the "teaching" of zoology by lectures alone became an anachronism.

The system of practical teaching thus inaugurated has not always been happy in its continuators, and the excellent manual in which it is partly embodied—Huxley and Martin's "Practical Biology"—has had something to do with certain misconceptions as to its nature. Huxley's method of teaching was based upon the personal examination by the student of certain "types" of animals and plants selected with a view of illustrating the various groups. But, in his lectures, these types were not treated as the isolated things they necessarily appear in a laboratory manual or an examination syllabus; each, on the contrary, took its proper place as an example of a particular grade of structure, and no student of ordinary intelligence could fail to see that the types were valuable, not for themselves, but simply as marking, so to speak, the chapters of a connected narrative. Moreover, in addition to the types, a good deal of work of a more general character was done. Thus, while we owe to Huxley more than to anyone else the modern system of teaching biology, he is by no means responsible for the somewhat arid and mechanical aspect it has assumed in certain quarters.

Considering Huxley's unrivalled capacity as a teacher, it is a remarkable fact that he never founded a school. His influence on contemporary zoology and zoologists was, as it could hardly fail to be, profound, but it was exercised mainly by his writings and by the magnetism of his strong individuality. His actual teaching was all elementary, and there never issued from his laboratory that perpetual succession of young investigators which makes the distinction of the great German universities, and which, in England, we associate especially with the names of Michael Foster, F. M. Balfour, and Ray Lankester. In the teaching of his regular class Huxley spared no pains and gave of his best, but when his duties were over he was too much engrossed in his own investigations to care about being worried with the difficulties and triumphs of the embryo researcher. I once went to him with a question about the codfish's brain at a time when he was working at some invertebrate group. "The cod's a vertebrate animal, isn't it?" he asked; "well, I don't know anything at all about vertebrate animals." This answer was quite characteristic; his immersion in the work in which he was actually engaged was so strong as to produce a complete want of interest—at least, during working hours—in anything else, and resulted in the fact that nearly all the students who began the study of zoology under him went elsewhere as soon as they began to feel their feet.

The unbounded pains he took with his lectures were nowhere better displayed than in the courses for working-men at Jermyn Street. A course of half-a-dozen lectures would take months of preparation: he neglected no point, however insignificant, slurred over no difficulty, however apparently unimportant, and gave as much thought and research to an audience of clerks and mechanics as he would have given to one composed of the most distinguished men of science. His books, "Man's Place in Nature" and "The Crayfish," are both founded on courses of this sort, and serve to give some idea of his notions of popular lecturing. And he certainly had his reward, and proved conclusively that a thoroughly popular lecturer is not necessarily the phrase-making *poseur* with whom we are all familiar. Although he never hesitated to use technical language, nor spared anatomical details when necessary, he was listened to, night after night, by an audience having no previous knowledge of the subject, with an attention that never flagged.

In connection with his position as a teacher, some reference must be made to his text-books. The "Lessons in Elementary Physiology," "Introductory Primer," and "Physiography," are so well known and so widely used that it is unnecessary to do more than allude to them as models of scientific method and lucid exposition. But "The Elements of Comparative Anatomy," "The Anatomy of Vertebrated Animals," and "The Anatomy of Invertebrated Animals," appeal only to the student and the teacher of zoology. The "Elements" really consists of two books in one. The first part, on the classification of animals, is, perhaps, the most brilliant sketch of animal morphology ever written: it was published more than thirty years ago, and is now, of course, quite out of date, but there is still much refreshment to be had from its perusal, especially in the enjoyment of the novel sensation of finding a writer of scientific text-books with a style. The second part, on the vertebrate skull, is equally striking as a detailed exposition of a limited, but complex, problem: some parts of it are as readable as his popular essays, and in the rest anatomy was surely never made so interesting.

The "Vertebrated Animals," though published nearly five-and-twenty years ago, still remains, so far as conception and mode of treatment are concerned, the best elementary work on the subject. It is clearly and logically arranged, and, while keeping the generalisations of the subject always in view, never fails to give that attention to the details of anatomy without which any statement of principles and theories is absolutely valueless to the student. The "Invertebrated Animals" is a far less satisfactory book; it is uneven and in many ways ill-arranged, and enjoys the distinction of being one of the worst illustrated books of its kind. But all its faults are redeemed by the masterly introductory chapter—one of the sanest, most luminous, and most philosophical essays ever written on the general principles of biology.

As professor, Huxley's rule was characterised by what is undoubtedly the best policy for the head of a department. To a new subordinate "The General," as he was always called, was rather stern and exacting, but when once he was convinced that his man was to be trusted he practically let him take his own course; never interfered in matters of detail, accepted suggestions with the greatest courtesy and good humour, and was always ready with a kindly or humorous word of encouragement in times of difficulty. I was once grumbling to him about how hard it was to carry on the work of the laboratory through a long series of November fogs, "when neither sun nor stars in many days appeared." "Never mind, Parker," he said, instantly capping my quotation; "cast four anchors out of the stern and wish for day."

To many people Huxley appeared hard and unsympathetic, but never to those who saw beneath the surface. Like most men of strong individuality, there were certain kinds of people who excited his strongest prejudices, and when he thoroughly disliked anyone he took no pains to hide his feelings. He once said to my father: "You're a Christian, I'm a pagan; you say 'love your enemies'; I say 'love your friends and hate your enemies,' *and I do hate them.*" To parody a well-known saying—"he hated a bore, he hated a prig, and he hated a parson: he was a very good hater." Naturally, therefore, in his utterances about people and opinions he disliked, he sometimes showed, like Luther, a certain "göttliche Brutalität"; but the half humorous way in which he usually delivered himself of his denunciations took away all their sting. I was once saying what an edifying sight it must have been to see him showing Cardinal Manning round the rooms a tone of the Royal Society's conversazioni. "Oh! yes," he said; "the Archbishop and I are great friends; he'd burn me if he could, and I'm sure I'd knock all his fraternity on the head." But the twinkle in the deep-set grey eyes deprived this truly mediæval speech of all actuality.

Indeed, no one who came much into contact with him could fail to see that beneath all his prejudices and all his pugnacity was concealed—and not very deeply concealed either—a singularly tender and lovable nature. One of my earliest recollections of him is in connection with a letter he wrote to my father on the occasion of the death, in infancy, of one of my brothers. "Why," he wrote, "did you not tell us before that the child was named after me, that we might have made his short life happier by a toy or two?" I never saw a man more crushed than he was during the dangerous illness of one of his daughters, and he told me that, having then to make an after-dinner speech, he broke down for the first time in his life, and for one painful moment forgot where he was and what he had to say. I can truly say that I never knew a man whose way of speaking of his family or whose manner in his own home was fuller of a noble, loving, and withal playful courtesy.

It has been remarked that great fighters, when they retire from active life, usually take to gardening, and this was true of the most brilliant of Darwin's lieutenants, who "sharpened his beak and claws" to such excellent effect in the great fight which followed the publication of the "Origin of Species." He wrote to me not very long ago, "I begin to think with Candide that 'cultivons notre jardin' comprises the whole duty of man." No one—at least no man of science—could help regretting that he retired from active scientific work so early, and he evidently had something of the same feeling himself. In the letter from which I have just quoted he says: "Looking back from the aged point of view, the life which cost so much wear and tear in the living seems to have effected very little." But the explanation is not far to seek. Apart from ill-health ("some years of continued ill-health . . . have driven me quite out of touch with science, and, indeed, except for a certain toughness of constitution, I should have been driven out of touch with terrestrial things altogether"), he was a man of such wide interests that he could never reasonably have been expected to be wholly devoted to natural science. Religion, politics, psychology, social problems, all that men think of deeply and strive for earnestly, were profoundly interesting to him, and it is hardly to be wondered at that, when he retired from professional work, these things were more to him than the phylogeny of the Mollusca or the last new notochord. Moreover, it must be remembered that he was not, like Darwin, a born naturalist, but a man of all-round capacity, who drifted into biological work by the mere force of circumstances. If those circumstances had been different he might now be remembered as one of the greatest of engineers, surgeons, or politicians, or he might have died Chief Justice of England or Archbishop of Westminster—one can hardly conceive of his taking the *via media* which leads to Canterbury.

Whether a professor is usually a hero to his demonstrator I cannot say; I only know that, looking back across an interval of many years and a distance of half the circumference of the globe, I have never ceased to be impressed with the manliness and sincerity of his character, his complete honesty of purpose, his high moral standard, his scorn of everything mean or shifty, his firm determination to speak what he held to be truth at whatever cost of popularity. And for these things "I loved the man, and do honour to his memory, on this side idolatry, as much as any."

T. Jeffery Parker.

Otago University, Dunedin, N.Z.

II.

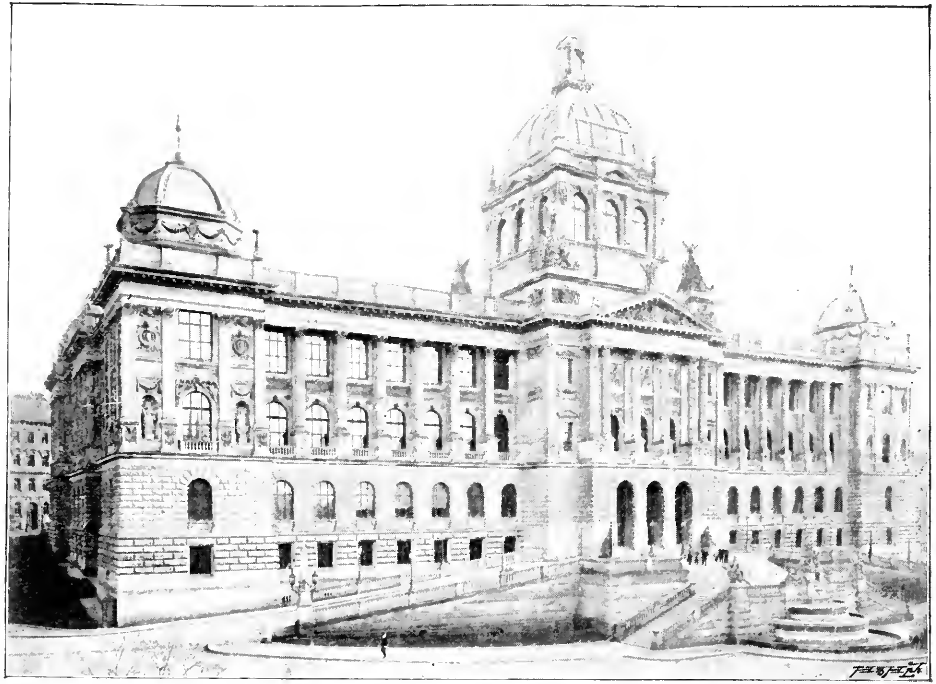
The Natural History Departments of the Bohemian Museum.

TWO years ago the Museum of Natural History at Prague, Bohemia, was transferred to a magnificent building standing in a commanding situation at the top of an ascending street more than a kilometre in length (Plate V.). The first floor of the new building contains the historical, archæological, numismatic, and ethnographical collections, as well as the mineralogical and botanical departments; the second floor, the palæontological and zoological collections.

The chief idea in arranging the collections has been to give prominence to everything characteristic of Bohemia. The foreign collections comprise only such types as are of general scientific interest.

In accordance with this plan, the Bohemian minerals are arranged in the order of their geological age in two large rooms, while the general collection of minerals occupies only one room twenty-six metres in length.

The first room of the geological collection is the Barrandeum, devoted to the collection of the late Joachim Barrande, described in his classic work, the figured specimens being arranged in the transverse cases. The wall-cases contain a collection of azoic rocks, forming the base of Barrande's "Silurian" formation, and consisting of typical specimens collected by Professor Zippe. The fossils from the "Lower Silurian" of Barrande are already arranged and provided with printed labels; while those from the "Upper Silurian" are only partly arranged, because the corals, crinoids, and gastropods are still in the hands of monographers (Professor Waagen and Dr. Počta). The more minute specimens are explained by means of the figures of Barrande's plates, for which purpose the Barrande family has kindly furnished a copy of the entire work (Fig. 1). A special case, devoted to the memory of Barrande, contains the volumes of his monumental work, presented for the purpose of exhibition in the Barrandeum by the executrix, Mdlle. Alène Girardeau. The work consists of 24 volumes and 1,237 plates, and contains the description and figures of 4,630 species, distributed as follows :—



THE NEW BUILDING OF THE BOHEMIAN MUSEUM AT PRAGUE.

Pisces	6	Trilobita, and other Crustacea	447
Cephalopoda	1,127	Bryozoa	88
Gastropoda	600	Echinoderma	80
Acephala	1,269	Species undetermined, about	300
Brachiopoda	640		
Pteropoda...	73		

Beneath a portrait of Barrande, representing him at forty years of age, are exhibited his hammers and other tools, together with photographs of the memorial plate on the rocks at Kuchelbad, and of the house in which he lived and where he kept his collection.

The second room is the Sternbergeum, beautifully arranged, in

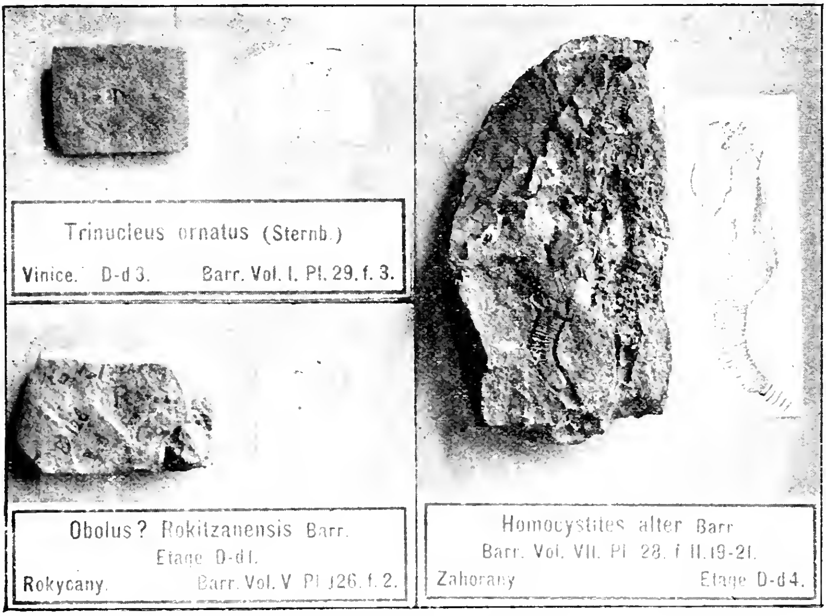


FIG. 1.—SAMPLE OF MOUNTING EMPLOYED IN THE BARRANDE COLLECTION; HALF NATURAL SIZE.

which are all the original specimens figured by Count Caspar Sternberg in his "Flora Fossilis," and in the publications of Corda. A marble bust of Sternberg is placed opposite a central group of large fossil plants. One case containing the Arthropoda (scorpions, spiders, etc.) from the Coal-measures is of special interest.

Then follows a room in which the rocks and fossils of the Carboniferous and Permian formations are arranged in stratigraphical order, illustrating the papers of K. and O. Feistmantel, and where all the originals of Dr. A. Fritsch's "Fauna der Gaskohle" are exhibited, explained by figures from that work. One case containing the Jurassic fossils described by Geinitz and Bruder finishes the series.

The next three rooms when finished will contain specimens from the Cretaceous, Tertiary, and Diluvial formations. The series opens with a collection of Cenomanian plants, consisting of more than 200 species, mostly conifers, cycades, and dicotyledons, described by Dr. Velenovsky. The marine fossils from Cenomanian to Senonian

Fig. 2.—Natural Group of Bats (*Vespertilio murinus*) on the entrance of a stalactitic cave.

are represented by the originals of Dr. Fritsch's studies of the Chalk formation of Bohemia, and of the monographs on fishes, cephalopods, and crustaceans published by him, and by Drs. Počta, Kafka, and others. Among the Tertiary fossils, the original land and fresh-water shells from Tuchořic, described by Reuss, Slavik, and Klika, form a beautiful series. A smaller room, with the Diluvial Mammalia, closes this instructive exhibition of animal and plant remains found in Bohemia.

The general geological collection, for which the cases are not yet ready, will be placed in a room 26 metres in length, and opened to the public in three or four years.

The zoological collection begins with the Bohemian Fauna. The mammals are illustrated by natural groups of bats (Fig. 2), mice, etc. The birds are also shown in a life-like manner with nests

FIG. 3.—GROUP OF THE LIZARDS AND SNAKES OCCURRING IN BOHEMIA.

and eggs. Even the reptiles (Fig. 3) and amphibians are shown in groups taken from life. Among the fishes, the life-history of the salmon has received special attention. The lower animals, beginning with the Protozoa, are represented by models, drawings, and specimens as completely as possible.

Five large rooms have been devoted to the general zoological collection; but only typical forms are exhibited, intermixed with biological groups. In the mammal department a skeleton of *Balænoptera musculus* from Bergen, 23 metres in length, has been mounted with great care by V. Frič, together with a skeleton of an embryo of the same species. Very beautiful examples of rhinoceros, antelopes, etc., have been presented by Dr. Holub and E. St. Vraz, two Bohemians, to whom the museum is much indebted for their generous gifts. The ornithological series contains many originals of Dr. Fritsch's work on the Birds of Europe, especially a young *Alca impennis* (the Great Auk) without the white marks in front of the eyes. An original bill of the dodo is also among the treasures. All the families and the principal genera of the reptiles, amphibians, and fishes are very completely illustrated, being in every case represented by one large stuffed example, skeleton, and anatomical preparations. Large instructive labels are already placed in many of the cases.

The general collection of lower animals will in the future occupy a large room, but I will only mention at present that living and extinct forms will be seen side by side.

The arrangement of the Bohemian Museum thus solves two problems: a local country museum and a type museum for the instruction of visitors, of whom in the last year there have been over 90,000.

Anton Fritsch.

III.

The Pigments of Animals.

Part II.

ANOTHER group of pigments which of late has been much studied includes those which are physiologically the ordinary nitrogenous waste-products of the organism in which they occur, or are produced by a modification of these. This employment of waste products in coloration is best exemplified in insects, especially Lepidoptera, but is also a familiar phenomenon in fishes. As regards the latter class, we have a beautifully illustrated research by Mr. Cunningham and Dr. MacMunn (3), which contains many interesting facts as to the part played by guanin in the coloration of the skin, especially of the Pleuronectidæ. In the case of butterflies there are numerous papers which require more detailed consideration.

The colours of butterflies are partly structural and partly due to pigment. The following colours are usually due to pigments:—white (in part), yellow, red (at least in part), brown, black (in part), and, very rarely, green. On the other hand, so far as is at present known, blue seems to be always a structural colour, green and white are usually structural, as is also black in part; metallic or changing colours are of course always optical effects. The distinction of the two kinds of colour, however, presents considerable difficulty in practice, and it is therefore not surprising that at this early stage of investigation there should exist some confusion as to their relations. This confusion has been to some extent increased by the fact that many of the pigments have been investigated only from the chemical side, and not by a combination of microscopic and chemical observations. A recent paper by Spuler (13), however, contains a careful summary of other researches, as well as an account of his own observations on butterflies' scales, which is of great assistance in the interpretation of the result of others. In spite of this, the uncertainty is such that the lists given above must be regarded rather as the balance of probabilities at the present time, than as a statement of assured fact.

As structural and pigmental colours in butterflies can thus not be very exactly separated, it is perhaps advisable to give some account of Spuler's results.

Spuler is primarily concerned with optical colours, which he finds to be due either to the special characters of the individual scales, or to the relations of different sets of scales. Each scale consists of a double membrane, the parts being separated by a space which is continuous with the cavity of the stalk of the scale. The inner membrane is transparent, colourless, and usually slightly folded; the outer shows considerable differentiation and usually bears on its outer surface longitudinal rows of blunt projections, which are of much importance in the production of structural colours. The two membranes are connected by bridges of chitin. When pigment is present, it may occur in the form of granules or may be simply diffused through the chitin; it is always absent from the inner membrane, but it occurs freely in the bridges of chitin, in the stalk of the scale and its surrounding follicle, and in the outer membrane.

As to the exact nature of the pigments, our knowledge is still far from complete. The best known is perhaps the yellow pigment of the Pieridæ, which for some time has occupied the attention of Mr. F. Gowland Hopkins (4), (5), (6). This pigment is soluble in hot water, but not in the usual organic solvents (alcohol, chloroform, benzol, etc.); it gives the murexide reaction quite distinctly, is acid to litmus, and undoubtedly a derivative of uric acid. In the wings of the Pieridæ, indeed, uric acid itself is said to occur as a white pigment. According to Urech (16), however, the white scales of *Pieris brassicæ* appear yellow by transmitted light, and when treated with hot water yield a yellow solution which, besides yellow pigment, contains a white "crumbly" substance. This observation makes it appear doubtful how far even in this case white is an optical effect. White is certainly in most cases in butterflies an optical colour; in many cases it changes according to the direction of the light. In these cases, Spuler is inclined to think that it is produced by the relations of the layers of chitin in the scales. The phenomenon is thus to be explained as due to the interference colours of thin plates. It is interesting to compare the result obtained by Urech in the case of *Pieris brassicæ* with the observations made by Krukenberg on birds. Krukenberg (7) found that even the apparently pure white feathers of a cockatoo yielded a solution containing the yellow pigment characteristic of the family.

The yellow pigments found in the other Lepidoptera are not as yet well known; they do not all give the murexide reaction, nor are they in all cases soluble in water.

Among the other pigments, the red presents some interesting features. It has been noticed by several observers that in many cases scales of a bright red or scarlet colour yield a *yellow* solution when treated with hot water, but if the solution be evaporated to dryness a *red* residue remains. Similarly, the red colour is turned yellow by the application of acid, but the yellow colour may be restored by the addition of ammonia. This is the so-called "reversion effect" of Mr. Perry Coste (2). According to Hopkins, the red pigment is either formed from the yellow by hydration, or by the association of the yellow acid body with a weak base. Red pigment showing this peculiar character occurs, for example, in *Delias eucharis* and *Deilephila elpenor*. The phenomenon is of common though not universal occurrence, some reds being quite unchanged by acids.

Green in butterflies presents many difficulties. It may be entirely structural, and arise by surface markings or by the superposition of scales, as in the species of *Nematois* (Spuler). Again, from the green scales of *Papilio eurymedes*, Urech extracted a yellow pigment which was almost insoluble in water, but which dissolved readily in hydrochloric acid. He adds as a note, however, that the scales retained their green colour after treatment with acid and ammonia. It is almost impossible to doubt that in this case the green colour is structural, the part played by the yellow pigment being uncertain. Further, he found that the green scales of *Thecla rubi* are yellow by transmitted light, and almost colourless when the light falls from the base of the scale upwards, while to hydrochloric acid they yield a yellow pigment. These two cases seem to suggest that in butterflies, as in birds, green may be produced by a combination of a yellow pigment and a structural modification. On the other hand, from the green scales of *Sphinx nerei* Urech extracted a pigment which was slightly soluble in water and readily soluble in acid and ammonia. Of the three solutions the first was greeensh yellow, the second orange yellow, and the third green. The addition of ammonia to pigment turned yellow by acid restored the green colour. This fact would suggest that the green pigment of *Sphinx nerei* is derived from a yellow, in much the same way as is the red pigment of *Delias eucharis*.

So far we have treated of four colours which are either always or occasionally produced by pigment, viz., white, yellow, red, and green. Of these the white pigment is uric acid itself (?); the yellow (lepidotic acid of Hopkins) is, at least in the best known cases, undoubtedly a derivative of uric acid, and in the Pieridæ has been found to occur as one of the normal waste-products of the organism. Further, the relations of red and green respectively to yellow render it probable that these pigments also are derivatives of the uric acid group. It must not be forgotten, however, that in various butterflies there occur yellow pigments which do not give the murexide reaction, and whose affinities have yet to be determined. For example, the yellow pigment of *Papilio machaon* when tested with nitric acid and ammonia gave a green instead of a purplish colour. In view of this and similar facts, it would seem to be premature to assert that all yellow pigments, even in butterflies, are directly derived from uric acid.

We have in the foregoing account omitted all reference to the black or brown pigments. Black is usually due in part to the sculpturing of the surface, and in part to a dark granular pigment. All these dark-coloured pigments Urech found to be insoluble in water and organic solvents, but to dissolve in most cases (imperfectly ?) in acids. They never gave the murexide reaction. From Urech's description there can be little doubt that these pigments belong to the widely spread group of the melanins, which are chiefly characterised by their colour and their insolubility; their chemical relationships are unknown.

Looking now at the colours of butterflies in general, we may note that the *characteristic* pigments are derivatives of the uric acid group and melanins. Lipochrome pigments seem to be entirely absent in the adult. This is a very interesting fact, not only because lipochromes are so widely spread and so common as colour-producing agents, but because, as we have already seen, they are usually so important in the coloration of the larvæ. Again, there are many interesting analogies in the coloration of birds and insects, and yet in birds lipochromes are characteristically the pigments of the plumage, and waste products are not known to occur as colouring agents. Such facts as these must be explicable in terms of the physiology of the individual, and must, therefore, be allowed for in the construction of theories as to the origin of colour.

So far we have been concerned only with observed facts, but this paper would be incomplete without some reference to the conclusions which have been drawn from these facts. It has been repeatedly noticed that in the development of the individual a certain succession of colours can be seen. Thus in *Vanessa urticæ* towards the end of pupation, the wing-scales are white, and the development of the coloured elements takes place in the following order:—yellow, orange, red, red-brown, dark brown, and finally black. Urech, Eimer, and others believe that this ontogenetic succession corresponds to the phylogenetic order of the development of the characteristic colours. Urech, indeed, compares the succession of colours to various organic series where successive steps in substitution are associated with colour progression. He regards greenish-yellow or yellow as the simplest pigment, and says that, as the molecular weight increases, there is a colour progression through orange, red, violet, to blue and finally green. The cause of this increase in molecular weight he holds to be the influence of external conditions, such as better food and warmer climate; as to the nature of the effect and the question of inheritance, nothing is said.[1] He considers that the pigments arise from uric acid and from the allied nuclein bases (xanthin, hypoxanthin, adenin, guanin). Their proximate origin is from leucocytes, and their ultimate origin from nuclein, which undergoes spontaneous decomposition into the nuclein bases, albumin, and phosphoric acid. In connection with this suggestion, Urech notices the frequent occurrence in the scales of colourless substances which are associated with pigment, and, according to him, are derivatives of uric acid.

[1] Since this was written, a suggestive, if somewhat vague and mystical, paper has been published by Simroth (*Biol. Centralbl.*, xvi., pp. 35–51; Jan., 1896), who works out in detail a similar view as to the evolution of colour.

Urech's suggestions, though of great interest, are difficult to work out in detail, and are probably premature. As to the significance of the colour change in the *Vanessæ*, opinions are still divided. Spuler opposes the theory of its phylogenetic significance and the correlated assumption that the *Vanessæ* were once all white. Certainly, at the present time, the trend of scientific opinion seems against such detailed applications of the Recapitulation Theory.

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See also E. B. Poulton's "Colours of Animals," 1890, and F. E. Beddard's "Animal Coloration," 1892.

M. I. Newbigin.

IV.

A Rowing Indicator.[1]

IT is curious that, in a pastime which so readily lends itself to experiment as rowing, little has yet been done to investigate many questions of interest to the physiologist, as well as to the oarsman. Such researches as have hitherto been made have generally been carried out without the aid of special apparatus, and have in consequence been very indirect.

The valuable researches made in Oxford more than twenty years ago by Dr. Parkes and Mr. Maclaren will serve as an example. Their object was to ascertain the value of a "man-power" in rowing, and they appear to have been received as the standard results on the subject.[2] The resistance offered by the water to a racing eight travelling through it was obtained by means of a dynamometer attached to the tow-line dragging a loaded eight at a rate of 2·65 knots. Assuming the resistance to vary as the square of the velocity, and that at racing speed an eight travels at 8·57 knots, a calculation was made of the work expended by each member of the crew in a given time. The two necessary assumptions are sufficient to render this reasoning hazardous. The calculation, moreover, neglects the fact that men and oars are very different to their equivalent ballast in sandbags. First, there is very considerable wind-resistance which the ballast does not set up. Any oarsman will realise the meaning of this, remembering that, not only the body, but the oar—and especially the blade in the swing forward—has to be reckoned with. Secondly, a portion of the energy expended in rowing is devoted to communicating kinetic energy to the water at the blade, so that this experiment takes no account of the swirl or "wash" left behind in the water.

The "Indicator" (Fig. 1) affords a means of *directly* measuring, not only the whole work done by any particular oarsman, but also of the way in which the work is done. In general principle the instrument is similar to the ordinary steam-engine indicator, but the diagram obtained is necessarily rather more complicated than the familiar "indicator diagrams."

[1] From a paper read before the Oxford University Junior Scientific Club, November 15, 1895.

[2] Haughton's "Principles of Animal Mechanics."

The indicator replaces the back thowl of the rowlock, so that in rowing the stroke the oar presses against the front face (BC, Fig. 2) of the instrument with the button at C. The instrument consequently turns with the oar, and carries the indicating point, E, over the card fixed to the plate, DD. If the stroke could be rowed without pressure against the indicator, the indicating point would simply

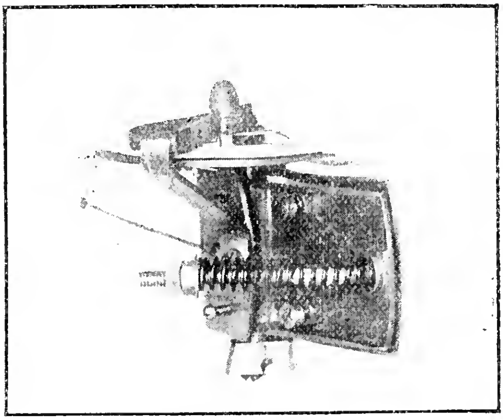


FIG. 1.—PHOTOGRAPH OF INDICATOR.

describe a circle. Pressure, however, tends to drive the face back and make the back-plate, AI, turn about B and compress the spring, SS, and then the pencil moves nearly radially outwards. The plate, DD, is fixed to the axle, A, which at its bottom end screws on to the

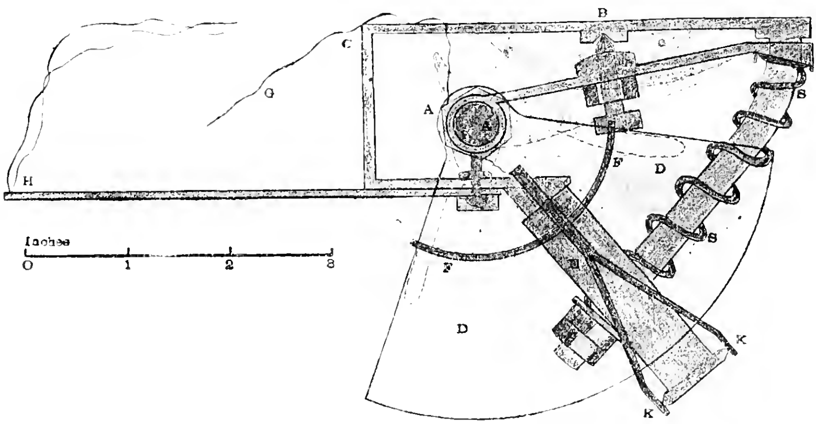


FIG. 2.—PLAN OF INDICATOR.

outrigger. In this way, while rowing the stroke, a diagram (Fig. 3) is drawn, the "base-line" being formed as the oar is coming forward. The pencil (in reality a brass point working on "metallic paper") is fixed to an arm which turns freely about the pivot, K, and is usually held off the card by a rail (FF). The diagram, then, is only traced when the rail is depressed by a string (G), which is under the control of the coxswain. The wire and string (H) move the indicator forward, when, of course, the oar is no longer pressing against it, and admits of free "feathering," while securing that the indicator shall be in position for the next stroke. The instrument is reversible, to admit of use on bow and stroke side. In using the instrument it is convenient to be able to regulate the initial pressure of the spring (*i.e.*, the pressure at which the spring *begins* to close). This is done by means of the nut and locknut at the end of the spring, and the pressure is known by the number of turns given, after the nut has just touched the uncompressed spring. The value of one turn is found by observing the movement of the pencil over the diagram when the indicator is opened by screwing up the nut. The strength of the spring was found by comparing the *compression*, produced by a beam pressing against the indicator, with the *pressure* measured on a spring balance. These two constants enable the pressure corresponding to a given position of the pencil to be determined.

It is now necessary to describe the card on which the diagram is drawn. As stated above, increase of pressure of the oar (without turning) moves the pencil approximately radially. In reality, it moves in a circle, parallel to that described by the joint, B, about A as centre. In the cards used these pressure lines are drawn 5 degs. apart. The pressure is found along each of these lines by adding the initial pressure to that corresponding to the distance from the base-line to the upper line of the diagram (Fig. 3).

To observe the nature of the stroke, it is best to reduce the diagram to a form in which the pressures are measured as ordinates perpendicular to the base-line, corresponding to the position of the oar. In this way the diagrams in Figs. 3 and 4 were obtained.

Table I. illustrates the way in which the diagram is measured up. The pressures along each line are simply added together, and a correction is applied for the ends of the diagram. The result, when multiplied by a proper factor, measures the work done in the stroke.

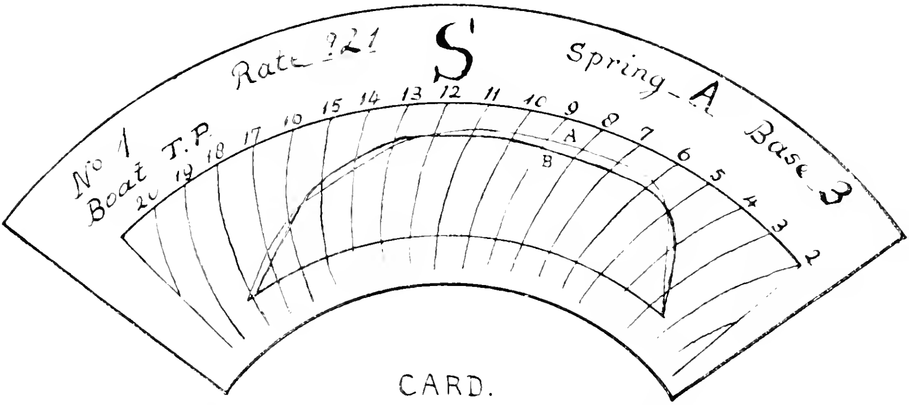
TABLE I.—EXAMPLE OF REDUCTION OF DIAGRAM.

Number.	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	End Correction.	Total
1 (A)	40	78	127	161	177	180	180	181	173	169	160	148	129	109	91	68	46	[.2]	+5	2222
(B)	40	78	133	161	166	160	162	165	161	162	160	158	142	118	91	60	[.6]	..	+20	2137

The "end correction" arises from two causes. The first is the geometrical fact that the sum of the ordinates is in excess of the required quantity (the area) by half the sum of the end ordinates. The second cause is the initial pressure of the spring. In consequence of this the diagram terminates before the line of zero pressure is reached. Allowance is made for this by graphically estimating the

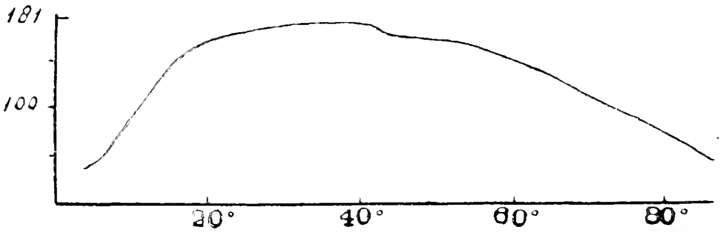
Fig. 3.

Indicator Card, with the Reduced Diagrams. No. 1.

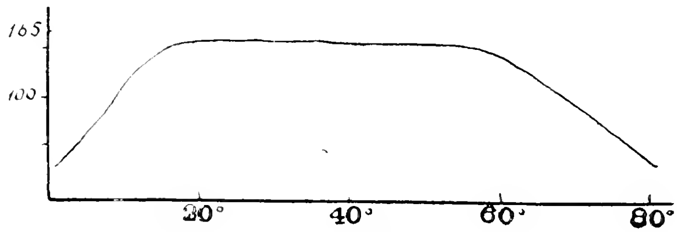


Finish. Beginning.

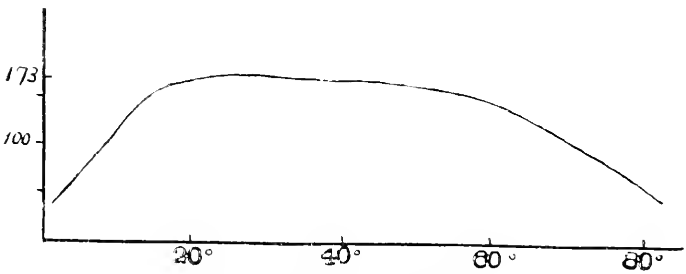
Beginning. Finish.



1 (A). 450 ft. lbs.



1 (B). 434 ft. lbs.



Mean of (A) and (B). 442 ft. lbs.

area enclosed by the true base-line, the ordinate at the end of the curve, and the curve produced down to the base-line. The two corrections together seldom exceed 1 per cent. of the whole.

The reduction factor is obtained as follows. To know the relation between *pull* on the handle of the oar and *pressure* on the rowlock, the "centre of pressure" of the blade on the water must be found. This was obtained by calculating the statical centre of pressure and allowing for the disturbing rotation (the position is thus known within 2 per cent. or 3 per cent.). The required result then follows from the principle of the lever. The ratio is found to be ·697. Finally, 5 degs. turn of the oar represents a motion of the handle of ·293 feet. Consequently, multiplying the results in Table I. by $\cdot 293 \times \cdot 697 = \cdot 203$ gives the result in foot-pounds.

The present form of indicator has various sources of error, all of which have been considered and found to have only a small effect on the result. The effect of friction was found at a pressure of 200 lb. to be about 1 per cent., and even this largely cancels, since the effect at one end of the stroke is opposite to that at the other. The compression of the spring is not strictly proportioned to the pressure, owing to the peculiar form of the instrument, but the variations were too small to be observed in testing the springs. Finally, at the commencement of the stroke, the outward pressure of the button of the oar very slightly exaggerates the "beginning." This has no appreciable effect on the whole work done, and in comparing different curves the effect on all is similar.

To pass now to some of the results obtained with the indicator. The first point to be noticed is that each oarsman has a marked individuality, both with regard to style and amount of work done. This fact makes generalisations difficult, and reliable figures of the average value of a man-power can only be obtained by a very extended series of observations. Table II. exhibits some of the results already obtained. The division into "rowing" and "paddling" is necessarily somewhat arbitrary. In the latter class are included all cases in which the rower was not working his hardest.

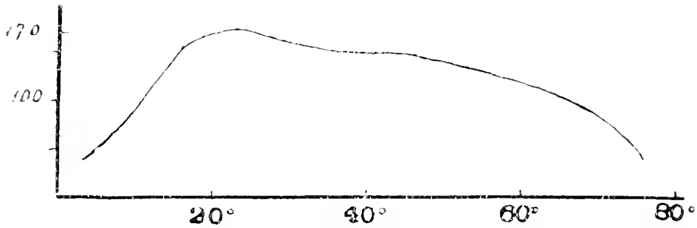
It has been found possible to indicate three or four strokes on the same card, and thus to obtain various stroke-diagrams in one piece of rowing. The stroke-rate was counted in the case of "rowing," but only estimated in the second class, and the 18 rate is possibly in cases 3 and 7 in excess or defect.

The results obtained show that in a "tub pair," in which it is only possible to row about 24 strokes to the minute, the horse-power at high pressure and short duration varies between ·23 and ·40. It should be said that these results have been obtained from oarsmen, all of moderate experience. All but one have rowed in their College Eight, and two—the reader will easily see which—have rowed in the 'Varsity Boat.

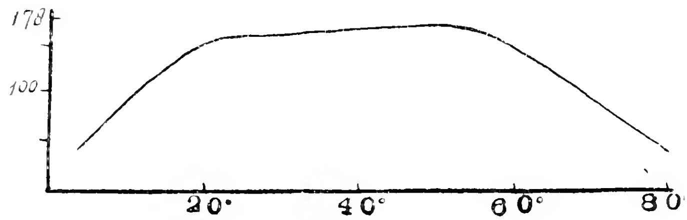
The diagrams reproduced will show the use of the indicator in

Fig. 4.

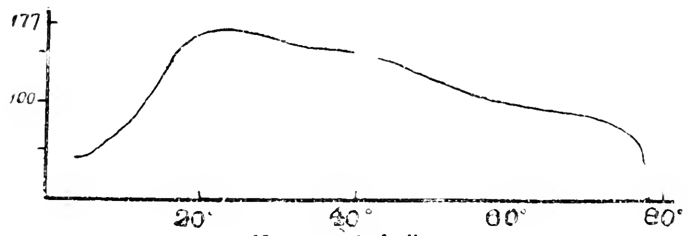
Some other Stroke Diagrams.



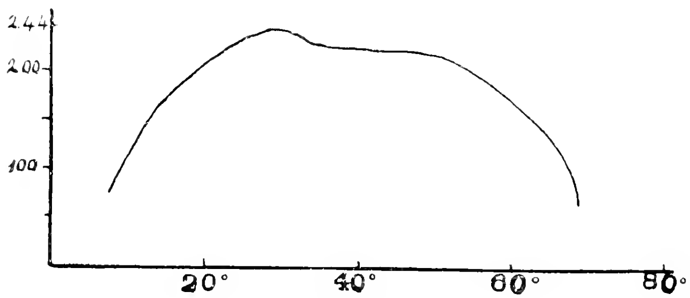
No. 7. 384 ft. lbs.



No. 11. 435 ft. lbs.



No. 13. 362 ft. lbs.



No. 15. 498 ft. lbs.

exhibiting "style" and determining some facts relating to what may be called the physiology of rowing. Fig. 3 shows a diagram actually drawn[1] and the figures reduced from it. In this case only two strokes were indicated. Fig. 4 consists of various other diagrams. The two strokes in Fig. 3 will be seen to be very similar, and to differ widely from any of the other diagrams, and generally it has been found that the stroke-curve of any "oar" is fairly constant, while it possesses a marked individuality. It is this fact that would make the indicator of assistance to the rowing coach in observing how far a pupil carries out his instructions, and what fault is most prominent. Compare, for instance, nos. 11 and 13 (Fig. 4). 11 has a slow "beginning," but rows his stroke firmly through, and achieves the very unusual result of reaching the highest pressure near the end of the stroke—suggestive of "pulling in with the arms" (of which, indeed, he is independently known to be guilty). 13, on the other hand, has a smarter "beginning," and very soon reaches a maximum pressure, which, however, he is quite unable to carry through; a fall of pressure immediately follows, and the stroke continues at this pressure till past the middle of the stroke. Here another fall occurs, and the stroke finally terminates as it began, more firmly than that of no. 11. These results suggest that the indicator could be of assistance in choosing a crew, both with regard to strength and—so far as "blade" is concerned—"style."

TABLE II.

Number.	Duration.	Strokes Indicated.	Greatest Pull.	Foot-pounds.	Rate.	Horse-power.	Mean.
I.—"ROWING."							
1	1 min.	2	120	442	21	·282	
11	1 min.	2	124	435	21	·303	
13	1 min.	2	124	362	23	·242	
14	½ min.	2	117	351	22	·234	
15*	½ min.	2	166	498	22	·331	
16* †	½ min.	1	174†	602†	22	·401†	·299
II.—"PADDLING."							
3	..	2	116	362	?18	·198	
7	..	2	118	384	,,	·209	
10	..	4	117	383	,,	·209	
12	..	3	112	293	,,	·160	·194

All the experiments were tried in a gig pair.

* In the case of 15 and 16, two men were seated in the stern, in other cases only one.

† In 16, the instrument was completely closed during part of the stroke, so that the work was really in excess of that indicated.

These preliminary trials of the indicator have suggested many other experiments which should afford interesting results. The

[1] Unless the rigger is very steady, the beginning and end of the stroke-curve consist of dots instead of a continuous line.

author hopes at some future time to carry out at least some of them. The indicator could, for instance, be left working for a long time, and so indicate every stroke of a "course." The result would be a thick line formed by the mingling of all the stroke-diagrams. This would afford an accurate measure of the mean power over the course. A modification of the indicator has been roughly designed in which each stroke could be indicated separately on a tape. Unfortunately, the increased complexity of the machine and the time required to measure some 300 strokes would seriously diminish its utility. Another series of experiments which the author is anxious to try, is to compare the stroke-forms of the same individual in different boats. It is quite possible that whereas, for instance, no. 13 has what may be called a *false* beginning in a heavy tub-pair, he might in a light ship have a better stroke-form than no. 11, who, even in a heavy boat, has a slow beginning and finish.

An extensive series of experiments with the indicator might throw light on the very difficult question of the best proportions of oars; whether a fast stroke with oars having large handle leverage, or a slower rate with less leverage, is most efficient. That experience has not finally settled such questions is shown by the great differences in style between English and American rowing.

Such are some of the results and problems arising out of a first trial of the rowing indicator. Sufficient has been done to justify the author in the hope that his instrument is a step in the direction of the scientific study of rowing.

E. CUTHBERT ATKINSON.

V.

Dispersal of Seeds by Birds.

THE dispersal of seeds to a place where they can germinate and develop is to a plant a matter of almost as great importance as the cross-fertilisation of the flower; and the modifications of the plant to ensure this end are worthy of more attention than has been paid to them. It is a subject which must be studied in the field, for, otherwise, many important points in the structure of the fruit or seed may not be intelligible. I have already published, in the *Journal of the Straits Asiatic Society*, vol. xxiv., p. 10, 1893, an account of the means of seed-dispersal by mammals in the Malay Peninsula, and I propose here to continue those notes by accounts of the other means by which seeds are disseminated, viz., by the aid of birds and insects, by wind, by streams and sea.

The subject has naturally a considerable bearing on the geographical distribution of plants, but I believe its value in this direction has been often over-rated. I have already (*loc. cit.*) pointed out that it is not to the advantage of any plant that its seeds should be borne to a very great distance, and I shall show that, except in the case of sea-borne seeds, the distance to which they are usually borne, and the journey for which they are modified, are really very short, and although numerous exceptions occur in which seeds are known to have been carried very far by natural causes, this is not the rule.

The study shows, not only how certain plants are found in certain localities, but also why certain groups are absent. Nothing in the distribution of orders in the Malay Peninsula is more striking than the paucity of Compositæ. Now, the Compositæ are a group in which the calyx is usually developed into a plume, by which the fruit is borne along by the wind. They are nearly all low herbs, so that, when ripe, the fruits are drifted along at no great height above the ground; they thus require open country for the dispersal of their seed, for a dense jungle, such as is common in tropical countries—especially if fringed, as it often is, with a tangled mat of creepers—stops the drifting seeds immediately at its edge. A clearing in such a jungle, if there is no direct communication with the open country, will remain free from plants of this character, but if a pathway of sufficient breadth is cut from the plain to the clearing, these plants very soon make their way in. Now, the Malay Peninsula is almost entirely covered with jungle of the densest character, and the result is that Compositæ are almost entirely absent from the native flora. Along the open edges of the sea-coast, however, we have *Wedelia*, the fruits of which, unprovided with a pappus, are drifted along the coast in the sea: *Pluchea indica*, the fruits of which have a pappus, and are wind-dispersed; this latter, though usually a sea-shore plant, has been found by me on cleared ground in the interior of Singapore: *Gynura sarmentosa*, a climber to the tops of trees in the jungles, from which altitude its fruits can drift like those of other jungle-climbers: and *Vernonia arborea*, a lofty tree, which, however, occurs only on the outside of the jungles or in the open country. The remaining twenty-five or thirty species are apparently introduced weeds, and wander but a short distance from cultivated ground.

In some orders of plants the modifications for dispersal of seed are on the same lines in all the species, but in almost every order there are exceptional modifications. Thus the Orchideæ, whether epiphytic or terrestrial, have capsules filled with fine seed, the testa being prolonged into a thin process, by the aid of which the seeds are drifted to suitable spots by the wind. *Vanilla*, however, is an exception. It has a sweet, succulent, fleshy pod containing minute seed, unprovided with any prolongation. It is eaten by animals, and the seed is thus dispersed.

Most of the Apocynaceæ have plumed seeds, which are disseminated by the wind; they are here either climbers or large trees, more rarely shrubs. *Cerbera* and *Ochrosia*, natives of the banks of tidal rivers, have large drupes, which are adapted for sea-dispersal; *Kopsia* has an inconspicuous drupe with a single seed, and is apparently dispersed by mammals; *Willughbeia* and allied genera have large berries eaten by mammals and birds; *Tabernæmontana*, often a low shrub, inhabiting dense jungles, has a brilliant orange capsule, the seeds of which are enclosed in a crimson aril and are devoured by birds. Sometimes, however, very closely allied plants have entirely distinct means of dissemination; thus *Neuwiedia Lindleyi*, Rolfe (Apostasiaceæ), and *N. Griffithii*, Rchb. fil, have capsular fruits with seeds resembling those of orchids, while *N. Curtisii*, Rolfe, a plant which so closely resembles *N. Lindleyi*, Rolfe, both in habit and flower as sometimes to be hardly distinguishable at the first glance, has orange-coloured fleshy berries, with minute globose seeds, the testa of which is not developed into wings as in that plant.

Perhaps no group of plants shows so much variation in its means of dispersal as the Cucurbitaceæ. Thus *Bryonia*, a native of open woods and hedges where frugivorous birds are common, has small scarlet berries. *Trichosanthes*, on the other hand, a lofty climber in the tangled masses of creepers which fringe the jungles of the East Indies, has large scarlet fruit conspicuous from afar, but too large to be swallowed whole. The birds, therefore, tear it to bits, and as the placentas are of a deep blackish green, a partially-torn fruit is even more conspicuous than an entire one, owing to the contrast between the two colours. A species of *Melothria*, which I found in Perak, is a small creeping gourd which frequents sandy spots. The fruit is dull-coloured and adapted for dispersal by mice, which tear the gourd to pieces and carry them away with the seeds. *Hodgsonia heteroclita*, Hook. fil., frequents dense thickets on river banks. It bears very large woody gourds, covered with a grey pubescence. These gourds drop from the plant, when ripe, and float in the river. The pubescence prevents them from injury by wet, so much so that a gourd may be plunged in the water and taken out again dry. The seeds, too, are large and woody ; they float in water and are protected from injury as the pulp of the fruit is exceedingly oily. This is an example of modification for dissemination by water. *Zanonia macrocarpa* is a native of the densest hill-jungles of the Malay Peninsula and elsewhere. Here are few birds or mammals to disperse the seeds by swallowing or carrying them away, and no river to drift them. The fruit is therefore adapted for dispersal by wind. It is a huge obconic capsule, of a dull green colour ; when ripe, it splits across the top into lobes, which recurve, and as, from its weight, it hangs with the broadest part downwards, the thin winged seeds drift away through the forest till they find a suitable spot to grow in. Finally, *Ecballium*, a native of dry deserts where animals and birds are few, and where there are no trees to climb up so that we might expect the seeds to be adapted for dispersal by wind, possesses a remarkable mechanism by which the seed is shot explosively to a sufficient distance from the parent plant. These examples, however, do not exhaust the minor modifications of the fruit in this remarkable order.

The methods by which seeds are dispersed may be briefly classed as :—

(*a*) Dissemination by animals, either by their swallowing the fruit, or seeds, or by bearing the seed to a distance in order to devour it, or part of it ; or by accident in the case of adhesive seeds and fruits.

(*b*) By wind.

(*c*) By water ; rain-drops, streams, or sea.

(*d*) By mechanical means, such as an explosive mechanism, by g, or by the mere inversion of the capsule.

It may be well to point out first that Epiphytes are invariably disseminated either by birds or by wind, and Saprophytes by merely shaking the seeds out of their capsule, or by dissolution of the whole fruit, when the seeds are carried away by rain-drops, or (more rarely) by wind ; but in no case are they provided with plumes or other appurtenances for wind-dispersal. Big trees and lofty climbers in jungles and woods are disseminated by animals or wind, unless habitually growing in or near the sea or rivers, when they are often adapted for water-transport. With very few exceptions it is herbaceous plants alone that are disseminated by adhesiveness of fruits or seeds.

The present paper, however, considers only the first of the above methods, namely Dissemination by Animals, and especially by Birds, as exemplified by the plants of the Malay region. Mammals, birds, and insects, chiefly ants, are the living disseminators of plants. Of the former I have already treated in the paper referred to, and will only repeat that the fruits and seeds disseminated by them are almost invariably dull-coloured, green or brown, partly because so many frugivorous animals are nocturnal, when colour is useless, and partly because in thick jungles the animals are unable to see for any great distance on account of the density of the foliage, while birds, on the other hand, flying above the trees can easily detect coloured fruit at a distance and find their way straight to it.

Colour, however, especially red, occurs accidentally in fruits not destined to attract birds, and may be absolutely injurious to the fruit. It is most conspicuous in species of *Dipterocarpus*, *e.g.*, *D. pterygocalyx*, *D. oblongifolius*, Bl., *D. cornutus*, Dyer, and several species of *Hopea*, *Melanorrhœa Curtisii*, Oliv., and *M. Wallichii*, Br. (Anacardiaceæ). These trees have winged fruits of the most brilliant crimson or red, and when in full fruit are truly magnificent. I have seen nearly all the fruits on a tree of *D. cornutus*, Dyer, destroyed by monkeys, which devour the seed. *Parameria polyneura* is a climber (Apocynaceæ) which produces slender pods about two feet long, containing plumed seeds. The pods often become red and somewhat conspicuous when the fruit is ripe, and I have seen pods in which every seed was bitten out and eaten by some animal before it was ripe.

But, with these few exceptions, seeds and fruits destined for dispersal by wind or water are dull green or brown, and even in plants in which the persistent calyx or bracts are coloured to make the flower the more conspicuous, as in *Bougainvillea*, *Petræa*, *Congea*, etc., the calyx or bracts usually lose their brilliancy in fruiting, and become dull and inconspicuous.

The birds which play the most important part in seed-dissemination are the fruit-eating birds which are attracted by bright colours. Among the most prominent of them here are the common bulbul (*Pycnonotus analis*, Horsf.), the dark blue starling (*Calornis chalybea*, Horsf.), and the mynah (*Mainatus javanensis*, Osb.) The hornbills (*Buceros*, *Anthracoceros*, etc.) play a large part in the dispersal of the larger seeds such as nutmegs; the pigeons (*Chalcophaps*, *Carpophaga*, *Turtur*, *Treron*) eat all kinds of fruits, especially those of *Ficus*; the parrots, of which there are here but few species, also aid in dispersal; I have seen numbers of *Palæornis* at the fruit of *Macaranga populifolia* and other trees. The graminivorous finches (*Munia maja* and *M. atricapilla*) probably account for the dispersal of many of the grasses, not only by swallowing the fruits, but also by bearing away many of the adhesive ones in their feathers. It is also very probable that the migrant waders, *Ægialitis*, *Tringa*, etc., carry seeds of marsh-loving and aquatic plants about in this manner; for a number of plants, such as *Rhynchospora aurea*, Vahl., which did not grow within a considerable distance of a stone tank in the gardens, appeared there after the visits of a snippet (*Tringa* sp.). But more direct evidence of the part played by these birds is wanted. Many other birds no doubt play an irregular part in dissemination. Mr. G. Clunies Ross tells me that on Cocos islands when the boobies are not nesting and have consequently left, the frigate birds (*Tachypetes aquila*) are unable to procure their ordinary food, which consists of fish taken from the boobies, and that they then swallow seeds of *Guilandina* and beans which they find floating in the sea, and on flying to the land vomit them up again; apparently merely using them to fill up temporarily the empty crops. In this way seeds of these plants may be carried to some distance inland.

In pointing out that coloured fruits are especially attractive to birds, it is not intended to imply that they do not seek brown or green fruits at all. On the contrary, many inconspicuous fruits are devoured by them, and the seeds thus dispersed; such are those of the Macarangas, *M. javanica*, Muell., with small brown capsules, *M. populifolia*, Muell., with green ones, which are popular with parrots and pigeons (chiefly *Treron* and *Turtur*); but there is no doubt that coloured fruits are cleared off with much greater rapidity than the dull-coloured ones.

It is not essential that fruits should be flavoured to our taste in order to induce birds or animals to swallow them. The *Macaranga* capsules, covered with a viscid gum most unpleasant to the mouth, the hot *Capsicums*, the drupes of the palm *Kentia Macarthuri*, the berries of the wild grapes (*Cissus* spp.), which have a most irritating effect on the mouth, and the poisonous fruits of *Sapium* are all highly popular with birds, and even the fruit of *Strychnos Tieute*, Bl., with its intensely bitter pulp, is eaten by civet cats. A large number of the wild fruits, too, though very astringent, are often eaten by birds or animals.

Here by far the commonest attracting colour is red, followed by orange and yellow, then come black, white, pink, purple, and blue, which last is by no means common. It is not rare to see two, and sometimes three, colours combined in the fruit or fructification, and these are usually red and black; red, black, and yellow; red and yellow, and black and white. Combinations of white with red, pink with black, and black with yellow occur more seldom.

Very many plants have red drupes or berries, especially those which inhabit thick jungles or the borders of forests, *e.g.*, *Fagrea fragrans*, Roxb., *Leucopogon malayanus*, Jack., *Piper caninum*, L., *P. nigrum*, L., and other peppers, *Anisophyllea disticha*, Baill., *Neuwiedia Curtisii*, Rolfe, many palms, *Kentia*, *Drymophlœus*, etc. Sometimes the peduncles of the fruit also become of a bright red when fruiting, making the plant even more conspicuous. This occurs in *Jackia ornata*, Wall. (Rubiaceæ), and *Medinilla Hasseltii*, Bl. (Melastomaceæ).

One very simple way in which red and black are combined is that the fruits pass through a red stage before turning eventually black, and as they are not all equally ripe at the same time, the different colours on the plant make it the more conspicuous. This is well seen in *Rhodamnia trinervia* (Myrtaceæ), and *Gynotroches axillaris* (Rhizophoreæ), common trees in open country. In the epiphytic *Heptapleurum subulatum*, the drupes pass from yellow to red and finally to black, giving a very striking effect. Sometimes the rachis or branches of the inflorescence are red, while the fruit is black; examples of this are *Nenga Wendlandiana* and *Cyrtostachys Lakka*, among palms, and *Phœbe opaca* (Laurineæ). *Pterisanthes* is a remarkable vine which has the rachis developed into a thin flat lamina in which the female flowers are embedded, the males being borne on stalks on the edge. This lamina, when the plant is in fruit, becomes of a bright-red colour, the grapes, which are sessile upon it, being black.

Sometimes the peduncle of the fruit is swollen and red, while the fruit is black or brown. In these cases it is the peduncle which is the eatable portion, the fruit or seed being protected in various ways from injury by the disseminator. Such fruits are those of the well-known cashew nut, *Anacardium occidentale*, L., a plant very commonly dispersed by birds, and *Semecarpus Anacardium*, L. In both of these the testa of the seed is charged with a black acrid resin which protects it from injury. *Dehaasia* (Laurineæ), *Podocarpus neriifolius*, and *P. cupressinus* are also examples of this colouring. *Scleria malaccensis* is remarkable for being one of the few Cyperaceæ modified for the purpose of attracting birds; in it the disc upon which the nut is seated is enlarged into a red cup with lobed edges, while the nut is dark brown or black. The combination of a red calyx with a black berry, though not very common, is a very striking form of colouring. It occurs in *Clerodendron disparifolium*, *C. nutans*, *C. myrmecophilum*, and *C. Siphonanthus*. In these the calyx, which is green in the flower, develops in fruit to a considerable size and becomes bright red, spreading out so as to set off the black or deep black-green berry. In *C. elegans* the flowers, which are clustered in a head, are white with red calyces, and the berries are black, so that the red calyx sets off the white flower first, and is utilised also to show off the black fruit. *Ixora Clerodendron* has the same arrrangement, and much resembles *C. elegans*.

One of the most remarkable modifications for dispersal that occurs here is in the fruit of *Erythropalum scandens*, Bl. (Olacineæ), a climbing shrub usually to be found on the borders of jungles. The drupe, which is about an inch long, is at first red; when ripe the outer coat splits into several lobes, which are recurved and resemble the petals of some scarlet flower, while in the centre stands the single deep-blue seed. This plant seems very attractive to birds, as seeds seldom remain very long on the pedicels.

Pink fruits are comparatively scarce, being less conspicuous than red. The pink grapes of *Cissus Hookeri*, Laws., are, however, very showy. They are as large as cherries and of a beautiful translucent pink. The most interesting plant in which pink serves as an attracting colour is *Harmandia Kunstleri*, King (Olacineæ). This is a tree with small inconspicuous green flowers, but, when fruiting, the calyx develops into a large pale-pink disc two inches across, in the centre of which stands the black oblong fruit.

Yellow drupes and berries are very common, and nearly all are inhabitants of dense jungles. Such are the various species of *Urophyllum*, some species of *Cissus*, *Chrysophyllum Roxburghii*, Don, some species of *Heptapleurum*, *Mimusops elengi* and *Microdesmis caseariæfolia*, Don, and *Champereia* (Santalaceæ). Many figs, *e.g.*, *Ficus vasculosa*, *F. urophylla*, have yellow syconia.

Black drupes, or berries, are commonest among the plants of the open country. It is comparatively rare to find them in the deep jungles, where they would naturally be inconspicuous. Indeed, when they do occur in jungle plants, they are usually set off with a red calyx or rachis, as has been already described. *Brucea sumatrana*, Roxb., *Matthaea sancta*, Bl., *Rhodamnia trinervia*, Bl., *Cissus diffusus* (Miq.), *Vaccinium malaccanum*, Wight, *Clidemia hirta*, Don, *Alpinia allughas*, L., are examples. *Geophila melanocarpa*, Ridl., however, a low herb which inhabits dense woods, has black berries like black-currants, and is certainly by no means conspicuous. *Melastoma polyanthum*, Bl., frequents open sunny spots, and its fruit, of a dull pinkish colour, would be very inconspicuous if it did not, when ripe, split transversely and disclose a black pulp containing its minute seeds. This black mass is very conspicuous, and few plants are so freely disseminated by birds as this one. A number of black-fruited trees, such as *Dialium*, *Cryptocarya*, *Parinarium Griffithianum*, Benth., are chiefly disseminated by mammals, such as monkeys and civets, as described in the paper above referred to. In *Chasalia curviflora*, Thw. (Rubiaceæ), a low shrub found in open woods, the black drupes are set off by the thickened white peduncles and branches of the inflorescence.

White berries and drupes occur commonly in plants growing in damp spots in dense jungles, such as *Adenosacme longifolia*, Wall., *Chloranthus officinalis*, *Alpinia scabra*, Bl., *Elettariopsis longituba*, Ridl., *Gomphostemma*, most of the climbing *Psychotrias*, *Pimelandra Wallichii*, Dec., *Aglaia glabriflora*, Hiern., *Clinogyne grandis*, Benth., and *Hedyotis congesta*, R. Br. This latter is especially interesting, as it belongs to a genus in which nearly all the species frequent open country and have capsular fruit. There are also a number of white-fruited plants which occur in sandy open woods near the sea, and in these the fruits are usually massed together so as to be more conspicuous. *Euthemis leucocarpa*, Jack., has the berries either snow-white, deep rose-colour, or crimson-scarlet, and *Sauropus albicans*, Bl., the fruits of which are usually white, sometimes has them rose-coloured. *Fluggea microcarpa*, Bl., *Callicarpa longifolia*, Benth., *Psychotria sarmentosa*, Bl., *Cissus carnosa*, Wall., and *Cyclea Arnotti*, Miers, are natives of river banks and hedges. They have small or medium-sized fruits, of a pure white, often massed together and very conspicuous.

Several of the Eugenias, *e.g.*, *E. zeylanica*, Wight, *E. lineata*, Bl., are very conspicuous when in fruit, being loaded with small snowy drupes, which are much sought by birds. A rather curious arrangement is found in *Sloetia sideroxylon*, Teysm. (Urticaceæ). When the fruit is ripe the green perianth is found to have increased very much in size and become of a whitish colour, and the inner pair of lobes is quite white, swollen, and fleshy, and sweet and eatable. These lobes grasp tightly the pea-shaped nut, and when a bird or other animal bites the fleshy petals the nut is shot out to a short distance, and so not only escapes injury from the animal, but is also thrown to some distance from the tree.

Blue is, perhaps, the rarest of all colours in fruits, that is to say pure blue, for there are a number of fruits of a deep steely blue which at a little distance appear black, such as those of *Cinnamomum iners*, Bl. Pure blue occurs in a few plants which inhabit dense dark jungles. Nearly all the *Lasianthi Cephaelis* (Rubiaceæ), *Symplocos fasciculata* and other species, *Dianella ensifolia*, Red., are the only blue-berried plants I have seen here. *Peliosanthes*, however, has blue seeds which are exposed in a remarkable way. The pericarp of the fruit does not increase in size concomitantly with the seeds, but is pierced by the latter, which eventually become of considerable size and drupe-like, with a thick eatable testa of a light blue colour. In some of the *Lasianthi* and *Dianellæ* the fruits are at first white, changing to blue, and sometimes they remain white even when apparently ripe. Blue is really more conspicuous than white in thick jungle where the flecks of sunlight on the wet leaves look white, and prevent isolated white fruits from being as conspicuous in the dark woods as might be expected.

Purple and violet fruits are not very common but are sometimes to be met with. *Eugenia acuminatissima*, Kurz., *Dissochæta gracilis*, Bl., *Anplectrum glaucum*, Triana, *Callicarpa rubella*, Benth., and a few others, possess purple fruits, which, however, usually look black at a short distance. They occur in open places, like most of the black-fruited plants. Many capsular fruits are brightly coloured, and in this case it is usual for the seeds to be provided with either an edible testa or an aril. Sometimes the whole fruit becomes soft and is eaten like a berry; indeed, in these cases it is sometimes difficult to decide whether the fruit is to be called capsular or baccate. *Xiphidium floribundum* Aubl. (Hæmodoraceæ), a native of South America, is an example of this. The fruit is a nearly globose orange-red capsule, the walls of which are pulpy and sweet. The cells in the ripe fruit are not filled up with outgrowths from the walls or developed placentas, as is the case in a berry, but there are large spaces between the seed and the cell-walls. Its appearance suggests that it is a capsule becoming baccate.

The variations of the arrangements for the dispersal of the seeds of capsular fruits by birds seem almost endless, and only a few of the more striking and commoner forms can be here described. As in the drupes and berries, red is the most common attracting colour. Frequently the capsule is red and the seeds are black, red, or yellow, or provided with a red or yellow aril. One of the most showy fruits is that of *Sterculia rubiginosa*, a common tree. The capsule is of an intense crimson-scarlet, and when ripe each carpel splits widely and exposes the black oblong seeds hanging from the edge by the raphe. Beneath the black testa is a thin white pulp, which is the only eatable part of the fruit. This appears to be highly appreciated by birds, which devour the seeds as soon as they are ripe. *S. parviflora*, has the same arrangement, but the capsule is pink and less showy, and I note that the seeds are less popular with birds, the ground beneath a fruiting tree being covered with fallen seeds, which is not the case with the other brighter-coloured species, *S. rubiginosa* and *S. lœvis*. A somewhat similar arrangement occurs in *Pithecolobium* (Leguminosæ). Here the pod, which is often curiously contorted, is of a bright orange-red, while the seeds are black; and in *P. fasciculatum* the seeds, very much like those of *Sterculia rubiginosa* in appearance, are pendulous and conspicuous and very soon carried off by birds. *P. lobatum* is an exception to this plan; the fruits and seeds are very large, too large to be taken off by any ordinary bird. They are dispersed by squirrels, and, as in all plants dependent on mammals for dispersal, they are not gaily coloured, the pod and seeds being of a dull brown. I once saw a squirrel running with one of these seeds in its mouth fully a hundred yards from the tree. It dropped the seed, which I found to be quite sound, though it had nibbled off much of the testa.

Ternstrœmia penangiana is commonly described as having a baccate fruit, but it should rather be described as capsular. It consists of an elliptical scarlet capsule which splits open and permits three or four crimson seeds to hang out. The crimson outer covering, apparently part of the testa, is eatable, and a tree in fruit with the scarlet and crimson fruit standing out against the deep green leaves is very showy.

In some plants, such as *Gardenia tubifera*, a common tree in jungles, the outside of the fruit, which is generally spoken of as baccate, is of a dull green colour and quite inconspicuous, but it breaks open irregularly, and then the inner lining of the woody pericarp is seen to be of a bright orange, setting off the black seeds which are enclosed in a sweet shining substance.

Fagrœa imperialis is an interesting example of modification of the arrangement for dissemination entailed by the modification of other parts of the flower. The genus to which it belongs consists of a number of species very different in the size of flower. *F. fragrans*, with small flowers in corymbs, has small orange berries, dispersed by birds and bats. *F. zeylanica* has large flowers and globose grey berries an inch and a half in diameter; too large for our small birds, and thus adapted rather for dispersal by civets. *F. imperialis* has enormous flowers, followed by correspondingly large fruit six inches long and conical in shape. It would be impossible for any of our birds to carry them away whole, so some modification becomes necessary. The fruit, which is of a grey colour outside, splits vertically, and the segments enclose an orange-coloured conspicuous pulp easily accessible to birds, which must swallow the minute seeds with the pulp. Unlike the fruits of *F. zeylanica* this fruit is not readily detachable, as it would not be to the advantage of the plant were it to fall off easily; whereas in *F. zeylanica* the fruit readily falls off whole without ever splitting, and it being intended to be taken whole by nocturnal animals, the pulp is not coloured.

One may compare the arrangement in *F. imperialis* with that in *Momordica Charantia*, a pumpkin half wild, and cultivated all over the tropics. This pumpkin is, in many forms at least, too large for birds to carry off whole. It therefore splits, and the segments recurve and expose the seeds lying in a sweet crimson aril.

In this case, however, the fruit itself is of a brilliant orange, and the colouring of the segments sets off the crimson seeds well. Its appearance suggests that at one time the fruit was small and eaten whole; but as it increased in size and its disseminator was unable to carry the whole fruit off, it was so far modified that it practically became capsular with arillate seed so as to suit the exigencies of the case. In very many capsular fruits the seeds are provided with an eatable aril of very variable size, sometimes so small that one wonders that birds or mammals should find it worth while to seek it. *Dysoxylon cauliflorum* (Meliaceæ) is an excellent example. The capsules are about an inch long, ovoid, and of a bright orange-red. They are borne on the trunk of the tree, and, when ripe and split, stand horizontally, the apex facing the spectator. The seeds are black and from two to four in number. On the apex of the inner face of each is a small but conspicuous orange aril not a quarter of an inch long. This is the only part eaten, and I can perceive no taste in it, yet it is a most popular fruit, being eaten, not only by birds, but also by squirrels and Tupaias as soon as it is ripe. *D. acutangulum* has a very large orange capsule, as big as a small pear, in each cell of which is a single large black seed with a yellow aril, forming a contrast of three colours. Another species of *Dysoxylon* (*D. angustifolium*) is chiefly remarkable for its capsule being creamy white. It splits at the apex and discloses three or four seeds covered with a thin crimson aril, which is very sweet.

The split carpels of the *Wormias* (Dilleniaceæ) are nearly as showy

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as their beautiful flowers. In *Wormia suffruticosa*, a large shrub common in the south of the Peninsula, the carpels, when ripe, split and spread out in the form of a large pink rosette, exposing the small black seeds provided with a sweet red aril. The seeds are carried off by birds very speedily, and so well disseminated that the plant appears in all kind of odd places. *W. tomentella* has the same arrangement, but the carpels are white. In the allied genera *Delima* and *Tetracera*, the carpels are small and of an inconspicuous brown colour, but the black seeds are ornamented with a fimbriated crimson aril, which only partially covers them.

The form of the fruit of the common nutmeg (*Myristica moschata*) is well enough known, but it is interesting to compare it with those of others in the genus. In *M. moschata* the pericarp is dull yellowish, the aril a loose crimson network partly covering the black testa of the seed. In *M. Farquhariana* the pericarp is of a bright orange-pink, while the aril is yellow and completely covers the seed. In this case, and in all other similar ones that I have seen, the testa, being covered completely with the aril, is merely brownish, and is not jet black, as it is in all cases where the aril does not completely cover it, for it is of no advantage to the seed to be fully black when the contrast of the two colours would not be visible. In a few wild nutmegs the fruit is bright pink outside and the aril yellow, but as a rule the pericarp is not very conspicuous.

The Euphorbiaceous genus *Baccaurea* is an interesting one in its variety of adaptation for dispersal. In *B. motleyana* the fruit is really baccate; that is to say, the pericarp is soft and leathery, and does not split. The berries are creamy-white, about an inch and a half long, and contain three or four seeds enclosed in a white translucent pulp. The fruit is produced on the trunk of the tree. In this position it is not easy for birds to see it or to get at it, and it seems to be exclusively dispersed by mammals. The fruit much resembles that of the Langsat, *Lansium domesticum* (Meliaceæ), which is dispersed in a similar way. In *Baccaurea parviflora* we have the fruit produced in masses at the base of the tree, where there is sometimes quite a large pile of it. It is deep claret-colour, practically black, the pericarp fleshy and eatable. It is, I believe, dispersed by mice, which carry off the fruits and drop the seeds about. Here the whole fruit is eaten.

Many species of *Baccaurea* bear their long racemes of fruit on the branches of the tree. The fruits are globose, or nearly so, and capsular. They are of a greenish, or more commonly yellow or orange-colour, but the pulp is bright orange. In most species, when the fruit is ripe the pericarp splits in three and falls off, leaving the seed enclosed in its sweet yellow pulp, hanging attached to the very long placentas (*B. minor*).

Before concluding, I would refer to the suggestion that has sometimes been made that some of the seeds of Euphorbiaceæ, notably those of the castor-oil plant (*Ricinus*), resemble beetles, and, as such, may be mistaken by birds and carried a small distance before being dropped. This seems very doubtful. *Ricinus* seeds and those of Para rubber (*Hevea braziliensis*), which resemble them on a large scale, are ejected explosively from their capsules to a distance quite sufficient for their dispersal, and falling, as they constantly do, among other herbage, would certainly escape most insect-eating birds.

Mimicry in another form plays, I believe, a considerable part in ensuring the dispersal of such seeds as those of *Adenanthera bicolor* and *Abrus precatorius*. In the former, a big tree, the pod splits and allows the seed to hang out, as it does in *Pithecolobium*; the seed is half scarlet and half black, the effect at a little distance being that of a black seed with a red aril, the red, as is usual in arillate seeds, being at the base. A bird flying past the tree might readily pick off the seeds, under the impression that they were provided with an eatable aril, and would quickly swallow them. The seed is very hard, and cannot supply any nourishment to most birds, who would be unable to break it up or digest it. There is reason to believe that birds do carry away the seed, but, after fruiting, a considerable quantity is left beneath the tree. *Abrus*, which is a climber, may sometimes get disseminated in a similar way; but here, at least, it usually frequents sea-shores, and the seeds are drifted about in the sea, and may rather be classed as sea-borne. In *Adenanthera pavonina* and most of the *Ormosias*, the seed is entirely red and shiny, certainly suggestive of a soft, eatable aril, and I have little doubt, from the position in which I have found plants, that birds have borne away the seeds.

In order to show what an important part birds play in dispersal of seeds, I examined a number of trees in the botanic garden, such as oil-palms (*Elæis Guineensis*) and dates (*Phœnix dactylifera*), which, owing to the retention of the bases of the leaves, form a nidus for the growth of any seeds which have fallen therein. I give a list herewith of plants found on these trees.

On an oil-palm tree:—*Rhodamnia trinervia*, fruit a berry much sought by bulbuls; *Ficus urophylla*, figs orange, eaten by birds; *F. Miquelii*, figs dull red or green, eaten by fruit-bats. On another oil-palm:—*Clidemia hirta*, berry black, much sought by birds; *Fagræa fragrans*, berry orange, much sought by birds; *Ficus* aff. *Benjamina*, fig black, much sought by birds; and many ferns. On another: *Ficus* sp., *Clidemia hirta*, *Phyllanthus Niruri* (several plants very high up the stem).

On a sago-palm (*Sagus lævis*):—*Clidemia hirta*; *Macaranga hypoleuca*, capsules eaten by pigeons and parrots; *Melastoma polyanthum*, eaten by birds; *Ficus alba*, figs orange, eaten by birds; *F. Miquelii*; *Dacrydium cupressinum*, seed with red peduncle, eaten by birds; *Psychotria* or *Ixora*, drupe probably red.

On the stem of a date-palm (*Phœnix dactylifera*):—*Ficus urophylla*; *Phyllanthus urinaria*; *Davallia solida*; *Nephrolepis*; *Psilotum complanatum* (the last three wind-dispersed). In the last case the greater part of the plants are wind-dispersed, as the tree is not well suited for birds to roost in, and the stem is much exposed to the breeze.

The greater part of this tree-flora is, it will be seen, composed of bird-disseminated plants, the remainder being wind-drifted, with the exception of the herbaceous *Phyllanthi*. I cannot suggest how these plants succeeded in getting so high up the trees.

But besides roosting upon trees, birds have a habit of frequenting bushes, and often drop seeds round the buttressed trunks of big trees. These spring up and form thickets; more birds come and bring more seeds, and so, eventually, woods may be formed. I have examined several instances of this in the Botanic Garden, which are very instructive.

A very lofty tree of a new species of *Terminalia* allied to *T. pyrifolia* has a big climber, *Spatholobus gyrocarpus*, at its base, which climbs to the top of it. Birds frequently roost there, and have produced a veritable thicket of shrubs between the stem of the climber and the buttresses of the tree, including: *Flacourtia cataphracta*, a tree with a dark red berry, very popular with birds; *Erycibe Princei*, berries dark red; *Passiflora laurifolia*, fruit eaten by birds and bats; *Pithecolobium lobatum*, seed carried about by squirrels, which very commonly frequent this tree; *Fibraurea tinctoria*, a large yellow drupe usually carried about by civets, but also, I believe, eaten by birds; *Clerodendron disparifolium*, berry black, with a red calyx, eaten by birds; *Scleropyrum Maingayi*, a shrub with green fruits (I cannot guess how this got here; it is a rare plant and I do not know of its occurrence within ten miles); *Agrostistachys longifolia*, a shrub, the seeds of which are dispersed by explosion of the capsule.

A large *Shorea leprosula* close by offers shelter to: *Pithecolobium lobatum*; *Passiflora laurifolia*; *Cupania pallidula*, a tree with red capsules and black seeds, with a yellow aril much sought by birds.

A large bush of *Bougainvillea spectabilis*, a favourite resort of birds, contains: *Embelia Ribes*, with red drupes very popular with birds; *Cissus sagittifolia*, grapes black; *Clidemia hirta*.

A large much-branched *Ficus* standing alone on the lawn bore between its stems many plants, some of which are now fairly large trees, namely: *Eugenia Jambos* and *E. grandis*; *Calophyllum Inophyllum*, these are usually disseminated by fruit bats, which roost in the tree; *Flacourtia calaphracta*, several plants; *Cinnamomum iners*; *Quassia amara*; *Arthrophyllum diversifolium*, fruit green; *Rhodamnia trinervia*; *Ilex cymosa*; *Olea maritima*; *Gomphia sumatrana*, drupes black on a red disc; *Cupania pallidula*; *Lantana Camara*; and *Caryota mitis*; of the last two the drupes are black and eaten by birds. Indeed, all these are commonly eaten by birds, their fruit being drupaceous or baccate, except *Cupania*, *Thunbergia laurifolia*, and *Ruellia repens*, the two latter having explosive capsules. The last is common in the surrounding grass.

These are examples of the results of dissemination by birds, and it may be said that far the larger number of seeds are evidently brought from no great distance, a hundred yards or so at most, but other examples make this clear. *Kentia Macarthuri*, a palm cultivated in the gardens, the scarlet drupes of which are very popular with the blue starling (*Calornis chalybea*), constantly appears as seedlings within an area of about twenty yards; but looking all about the garden I cannot find any at a greater distance; *Olea maritima*, a sea-shore plant cultivated in the gardens, has spread for a distance of a hundred yards, and though it grows very well in many spots where the seeds have been carried by birds, yet I cannot find any plants beyond that radius. *Clidemia hirta* a South American plant, which was probably accidentally introduced into the gardens and is now a troublesome weed there, is confined to a very few spots in Singapore, and though abundant in these is extending its area very slowly. *Brucea sumatrana* was collected by Wallich in Singapore in 1822, but I have never been able to find it again here. However, in 1891 I brought seeds from Pahang, which grew and fruited, and now young plants often appear along the roadsides near the gardens, the seeds being carried about by birds. Birds, as a rule, it appears, remain about a tree so long as it has any fruits on it, and discharge the seeds in the immediate neighbourhood. That they do sometimes carry seeds to a great distance also is shown by the number of bird-disseminated plants in ocean islands; but this is probably very exceptional, as otherwise many local plants would be much more widely dispersed than they are. Further information is, however, required on this subject, and it is well worth the attention of field-naturalists.

H. N. Ridley.

Singapore.

SOME NEW BOOKS.

Darwin and After Darwin.

Darwin and After Darwin: An Exposition of the Darwinian Theory and a Discussion of Post-Darwinian Questions. By the late G. J. Romanes, F.R.S. II.—Post-Darwinian Questions: Heredity and Utility. Pp. x., 344. London: Longmans, Green & Co., 1895. Price 10s. 6d.

Professor Lloyd Morgan has edited tnis volume, and he tells us that he has made no substantial additions, as the greater part of the book had been prepared before the death of its author. The present volume consists of an Introduction, a section on Heredity, and a section on Utility. Isolation and Physiological Selection are reserved for a third volume.

In the Introduction, Professor Romanes distinguishes between the Darwinism of Darwin, what he calls the Darwinism of Wallace, and the neo-Lamarckian schools. He begins by a series of quotations, to show that Darwin did not insist on the all-sufficiency of natural selection, his point being to suggest that other naturalists are departing from orthodox Darwinism. Now we grant his quotations completely, and agree that they fully bear out the somewhat unnecessary proposition that Darwin, to use his own words, believed natural selection to have been "the main, but not the exclusive means of modification." With the minor means of modification, from use-inheritance to physiological selection, an indefinite number of names are associated; the name of Darwin has been and will be associated with the origin of species by means of natural selection. That was his theory: the other "causes" were mere shifting accessories; many of them accepted by Darwin, as by others, on trust, and not questioned until the passing of the years and the progress of knowledge threw doubt on them.

Section 1 of this volume deals with characters as hereditary and acquired. It is somewhat remarkable that Romanes himself, and his editor, allowed a large part of this section to stand. Those who are familiar with the controversy as to the inheritance of acquired characters will remember that Romanes chose to assume that Weismann made the non-inheritance of acquired characters a fundamental postulate from which to deduce his theory of the germ-plasm and his theory of evolution. It has been pointed out sufficiently often that Weismann did not begin by doubting the evidence of acquired characters, but that his conception of the continuity of the germ-plasm led him to doubt their inheritance and to examine afresh the supposed evidence in its favour. However, Romanes wrote his "Examination of Weismannism" on the double theory that non-inheritance was a fundamental postulate and that the slightest possibility of use-inheritance would be fatal to all Weismann's views. In his recently published "Life and Letters" we find that Romanes read the "Germ-plasm" only after he had written the "Examination of Weismannism," and that he thought it "a great nuisance" to find that Weismann had anticipated the points of all his longer arguments. Weismann had shown, in the plainest fashion, that his views of non-inheritance were inferential, not fundamental, and he had actually included the possibility of the inheritance of acquired characters in his theory. Perhaps it was too much to expect from Romanes that he should have withdrawn or altered his "Examination"; but for this volume there was no excuse. Professor Romanes was not ignorant, and his editor has no business to be ignorant, that the attack upon Weismann is based on a position which Weismann does not hold.

The longer part of this section is devoted to a summation and criticism of the evidence in favour of use-inheritance. The most interesting and novel part of this is the suggestion that the acquisition of reflex actions furnishes indirect evidence in favour of use-inheritance. A brainless dog, for instance, will make scratching movements with its paws when its sides are irritated. Romanes suggests that even if the removal of parasites could have been of advantage in the struggle for existence, a dog with a brain would have removed them by a conscious act, and a reflex act, therefore, would not have been produced by selection. But the memory of the habit, if transmitted, might be the source of the reflex on the supposition of use-inheritance being a fact.

We admit freely the ingenuity of the argument. But we know too little of the real nature of reflex actions to base any sound argument upon the nature of their acquisition. Moreover, it seems to us plain that the possession of reflexes is of the highest utility to any creature. It is no answer to say that reflexes can always be replaced by conscious acts. Nothing is more difficult than to perform two conscious correlated movements of different kind simultaneously, as anyone may see who tries to card wool in different directions with each hand at the same time. The chapter on the direct evidence in favour of the inheritance of acquired characters gives an account of many experiments upon guinea-pigs and so forth, in which Romanes, following Brown-Séquard, tried to gain evidence of the inherited results of nervous lesions. The chapter only makes us regret more than ever the early death of the author. He was admirably patient in executing experiments, and brilliant in conceiving them. But he had not got nearly far enough to show positive or negative evidence of any validity. In fact, we feel that the whole of this section upon characters as acquired and hereditary has little scientific value.

The last section of the volume deals with characters as adaptive and specific. It is directed mainly against the position, urged with great force by Wallace, that all specific characters are either directly useful or are correlated with characters directly useful. Romanes' method is to produce instance after instance of characters whose specific nature is admitted, but whose utility it is impossible to see. For our own part, we find such arguments not a little futile. The study of correlations is in its infancy. Exact inquiry into the relations between death-rates and variations is equally young, and upon these two must depend any definite knowledge of the "way the wheels go round" in organic nature. None the less, this last section of Romanes' volume is exceedingly interesting, and more than justifies a book whose earlier part requires no small justification.

HENSLOW *versus* DARWIN.

THE ORIGIN OF PLANT STRUCTURES BY SELF-ADAPTATION TO THE ENVIRONMENT. By the Rev. George Henslow. Pp. xiii., 256; Int. Sci. Series, vol. 77 London: Kegan Paul & Co., 1895. Price 5s.

MR. HENSLOW aims high. He is going to prove that natural selection plays no part in the origin of species. In a former volume of the same series, "The Origin of Floral Structures through Insect and other

Agencies," he endeavoured to show that the direct action of the environment, coupled with the responsive power of protoplasm, were the sole and efficient causes of the forms of flowers; the object of the present work is to substantiate those statements for vegetative structures, "so that the two books taken together, it is hoped, will furnish a tolerably complete proof that the origin of all plant structures issues from self-adaptation to the environment (directly or indirectly), without the aid of natural selection."

There are twelve chapters. The first is introductory; in it the writer states his case and draws his conclusions. The rest are occupied with an account of the structural peculiarities of plants growing under certain conditions, such as desert plants, arctic and alpine, maritime and saline, aquatic; of climbing plants; of subterranean stems and roots; and of leaves.

We can recommend the book. Mr. Henslow has been at great pains to bring together a large number of facts, which will interest and instruct the reader and convince him that plants are more plastic organisms than he had probably imagined. But we do not think his opinion as to the value of natural selection will be at all influenced thereby. Before he has got through many pages he will be struck with the fact that Mr. Henslow's arguments may sometimes be used against his theory. For instance, in an early paragraph in the introduction on "The Supposed Requirements of Natural Selection," the author asks if there is any evidence, direct or indirect, that trivial morphological differences are of the slightest consequence to a seedling so as to enable it to survive in the struggle for life. "A seedling," he says, "survives among others solely because it is vigorous." But what *is* "vigorous"? In some cases it may mean larger cotyledons, giving it a greater assimilative area; or a taller stem, to lift those first leaves above its competitors; or a thicker cuticle, to withstand better the attacks of parasitic fungi, like that which is often so fatal to seedlings, the "damping off" fungus. He then instances several experiments, to which others might be added, that larger seeds will produce stronger seedlings than smaller seeds. That is to say, trivial differences in the seeds from the same capsule, such as in size or in amount of stored nourishment, or in a thinner or thicker seed-coat, *are* of great importance to the embryo in its development to form a seedling, and the experiments quoted by Mr. Henslow do indicate a selection by nature of the resulting seedlings, the basis of that selection being the trivial variations.

In the next section, on "Darwin's fundamental error," Mr. Henslow refers with regret to the large proportion of Darwin's work which was done on domesticated plants and animals. The evident artificial selections led him to the erroneous assumption of natural selection. On the whole, however, we are not sorry that the author of the "Origin of Species" was attracted to the study of the variations of plants and animals under domestication. Had it been otherwise his greatest work embodying his greatest idea might never have been written, and biology might have had to wait for someone else to give it the enormous impulse which has followed its publication.

Many botanists will admit that Darwin did under-estimate the action of the environment, and Mr. Henslow does good service in bringing together a large number of facts in evidence of such action; but it is possible to recognise this and still to leave ample room for the action of natural selection, even though we cannot go and sit down in a field and observe nature in the act of selecting before our very eyes.

The purchaser of the volume may or may not be pleased to find that he has also acquired a classified list, occupying eighty pages, of Messrs. Kegan Paul & Co.'s publications, though one of their most important botanical works is, we notice, conspicuous by its absence.

Biblical Botany.

The Plants of the Bible. By the Rev. George Henslow, M.A., F.L.S. Fcap. 8vo. Pp. 128, with 7 plates. London: Religious Tract Society. Price 1s.

This little book forms one of the "Present Day Primers" series in course of issue by the Religious Tract Society, for the benefit of ministers, teachers of Bible-classes, and all general readers who take an intelligent interest in subjects connected with Biblical study and with religious life and work. From this point of view, Mr. Henslow's brief account of the plants referred to in Holy Writ forms a useful little volume, and should find a place in every Sunday-school library. In the introduction is a short account of the flora of Palestine and its relation to those of neighbouring countries. The eleven chapters that follow treat of textile materials, herbs, odorous gums, resins and perfumes, fruit trees, timber trees, desert trees and plants, field weeds and water plants. Wherever possible, the plant-name of Scripture is correlated with its modern equivalent, and some account of its habit and properties is introduced, while the author often improves the occasion with a few remarks of more religious tone.

British Land and Fresh-water Molluscs.

A Monograph of the Land and Fresh-water Mollusca of the British Isles. By John W. Taylor, F.L.S., etc. Parts I. and II. 8vo. Pp. 128, with 2 coloured plates, and woodcuts. Leeds: Taylor Bros., 1894–5. Price 6s. per part.

Since the appearance of Jeffreys' book in 1862 and Reeve's in 1863 no work of first-rate importance on the non-marine Mollusca of the British Islands has appeared, although Tate, Rimmer, Adams, and writers of still less conchological note have from time to time put forth small volumes intended to be more or less popular treatises on the subject. Hence the time is fully ripe for the publication of Mr. Taylor's Monograph, which has been expected for many years. As all readers of the *Journal of Conchology* know, the quondam editor of that periodical has had the subject thoroughly at heart for many a year, and has spared no pains in the endeavour to master it, his efforts being crowned with a success which is all the more noteworthy considering its study had to be pursued in the leisure moments of a busy commercial career. That the present work should show traces of this handicapping was, of course, inevitable; the wonder is that more shortcomings are not visible.

In the two parts, whose appearance has been separated by a considerable interval of time, the author cannot be said to have touched the subject in question at all as yet, for, not without wisdom, he has prefixed some considerable preliminary matter which almost amounts to an introduction to Conchology in general. Starting with a definition of the science, he proceeds to give outlines of classification and nomenclature, whence he passes to the structure of the shell, its form and variations, both normal and abnormal, in shape, size, and colour; while remarks on the operculum and clausium bring the second part to a close.

Having hinted at shortcomings, perhaps it may be as well to dispose of the more prominent of these. At the outset, it seems a pity Mr. Taylor should have gone to an obsolete encyclopædia-article for a scheme of classification of the Mollusca, that he should have given a hopelessly out-of-date tabular view of the orders, etc., and have copied an unworkable diagram to explain the "visceral loop." The old and erroneous theory of the iridescence of nacre being due to lines of outcropping laminæ, with the popular misreading anent Brewster's button, once more makes its appearance, although a balancing sentence is inserted in part ii., where the subject is again brought forward, showing that the author evidently had his misgivings. For the system of bestowing extra or varietal names on what may be termed normal variations and on monstrosities, no word of condemnation is too strong. Again, why give to each figure of a shell the name of the collector, while the author of the anatomical diagrams is unacknowledged, whereas he at least has done something? "*Pereger*," we might hint, is considered by the best classical authorities to be a substantive and not an adjective; hence "*Limnæa peregra*" is not permissible. The nomenclature in other places is, we suspect, not above question, but that will be better seen when the systematic portion comes to hand. Many other major and innumerable minor points for criticism abound, but there is so much downright honest work to be grateful for that naught more shall be said, save to suggest that Mr. Taylor would do well to keep a closer eye on NATURAL SCIENCE if he wishes his work to be up to date.

A first cause for gratitude strikes the eye immediately on opening the book: it is the abundance of new, and, with few exceptions, excellent illustrations. They are so admirable that their frequent repetition is by no means a matter for resentment. The coloured plates, also, are far and away the best of their kind that have appeared in any English—we beg pardon—British work on the subject: their defects are those inherent in chromo-lithography. Of the text as a whole it is scarcely possible to speak till more be finished, but Mr. Taylor in those portions of his work where he is thoroughly at home expresses himself both clearly and well. Occasionally there is a repetition, as in the account of the iridescence of nacre, and in the description of the hypothesis of hyperstrophy (pp. 111, 112). This last subject is, however, very well handled and, moreover, may be quoted as evidence of how anxious the author is to do ample justice to his theme, since internal evidence shows that when the first part was written he still retained the impression that *Planorbis* was a dextral form, and changed his views later, owing, probably, to the appearance of Vanstone's paper in the *Proceedings* of the Malacological Society of London. Hyperstrophy and heterostrophy are, it may nevertheless be remarked, a little out of place under the heading "Monstrosities."

The work when complete will be one that cannot fail to be most serviceable to all varieties of conchologists, and we doubt not that the appearance of each future part will be eagerly looked forward to by all, more especially by those who, being distant from any good museum, require a well-illustrated guide such as this to aid them in their studies. B. B. W.

THE PERMIAN VERTEBRATA OF BOHEMIA.

FAUNA DER GASKOHLE UND DER KALKSTEINE DER PERM-FORMATION BÖHMENS. By Dr. Anton Fritsch. Vol. iii., pt. 4, pp. 105-132, pls. 123-132, with title-page and index to vol. iii. Prague: Fr. Rivnac, 1895.

IN reviewing the last part of Dr. Fritsch's well-known work on the Bohemian Gas-coal (NAT. SCI., vol. vi., 1895, p. 132), we referred to the interest of the Palæozoic Palæoniscid fishes as the probable ancestors of the modern sturgeons and their allies. The new part of this work, which completes the third volume, is again devoted to these fishes as represented in the Permian rocks of Bohemia, and summarises the author's general results. The systematic descriptions are continued in the usual manner, with numerous drawings of technical points and a few restorations of species of *Amblypterus*. There are also some beautiful drawings of the ornamented head-bones of the latter genus.

The largest known Palæoniscid fish, more than a metre in length, is the gem of the collection described. It is named *Acrolepis gigas*, and exhibited in the Royal Bohemian Museum, Prague.

Among the general observations it is interesting to note that the cranial bones are proved to be thickest when least ornamented, thinnest and most irregular when the ganoine is best developed. Large otolites appear in at least one species of *Amblypterus*. There is no undoubted evidence of calcifications in the sheath of the notochord.

We are glad to add that, having now completed the consideration of the Vertebrata, Dr. Fritsch will next proceed to the description of the Invertebrata of the Bohemian Permian rocks; and there will be a supplement at the end of vol. iv. to complete the whole work.

MENS INSANA IN CORPORE INSANO.

THE DISEASES OF PERSONALITY. By Th. Ribot, Professor in the Collège de France. Pp. viii., 162. Chicago: The Open Court Publishing Company, 1895.

PROFESSOR RIBOT has written sensibly and with adequate knowledge and caution on a subject of great interest and difficulty. He takes his stand upon the complex unity of consciousness as correlated with the complex unity of the normal and healthy organism. He shows that by a suppression of elements or derangement of elements in this complex unity, under abnormal or morbid conditions, the personality undergoes proportional modification. He works his way onward, in a treatment which is always lucid and sometimes brilliant, from cases in which the modification is slight and superficial to cases in which it is profound and conspicuous. We welcome this book in its Englished form and express our conviction that, though much still remains unexplained, the author rightly indicates the direction in which explanation is to be sought. C. LL. M.

CAVES AND THEIR INHABITANTS.

LES CAVERNES ET LEURS HABITANTS. By Jules Fraipont. 8vo. Pp. viii., 334, with 89 illustrations in the text. Paris: Baillière, 1896 [1895]. Price 3fr. 50c.

PROFESSOR FRAIPONT has added to the *Bibliothèque scientifique contemporaine* a useful little book detailing the state of our present knowledge on caves and their contents from the various points of view of geology, zoology, anthropology, history, and folklore. He devotes special chapters to the periods of *Elephas antiquus* and *Rhinoceros merckii*, the Reindeer and the Neolithic periods, and further deals with the age of metal and with historic times. An account is also given of legends and popular traditions attached to caverns. There are plenty of references to previous authorities, and this renders the book most useful to the reader; but mention should have been made of the important discoveries by Benjamin Harrison in the Plateau gravels of this country.

Bibliographies.

The bibliography of science is advancing rapidly towards more complete harmony and organisation. The Geological Survey of Belgium has long laboured in the bibliographic field of its own country. It intends shortly to publish a periodical bibliography in conformity with the decimal classification adopted by the Institut International. This work, which owes its origin to the energy of Mr. Michel Mourlon, will, as we have previously stated, be entitled *Bibliographia Geologica*. The Botanical section of the American Association for the Advancement of Science has been studying the working of the Zoological Bureau, and is likely to establish a similar bureau for botany. The International Congress of Physiology, which was held at Berne last year, adopted similar rules to those already put forward by the Association Française pour l'Avancement des Sciences, and by the International Bibliographic Congress held at Brussels. Professor Michael Foster and Dr. C. Richet, who were appointed on the bibliographic committee of the Congress, have investigated the decimal system of classification in its working at the Institut International in Brussels, and have, we understand, been favourably impressed with its applicability to all branches of science.

We have not hitherto alluded to the fact that the Department of Agriculture of the United States has for some time published a card catalogue entitled "Subject Index of Literature of Agricultural Experiment Stations and Kindred Institutions." The cards used are naturally those issued by the Library Bureau, and the classification adopted is analogous to, though not identical with, the decimal classification of Melvil Dewey. For the period from the beginning of 1888 to the middle of 1893, 9,000 slips have been published and a set is presented to every school of agriculture and every experiment station in the United States.

The Geographers, at their recent congress in London, also discussed the subject of bibliography, but left the final decision to the next congress. Meanwhile, in many countries valuable bibliographies of this subject are being published, such as the "Bibliotheca Geographica Germaniæ," by Dr. Richter of Dresden, the annual report on Austrian geography, edited by Dr. Sieger, and the "Bibliotheca Geographica Ungarica," by Dr. Rudolf Havass, which has already brought the bibliography of Hungary down to 1849, and which is to be continued by the Hungarian Geographical Society. In Switzerland, a great national bibliography is being produced by a central commission, and some 60,000 titles have already been published. In Europe, the United Kingdom shares with Spain *otium cum indignitate*. Even Brazil, Uruguay, and the Argentine Republic are engaged in bibliographing their own geographies, while the subject is being taken up in Egypt, in the United States, in Paraguay, in Australia, and in Canada. A catalogue of 3,800 writings and works relating to the geography and colonisation of the Congo has been produced by Messrs. A. J. Wauters and A. Buyl at Brussels.

The cause of decimal classification has received a temporary setback owing to the destruction of a large instalment of Professor Melvil Dewey's work, which was destroyed on its way to Europe, owing to the disablement of the s.s. "Cephalonia." We also deeply regret to hear of the serious illness of Dr. Haviland Field. Although a temporary substitute is engaged, this cannot but impair the efficiency of the Bibliographical Bureau for Zoology at the very time when it most needs Dr. Field's experience and enthusiasm.

Some Serials.

With reference to the note on *Science Gossip* that appeared in our February number, the editor has written to us as follows:—"I regret to say that from unavoidable circumstances, which I am glad to tell you were removed during the past week, *Science Gossip* has been late in publication, but we shall immediately pick up our arrears. On and after March 25 the magazine will appear as usual on the 25th of each month." We are exceedingly glad to hear that this rightly popular monthly is emerging from its retirement. The November number, which reached us after our February number was published, contains several interesting articles, among which we may mention some notes by Wilfred Mark Webb on Protective Coloration in British Clausilias, some of which resemble the bud-scales of the trees under which they live. There is also a suggestive article by J. H. Barbour, entitled "Unanswered Questions in Botany."

We have received volume v. of the third series of the *Journal of Microscopy and Natural Science*, which is the journal of the Postal Microscopical Society. Among the more interesting articles in the volume may be noticed a translation of Dr. F. Vicentini's memoir on the "Bacteria of the Sputa and Cryptogamic Flora of the Mouth." The editor states that this translation will shortly appear in book form, with a preface by Professor W. D. Miller, of Berlin, and with a bibliography and other additions by the author. The whole volume is full of interesting articles and shorter notes, and contains many original illustrations.

Volume iv. of the *Journal of Malacology* has also been received. Mr. Wilfred Mark Webb, who has been acting-editor during the past year, is to be congratulated on the success of his efforts in maintaining this useful little publication. He himself contributes to the present volume a paper on British *Testacellæ*, and some other notes. Among the contributors we notice the names of the Rev. A. H. Cooke, Charles Hedley, Walter E. Collinge, F. A. Bather, G. W. Chaster, and E. R. Sykes. The most important section of the *Journal* appears to us to be the bibliography of current malacological literature, which will in future be superintended entirely by the last-named gentleman. We understand that, owing to pressure of work, Mr. Collinge has now definitely retired from the editorship, and for similar reasons can no longer undertake to identify collections of slugs.

Literature Received.

Deep and Shallow-Water Fauna of the Kerguelen Region, John Murray: (*Trans. Roy. Soc. Edin.*). Catalogue of Fishes, G. A. Boulenger; Catalogue of Mesozoic Plants, A. C. Seward; Catalogue of Fossil Birds, A. S. Woodward: British Museum (Nat. Hist.). Evolution and Man's Place in Nature, Henry Calderwood: Macmillan. Grundriss der Krystallographie, G. Linck; Ueber Germinal Selection, A. Weismann: Fischer, Jena. By Tangled Paths, H. M. Briggs: Warne.

Entwurf einer Gliederung der pelagischen Sedimente des Trias-systems, E. Mojsisovics, W. Waagen, and C. Diener. Étude sur Mammifères, R. F. Scharff: Soc. Zool. France. Flora of Nebraska, pt. xxi., Rosales, P. A. Rydberg: Neb. Dept. Bot. Vanua Lava, J. J. Rendle: *Rep. Geol. Soc. Australia.* Notes on Georgina Basin, R. L. Jack: *Proc. R. Soc. Queensland.* British Geology, T. M. Reade: *Geol. Mag.* On Probable Origin of N.A. Species of Diabrotica, F. M. Webster: *Journ. N.Y. Ent. Soc.* History of Mankind, F. Ratzel, pt. v.: Macmillan. Royal Natural History, pt. xxviii.: Warne. Report on Injurious Insects, 1895, Ormerod: Simpkin.

Knowledge, Feb. Review of Reviews, Feb. Nature, Jan. 16, 23, 30, Feb. 6, 13. Literary Digest, Jan. 11, 18, 25, Feb. 1, 8. Revue Scientifique, Jan. 18, 25, Feb. 1, 8, 15. Irish Naturalist, Feb. Revue Générale des Sciences, Jan. 15, 30. Feuille des jeunes Naturalistes, Feb. Naturen, Jan. Nature Notes, Jan., Feb. American Journ. Science, Feb. Naturæ Novitates, Jan. (1 & 2). American Geologist, Feb. American Naturalist, Feb. Victorian Naturalist, Nov. Science, Jan. 31. Scottish Geographical Magazine. Feb. Science Gossip, Nov., Dec. The Naturalist, Feb. Westminster Review, Feb. Botanical Gazette, Jan. Biology Notes, Jan. The Photogram, Feb., and special no. Bull. Inst. Internat. Bibliographie, 2 & 3. Princeton Contrib. Psychology, vol. i., no. 3.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments have recently been made :—M. D. Hill, to succeed W. L. Sclater as curator of the Museum and Lecturer in natural science at Eton College; Dr. Otto Mügge, to be Professor of Mineralogy at Königsberg; Dr. A. Weiss, to be Assistant in the Mineralogical Institute of Greifswald University; Professor Theodore von der Goltz, to be Professor of Agriculture at Bonn University; Dr. K. Fritsch, to be Extraordinary Professor of Systematic Botany in Vienna University; Dr. K. Mikosch, to be Professor of Botany at the Brünner Polytechnikum; Felix Bassler, as Assistant in the Agricultural Institute at Leitmeritz; Dr. G. Horváth, of Budapesth, to be Director of the Zoological Department of the National Museum in that city; Dr. R. de Girard, Privat-docent in Geology at the Zürich Polytechnikum, to be Extraordinary Professor; Dr. F. Saccardo, to be Professor of Plant-pathology at the School for Viticulture in Avellino; Dr. W. J. Nickerson, of Colorado University, to be Instructor in Biology at the University of Evanston, Ill.; Charles D. Aldright, to the similar post at the University of Cincinnati; Dr. W. A. Setchell, of Yale College, to be Professor of Botany in California University; Dr. C. A. Strong, to be Lecturer on Psychology in Columbia College, N.Y.; Dr. W. S. Strong, to be Professor of Geology in Bates College, Lewiston, Maine; W. J. Blake, to be Professor of Geology and Mining at Arizona University; T. C. Hopkins, to be Assistant Professor of Geology in the Pennsylvania State College; Thomas A. Jaggar, to be Instructor in Geology, and Dr. Chas. Palache, to be Assistant in Mineralogy, at Harvard University; Dr. F. Katzer, formerly Assistant in the Mining Academy, Leoben, to be Director of the Geological Department of the Para Museum. Dr. Knuth, of the Kiel Ober-Realschule, has been raised to the dignity of Professor.

THIS year Lord Kelvin will celebrate his jubilee as Professor of Natural History in the University of Glasgow. The authorities of the University and the Municipality of the City intend to recognise this in some adequate manner.

THE Anthropological Institute of Great Britain has elected Dr. Hjalmar Stolpe, of Stockholm, an honorary member. Dr. Stolpe is well known for his ethnographical and archæological researches, and especially for his investigations on the evolution of savage art.

THE *American Geologist* announces that Professor James Hall has had several gold medals struck to commemorate the services of some of the men who have enabled him to carry on his official work in the State of New York. Among these are Jacob A. Cantor, James W. Husted, Daniel P. Wood, and Danforth E. Ainsworth: legislators whose friendship for science might otherwise have passed unrecognised.

THE Director of the British Museum (Natural History) has written a special letter to Mrs. Henry Seebohm, conveying to her the thanks of the Trustees for the bequest of the late Mr. Seebohm's ornithological collection, and their high appreciation of his labours in the cause of that science. "The collection," says the letter, "is found to contain about 16,950 specimens, including 235 skeletons, and in extent and scientific value it is one of the most important that the British Museum has ever received. The fact that many of the specimens are types, and form the material upon which much of Mr. Seebohm's ornithological investigations and work are founded, must greatly enhance the interest and value of the bequest. Besides the types in the collection, and a large series from localities hitherto unrepresented in the museum, there are many specimens with historical associations attached to them, such as Swinhoe's Chinese birds; Pryer's Japanese birds; Anderson's Indian birds; a nearly perfect set of the birds of Mount Kina Balu; and the invaluable series obtained by Mr. Seebohm himself in the Petchora and Yen-e-sai Valleys."

THE evening lectures at the Whitechapel Museum have been meeting with considerable success. Professors Michael Foster and Victor Horsley were the lecturers for January and February. On March 10 Mr. A. Smith Woodward will lecture, at 8 p.m., on the Savages of Ancient Britain. Admission is free, by ticket to be obtained in the museum or lending library.

THE Chadwick Museum at Bolton has recently had its collection of butterflies and moths considerably enriched through the generosity of Mr. J. P. Thomasson of that town. The Museum now has a nearly complete set of British birds, and we are glad to say that the specimens are not confined to skins, but that each family is represented by an articulated skeleton. Some progress has also been made in this direction with the higher vertebrates. We are not surprised to learn that, in the words of the curator, W. W. Midgley, "these exhibits are creating a new interest to many visitors, while to the student they are especially helpful." Numerous visits by the children of elementary schools have taken place under the recent alteration in the Education Code, and the results obtained are, in the curator's opinion, very satisfactory.

WE have already published a description, from the pen of Dr. Henry Woodward, of the way in which Norwich Castle has been transformed into a museum. An excellent little guide, compiled by Mr. Thomas Southwell, has just been published at the low price of 6d. by Messrs. Jarrold & Sons, and gives almost as much for the money as do the well-known guides of the British Museum. The greater part of it is devoted to the collection of birds, in which, especially in foreign raptorial birds, the museum is very rich. Most of these were presented by the late J. H. Gurney. The son of the latter, Mr. J. H. Gurney, of Keswick Hall, Norwich, is desirous of completing this collection, and has sent us a couple of printed fly-leaves containing the names of desiderata. He will no doubt send such lists to any who may have birds to sell. Among the novelties mentioned in the guide we note the collection of local antiquities, presented, just before his death in 1895, by Mr. R. Fitch. These are now exhibited in a small room specially constructed and fitted up for the purpose, and contain many remains from the Stone age, as well as from later periods, some of which are here figured.

The Curator, Mr. J. Reeve, informs us that the museum has been opened on Sunday afternoons since April last, and that the experiment has proved so successful that the council have decided to continue it. A pleasing feature of the success is that it has been a steadily growing one. Even during this year the number of visitors has gradually increased, from 1,126 on January 5 to 1,491 on February 9.

ON March 10 the Honourable W. B. Massey Mainwaring, seconded by Mr. Thomas Lough, will move in the House of Commons: "That in the opinion of this House it is desirable that the national museums and art galleries in London should be open for a limited number of hours on Sunday after two p.m., upon condition that no officer shall be required to attend upon more than six days per week, and that any who may have conscientious objections shall be exempt from Sunday duty."

ON March 3 a discussion on Zoological Nomenclature will be introduced at the Zoological Society in a paper by Dr. P. L. Sclater, entitled "Remarks on the Divergences between the 'Rules for Naming Animals' of the German

Zoological Society and the Stricklandian Code of Nomenclature." No doubt the reason why the rules of the German Zoological Society are specially mentioned rather than the rules formulated by the International Congress of Zoologists, is that the German Society, as we announced some time ago, is preparing a synopsis of all living animals, under the editorship of Professor Schultze.

A SPECIAL interest attached to the Linnean Society's meeting on February 6, when Sir William Flower presented, on behalf of the subscribers, a portrait of Mr. William Carruthers. In making the presentation, Sir William referred to three aspects of Mr. Carruthers' work—as a botanist, as a curator of the great national collection of plants at South Kensington, and as an active worker in the interests of the Society, especially during his term of office as president. His presidency included an important year in the Society's history, namely its centenary; and in the successful carrying out of the formalities and festivities connected therewith, Mr. Carruthers displayed his characteristic ability for organisation and capacity for saying the right thing in the right place. As evidence of the keen interest which he took in the Society, reference was made to the perseverance with which he had got together all possible information on the various portraits of Linnæus, visiting Sweden and Holland for the purpose. In accepting the portrait, on behalf of the Society, the president, Mr. C. B. Clarke, mentioned Mr. Carruthers' work in palæobotany and his services to agriculture.

A CONGRESS of delegates from the Natural History Societies in the three S.E. counties of England is convened by the Tunbridge Wells Natural History Society for Saturday, April 25, and will be held at Tunbridge Wells under the presidency of the Rev. T. R. R. Stebbing. The subjects for discussion are:—(1) A scheme for the circulation of lantern slides illustrating natural history subjects among the affiliated societies during the winter session. This is already in operation, and fifty slides are being exhibited in different towns; (2) the interchange of lantern and microscope slides, books, and magazines with affiliated societies and with similar associations in other districts of the United Kingdom; (3) the re-delivery of lectures before other societies; (4) the protection of footpaths, commons, etc.; (5) summer excursions and field-work; (6) the best kind of programme for the winter session. The congress will also discuss the rules and date and place of meeting of future congresses, should such be determined on. Others than delegates from societies are invited, though they will not be entitled to vote. Cards of invitation may be obtained from Mr. George Abbott, 57, The Pantiles, Tunbridge Wells.

THE French Association for the Advancement of Science will meet at Tunis from April 1 to 4. Further information may be obtained from the secretary, 28 rue Serpente, Paris.

THE various American Scientific Societies had their annual meetings at the close of last year. Lists of the papers read are published in the February number of the *American Naturalist*.

IN view of the attempts that have recently been made to legalise the use of the metric system in Great Britain, it is interesting to notice that it has been introduced into the new edition of the British Pharmacopœia.

WE regretted to hear a short time ago that a male and female of the Golden Eagle had been shot in Kent, and had passed into the hands of the local taxidermist. A correspondent of *Science Gossip* states that this was only "an immature white-tailed or sea eagle." *A propos* of this, Mr. H. S. Salt draws attention to the following suggestions offered by the Humanitarian League as to the best use which county councils can make of the powers given them by the Wild Birds Protection Act of 1894:—

(1) That all protection which mentions particular species of birds is unsatisfactory, because some species are almost sure to be omitted, which, not being common,

do not attract attention, and thus no protection is given to strangers or casual visitors, whom it is highly desirable to protect.

(2) That all birds without exception are of some use in the economy of Nature, and though certain classes may desire the destruction of some birds who interfere with their immediate interests, this destruction will probably result in loss to the community as a whole.

(3) That if all cannot be protected, the right principle is to make the law general in its terms, and enumerate just those species which are to be outside the pale of protection, not those which are to be within it.

The Home Secretary has ordered that :—" (1) The Wild Birds Protection Act, 1880, shall apply within the administrative county of the parts of Kesteven, Lincolnshire, to the following wild birds, viz. :—Kestrel, merlin, hobby, common buzzard, honey buzzard, swallow, house martin, sand martin, swift, and wryneck, as if those species were included in the schedule to the Act. (2) The taking or destroying of the eggs of the following wild birds is prohibited within the administrative county of the parts of Kesteven, Lincolnshire, viz. :—Goldfinch, kingfisher, nightjar, nightingale, owls (of all species), ruff or reeve, woodpecker, kestrel, merlin, hobby, common buzzard, honey buzzard, swallow, house martin, sand martin, swift, wryneck, teal, and wild ducks (of all species)."

An expedition of sixteen men, headed by Dr. Cook, has started in two small vessels of 100 tons each for the bay of Erebus and Terror. Six of the men are students of science.

The *Scottish Geographical Magazine* for February has a note on the new "Bell" River, more than 500 miles long, discovered last year by Dr. Robert Bell of the Canadian Geological Survey. The drainage-area of the new river is considerably larger than the whole of England. The country is gently undulating with an elevation of 1,000 feet along the watershed, diminishing to 400 feet at 100 miles from the mouth of the river, and then falling rapidly to James Bay. It is covered with forests, the soil is fertile, and the climate fairly good.

Through the courtesy of Mr. C. E. Fagan, we are enabled to state that the naturalists, Messrs. Austen and Cambridge, on the Siemens telegraph expedition to the Amazon have already begun successful operations, the fact that the "Faraday" was stuck for a whole week on a mud-bank at the west end of Parana de Buyassu in no wise interfering with the aims of the collectors. The chief find at present has been two specimens of *Peripatus*, belonging apparently to different species. The naturalists decided to stay at Santarem, while the "Faraday" proceeded to Manaos, which place it reached on February 8, all well.

Professor H. de Lacaze Duthiers informs us that, as in former years, he will conduct an excursion at Banyuls during the Easter vacation, that is, from March 28 to April 11. Those joining the party can obtain return tickets from Paris to Banyuls for 46 francs. Among those who will attend are Professors Von Graff, of Graz, Pruvot, of Grenoble, and Yung, of Geneva, and probably some naturalists from Barcelona. The Professor desires to extend through us a cordial invitation to any English naturalists.

On February 13 a telegram from Irkutsk was received in St. Petersburg, stating that Mr. Kuchnareff, a Siberian trader who acted as agent for Dr. Nansen, had received intelligence that Dr. Nansen had reached the North Pole, where he had found land, and that he was on his way back. The opinions of experts are divided as to the truth of this, and, up to the moment of going to press, no confirmation had been received.

The hydrographical exploration of the Skagerack has just been begun under the auspices of the Swedish Government and the direction of Professor O. Pettersson.

A proposal to prohibit vivisection in Zürich has, says the *Revue Scientifique*, been rejected by 39,476 votes against 17,297. On the other hand, a motion of the Grand Council to protect animals, except such as are required for scientific purposes, has been accepted by 35,191 votes against 19,551.

CORRESPONDENCE.

Foraminifera of the Chalk and of To-day.

After careful perusal of the criticism of my paper on Oceanic Deposits Ancient and Modern (Natural Science, vol. vii.; Oct., 1895), by Messrs. Burrows and Holland, I am forced to the conclusion that they have failed to grasp both the spirit and the substance of the hypothesis I had intended to suggest, and your insertion of these remarks may perhaps be of service in more clearly defining its scope and aim.

My object was partly to answer a very valid objection raised by Mr. Philip Lake (*Science Progress*, Feb., 1894) to a certain point in my paper on the "Genesis of the Chalk," and my study of the subject led me to the conclusion that the *association* of a number of forms in the lower beds of the Upper Cretaceous, and also the association of apparently identical forms in certain areas at the present day, notably at Culebra Island, could scarcely be accounted for except on the assumption that in both cases similar conditions had existed. On p. 271, par. 3, I endeavoured to show that this connection was a very close one, and cited, in support of this statement, the presence of various species, ten in all, including the Textularias and Verneuilinas; the fact of these forms being found separately in other areas, a fact of which I am perfectly aware, does not, to my mind, invalidate the interest of their occurrence *all together* only in certain limited positions.

The authors remark: "*T. trochus* is plentiful in the waters of many tropical and sub-tropical areas, and is by no means confined to localities having the peculiar position assigned by Mr. Hume to Culebra Island." If these gentlemen will turn to a work published by me in 1893 (Chemical and Micro-Mineralogical Researches, etc.), they will find on p. 17 that I remarked, respecting this actual form: "At the present day it is common off our own shores, but, though cosmopolitan, it is more generally restricted to tropical and sub-tropical areas." It will therefore be evident that it was association, and not individual distribution, to which I more specially desired to draw attention, and upon which, in fact, I based my argument. My reasons for confining my remarks specially to the arenaceous Foraminifera are: (1.) That these were the only ones I could obtain from the method adopted in the examination of the residues from Cretaceous beds. (2.) Because, from the fact of their being arenaceous, they would be the most likely to be affected by the presence of coast lines; and (3.) Because in all probability they are mainly, if not entirely, non-pelagic.

Seeing that I had no evidence to prove their existence during Cretaceous times, I excluded from the scope of my observations such irregular arenaceous types as *Rhizammina* and *Hyperammina*, which have a deep-sea extension of an altogether remarkable character; the hyaline and porcellanous forms, also, were not introduced as *association forms*, many of them being pelagic, and consequently independent of coast-line influences or of current-borne material, besides which their general zonal distribution during the Cretaceous period is as yet undetermined.

I think my critics will pardon me if I point out that it is scarcely fair criticism to detach lines from sentences, and remark upon them, without any statement whatever that they (together with the context, and only in such connection) form part of a general train of argument.

They thus make a quotation from p. 273 of my paper: "At the present day the coarse arenaceous Foraminifera are found at depths rarely exceeding 400 fathoms," but make no allusion whatever to the fact that in that very paragraph I closely connect the existence of the majority of Arenacea with the areas of terrigenous deposits, a point which, I maintain, is of the greatest importance. In their paper they have selected the type of *Haplophragmium* as a proof of the deep-sea extension of Arenacea, but entirely ignore that, on page 274, I have made special mention of two species of this same type as extending into greater depths.

Before writing the paper I made a minute examination of the "Challenger" reports noting the stations in their bathymetrical order, with the Foraminifera found at them, and to my mind the conclusion is irresistible that the vast majority of the arenaceous species and genera do not normally occur at depths beyond 400 or at most 500 fathoms; indeed it is a notable fact that, of the four examples quoted by my critics from Australia and Ceylon, not a single one is outside the limits of terrigenous deposits. When they inform us that 70 miles from Raine Island the arenaceous species are ten in number at 790, and twenty at 985 fathoms, they quite forget to mention that at Raine Island itself, at 155 fathoms, there are thirteen genera and forty-six species, *Textularia* alone having over ten species to itself! As regards those cited from off the Coast of Africa, under the letters *c*, *d*, and *e*, it is impossible to include these in this discussion, seeing that the authors give no details whatever of the character and species of the Arenacea they state to have been obtained there.

The reason why the coarse Arenacea should occur within this limit is evident; their tests being made up of fine sandy materials, they will, for the most part, be found where that material is most abundant, viz., within the area of the mud-zone. Seeing, therefore, that oceanic slopes are usually very gradual, it is only, as a rule, at a distance of about 200 miles from the coast that a 500-fathom limit would be reached; should, however, the slope be sudden, and the arenaceous material plentiful, they will in that case, as the writers observe, be found at any depth; but this, it must be observed, must always be within the range of materials indispensable for building up their shells.

If my critics will carefully reconsider the quotations taken from my article on pp. 273 and 274, they will probably admit that on two particular points they have misinterpreted my meaning. In the one case they appear to infer that under the term "coarse arenaceous Foraminifera" I include "all arenaceous Foraminifera"; and in the second case, quoting from p. 274, "Those species which are restricted to the Chalk Marl, etc., are those which occur to-day at depths of less than 400 fathoms," they seem erroneously to have taken the word "occur" to be intended by me as synonymous with "are restricted to."

These points, I think, are of special importance in their argument, for, acting under these assumptions, they proceed to deal with eleven species from different parts of my paper, all of which they erroneously commit me to have restricted to a depth of 400 fathoms, and having thus proved to their own satisfaction that all my premisses are wrong, they virtually assume that my suggested hypothesis is baseless.

Had Messrs. Burrows and Holland clearly understood my paper, it could scarcely have escaped their notice that, on p. 274, referring to four of the species, viz., *Textularia agglutinans*, *Gaudryina pupoides*, *Haplophragmium latidorsatum*, and *Ammodiscus incertus*, I cite them as being particularly capable of deep-sea extension—and why did I particularise this point? Certainly, it was with no intention whatever of demonstrating that my previous statements regarding distribution were erroneous, but with the special object of showing that those forms which are capable to-day of existing beyond the 500-fathom limit, and, as our anthors say, may go to any depth, *are precisely those and only those* which I have found to pass into zones of the Chalk *higher than those* of the Lower Grey Chalk, and I therefore consider them as strong evidence in favour of my hypothesis.

Again, it is evident that, when in my paper I specially mention Culebra and Raine Islands, I am referring to a geographical area which must equally embrace all other localities possessing the same climatic and other conditions within that area, therefore including New Guinea, Torres Straits, and the Arafura Sea. Of the four species noted by me, *Tritaxia tricarinata*, *Spiroplecta annectens*, *Gaudryina rugosa*, and *Frondicularia archiaciana*, as occurring all together at Raine Island, the first is known only there, the second occurs almost exclusively within that geographical area, the third (as Mr. Chapman reminds me) is stated by Brady to have its finest development at Raine Island, and the fourth has hitherto been discovered in no other place, and I must re-emphasise my opinion that the association of these forms, which are all typical Cretaceous ones, within a certain geographical area at the present day is extremely suggestive to the student of physical conditions during the Chalk period. The fact that *Spiroplecta annectens* has been found at greater depths is not in any way surprising, for, far from being a coarse-grained type, it is one of the most delicate of all the Arenacea.

One word upon their closing remarks, vol. viii., p. 104. "In reference to the question of the depth at which the Taplow Chalk was probably laid down, Mr. Hume places great stress upon the occurrence together at Culebra Island of *Verneuilina pygmæa, et seq.*" This statement is liable to mislead, seeing that I made no reference whatever as to the depth at which the Taplow Chalk was deposited. I only mentioned these species in association with others as additional evidence of the importance of Culebra Island from a Cretaceous point of view, and, as a matter of fact, there are at least thirty-two forms in actual existence there capable of being directly compared with Cretaceous types; but I expressly left them out of the discussion, seeing that a number of them might be considered as pelagic.

In studying the Foraminifera, I think it may be advisable to lay stress upon the fact that, in the present state of our knowledge of their animal structure, it is impossible to attach particular importance to "genera" and "species." These terms have been employed by me, as by all those who are interested in these fascinating little tests, to indicate forms, often of most beautiful and definite construction, but, nevertheless, throwing but little light on the nature of the organisms that constructed them. It is a presumption, and a fair one, that similar results have been produced under similar conditions; it is also admissible to assume that the animals constructing them at the present day are similar to, if not identical with, their prototypes of the Cretaceous period.

I have desired in my paper to refrain entirely from anything approaching dogmatism. My research has been merely carried out on these lines in the hope that some light may be thrown on a path which, at present, is very obscure. This, so far as it has gone, tends to show that, whatever the conditions may be now, they were, in Cretaceous times, running on parallel lines to those existing in certain areas at the present day, and my aim will have been attained if my researches should lead others to consider, without prejudice or factiousness, the problems underlying the ancient and modern faunal distribution.

W. F. HUME.

WITH reference to the foregoing remarks of Dr. Hume upon our criticism of the evidence from the Foraminifera adduced by him in his paper on "Oceanic Deposits Ancient and Modern," we have to say:—

1. As we were careful to explain, we refrained altogether from discussing the main hypothesis propounded by Dr. Hume. We simply ventured to question the evidence as to the distribution of certain Foraminifera in recent seas which the writer brought forward in support of his argument.

2. Dr. Hume objects that, in quoting from his paper the passage—"at the present day the coarse arenaceous Foraminifera are found at depths rarely exceeding 400 fathoms"—without giving the context, we have been unfair to him. We have again read over his paper, and we cannot see that it contains anything to show that the words we quoted were not intended to be taken as the expression of a general law. We find nothing to imply that *at the present day* the coarse Arenacea are to be met with, at all commonly, at depths beyond 400 fathoms. Now, doubtless, Dr. Hume has modified, to some extent, his former statement; but, if so unnecessary to the argument, why was a 400-fathom limit mentioned at all? In point of fact, however, anyone reading together Dr. Hume's papers on "The Genesis of the Chalk" and "Oceanic Deposits Ancient and Modern" must see that considerable importance was attached to this limit of 400 fathoms.

3. We were quite alive to the fact that Dr. Hume laid stress upon the *association* of certain forms—notably three species of *Textilaria* and three species of *Verneuilina*; and we put forward considerations tending, as we think, to show that such weight as the writer attached to this association could not properly be conceded. We cannot see that his further remarks make the argument from the association of so small a number of such protean forms as the Foraminifera any stronger. The associated forms occur as independent individuals; they do not make up a kind of zoological compound; and when it is shown—to take the three

Textilaria for example, that one of the species is found in all seas and at all depths, that the remaining two forms are very closely allied, if not the same, and that the more robust of the two is to be found commonly in localities having a far different character to that of the locality specially selected, we cannot see that such association can furnish evidence of much value.

4. Dr. Hume passes over the evidence adduced by us from our Indian Ocean soundings, notwithstanding that they are admittedly derived from a non-terrigenous deposit, because we did not give the actual list of species obtained. We omitted the list simply for the sake of brevity. It is as follows:—*Saccammina sphærica, Hyperammina elongata, H. subnodosa, H. vagans, H. ramosa, Rhabdammina abyssorum, Rheophax pilulifera, R. dentaliniformis, R. nodulosa, R. guttifera, R. spiculifera, R. distans, Haplophragmium agglutinans, H. emaciatum, H. rotulatum, H. latidorsatum, H. glomeratum, H. globigeriniforme, Ammodiscus tenuis, A. gordialis, A. charoides, Trochammina trullissata, T. ringens, Textilaria quadrilatera, T. agglutinans, T. agglutinans* var. *augusta, T. agglutinans* var. *porrecta, Verneuilina pygmæa, V. polystropha, V. propinqua, Gaudryina pupoides, G. siphonella, Clavulina communis.* Many of them, it will be seen, are coarse forms, and though Mr. Hume would like to leave some of the genera and species out of consideration, notwithstanding their coarseness, we do not see that he is entitled to do so.

5. We are accused of understanding the word "occur" in the sentence—"Those species which are restricted to the Chalk Marl and Lower Grey Chalk are those that occur to-day at depths of less than 400 fathoms"—as being synonymous with the phrase "are restricted to." We did not so understand it; but we did assume that it bore more than the merest literal signification. Surely the argument which the evidence was brought forward to support requires that the species cited should be particularly characteristic, at the present day, of depths not exceeding 400 fathoms. Moreover, if the word "occur" in the passage quoted is to bear a literal signification only, what is the force of the following parallel statement from the author's paper on the Genesis of the Chalk (p. 226): "It is of importance to note, then, that the Foraminifera which predominate in the lower zones of the Lower Chalk are those which *do not pass beyond the 400-fathom line*"? We are further accused of taking the species dealt with by us in detail "from various parts of the paper." It cannot be contended that we have wrongly brought them together as constituting the evidence in support of the argument; and that being so, we can only say that for their distribution over the paper we were not responsible.

6. Dr. Hume objects that, when referring to the number of arenaceous species found in the soundings seventy miles from Raine Island at depths of 790 and 985 fathoms respectively, we "quite forgot to mention that at Raine Island itself at 155 fathoms there are thirteen genera and forty-six species." We were not unmindful of the fact; but we were anxious to compare only things comparable. Our own material from the two soundings above-mentioned consists in each case of the contents of the sounding-tube at one haul. The *quantity* of material is the same. The "Challenger," off Raine Island, took "soundings and dredgings," and doubtless obtained a great quantity of material. Had we had as much material from the deeper soundings we referred to, we should doubtless have found a much larger number of "genera" and "species."

In conclusion, we should like to state again that we have made no attempt to disprove the main hypothesis that Dr. Hume has brought forward. It is quite possible that it may prove perfectly sound. It seemed to us, and it seems so still, that the evidence adduced from the distribution of recent Foraminifera had in it many weak points.

H. W. Burrows.
R. Holland.

PERIPATUS IN THE "CAMBRIDGE NATURAL HISTORY."

I am glad to have the opportunity, which your review on the last volume of the "Cambridge Natural History" has given me, to refer to the attempt made by Mr. Pocock to break up the genus *Peripatus* and to establish three genera in its place. Your reviewer reproaches me with having taken no notice of this suggestion, which was made, as he correctly states, in 1894. May I inform your reviewer that the very same suggestion was made to me in 1886, nearly ten years ago, by a distinguished zoologist, who adduced all Mr. Pocock's reasons, together with one not mentioned by Mr. Pocock? I considered that suggestion at the time, *i.e.*, when I was preparing my monograph, and had all the facts before me, and rejected it as bringing no benefit, and only adding unnecessarily to the nomenclature of the group. I read Mr. Pocock's paper when it came out, and so far from finding that he added to our knowledge of the genus, it appeared to me that his own knowledge of the facts already established was not up-to-date in at least one important particular. I was not, therefore, inclined to attach much weight to his remarks; at any rate they did not appear to me to have that importance which would justify reference to them in a work of the scope of the "Natural History."

As to the other point referred to by your reviewer, I may say, in justice to my editors, that the "Cambridge Natural History" is not a monograph, and is not intended to give a complete list of species or even of genera. My synopsis was reprinted to give an idea in a small compass of the principal forms and localities of the genus. I might, of course, have left out all but the best known forms, but I wanted to create an interest in the genus in the various places in which it is found. It was, as your reviewer points out, misleading on my part to call this list a synopsis, and I greatly regret having allowed such an oversight to pass. At the same time, may I call attention to the fact that some new points have been tentatively put forward in the "Natural History," in the so-called synopsis, which were not in my monograph? These points, it is true, require confirmation by extended observations, but if established they will have considerable interest and some importance. It is odd that they should have escaped the notice of a critic of the minuteness of your reviewer.—Yours faithfully,

Zoological Laboratory, Adam Sedgwick.
New Museums, Cambridge.
February 10, 1896.

My best thanks are due to Mr. Sedgwick for his courtesy in pointing out the error of my statement, that his "synopsis" in the "Cambridge Natural History" had been *exactly* reprinted from the monograph of 1888. There are indeed a few additions, which I must confess I overlooked; for I naturally thought that Mr. Sedgwick would have corrected his list before he added to it. It is of interest to know that a "distinguished zoologist" privately suggested the division of *Peripatus* into three genera ten years ago. It is the more remarkable that, with this fact in his memory, Mr. Sedgwick should have deliberately omitted all reference to the published conclusions of Mr. Pocock, who has done so much good systematic work on the animals most nearly related to *Peripatus*. Mr. Sedgwick's reasons for disagreeing with two naturalists of some eminence would be of general interest.

Science and Art Museum, Geo. H. Carpenter.
Dublin.

[The additions of "interest and importance" to Mr. Sedgwick's Synopsis are: the erection of variability of colour into a character of the genera that he diagnoses but refuses to accept; two statements concerning constancy in number of legs, which statements are mutually contradictory; a reference to Miss Pollard's paper, while still ignoring the name she proposed; two notes of interrogation, and a mis-spelling.

[Letters from Mr. Conway Macmillan, Mr. P. S. Buckman and Mr. T. T. Groom are unavoidably held over.—Ed. Nat. Sci.]

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NOTES AND COMMENTS.

Zoological Nomenclature.

IN our next Note, we attempt to express, so far as we can at all agree with them, the views of the younger and, perhaps, extremer advocates of reform in nomenclature. In these columns, from time to time, we have urged the necessity of immediate and concerted action, and it was with a lively gratitude that we regarded the action of Mr. Sclater in raising the question at a meeting of the Zoological Society. The attitudes of the extreme conservatives and of the keen reformers are to our mind alike inevitable and undesirable. Those who have been accustomed through years of laborious work to particular names not unnaturally magnify the evil of change. Those who have more recently entered upon systematic work, and who find that a great part of their time is absorbed, not by science, but by hunting through a confused synonymy that varies practically with every country and with every worker, have seized upon the principle of priority as a court from which there can be no appeal. The worst of it is that many of these workers, seduced by the idea of finality, have made the hunting of original names an end in itself, and have believed themselves to be advancing science when they were only adding to its confusion.

We hold that the disputants of either side were wrong in trying to appeal to principle. There is no principle involved in the matter; only the most vulgar expediency. Numbers would suit the purpose of designating organic conceptions as well as names, and for purposes of identification one name is in itself as good as another. If a man's fame only rests on the possibility of attaching his name, with or without an intervening comma, to the particular designation of so many species, we cannot do more than shed a passing tear upon him if the general advantage of science should blot out for ever his poor name and personality. In our next paragraph we discuss a proposal based on no principle or justice or right, but one that would autocratically rid us of confusion, and put an end to the constant changes of zealous pedants.

Zoological Nomenclature—A Proposal.

The discussion on zoological nomenclature, which was held, as announced in our last number, by the Zoological Society of London on March 3, was introduced to a crowded meeting by Mr. P. L. Sclater, F.R.S., in a concise and careful paper, and the points to which he drew attention were warmly debated beyond the usual hour. The discussion dealt with certain differences between the rules drawn up by the German Zoological Society for the guidance of the compilers of the Synopsis of the Animal Kingdom (" Das Tierreich ") which that Society is preparing, and the rules known as the Stricklandian Code, which for many years governed, or were supposed to govern, the usage of British naturalists. The discussion turned chiefly upon the following questions:—First, may the same generic names ever be used for both animals and plants? Secondly, may the same term be used for the generic and trivial name of a species, as in the well-known instance of *Scomber scomber*? Thirdly, are we to adopt as our starting-point the tenth edition of Linné's *Systema Naturæ* in preference to the twelfth edition? These questions are answered in the affirmative by the German code, and in the negative by the original Stricklandian. We do not propose to discuss them here: it is natural that there should still be found, especially among the older zoologists of this country, many to support the old-established British practices; in this, as in all other matters of nomenclature, convenience, not principle, is concerned, and it cannot be gainsaid that the general usage of zoologists, at all events in other parts of the world, becomes daily more and more in harmony with the rules adopted by the German Society.

Were we again to open our pages to the discussion of this thorny subject, we should probably prefer, as did many of those who spoke at the Zoological Society's meeting, to discuss points that appear of more vital importance; but after listening to the various ingenious arguments, and to the animated rhetoric, punctuated by shouts of applause, that were poured forth the other evening, we felt more inclined than ever to doubt the value of these discussions. There are, it appears to us, fundamental defects that so far have pervaded all of them. A casual glance at the list of modern codes of nomenclature exhibited by Mr. Sclater was enough to show how very limited has been the authority of those bodies that have, from time to time, ventured to suggest laws for the zoological world. Either it is a committee of a section of the British Association, or it is the Zoological Society of France, or of Germany; or, again, at one moment we find the ornithologists meeting in conclave, at another, the palæontologists, at yet another, the neontologists; even when we see a code drawn up and passed by two International Congresses of zoology, we must not, as the President pointed out, flatter ourselves that more than a very few of the actual workers have assented, or have even been consulted. Consequently, the best of the codes that has yet been proposed (and which that be, each reader must decide for himself) has lacked the authority and the sanction that alone can make it of value. For we must insist upon this point, if upon no other, that it is not the wording of any particular law that is of consequence, but the power of enforcing it. We venture to say that to the very best code that could possibly be drawn up each individual zoologist would remain a recalcitrant, were it only in so trivial a point as the insertion of a comma or the use of a capital letter.

If it be true that we come to some such *impasse* in whatever direction we proceed, it is worth considering whether we cannot follow some course more productive of finality than is this perpetual codifying of our whims and fancies. And here we would take up and push to their logical conclusion the suggestions that were thrown out at the meeting by Mr. H. J. Elwes and the President. It is not enough to imitate Mr. Elwes, and to follow the last monograph or the last catalogue of some great museum; for other monographers will arise, and rival museums will publish rival catalogues, each with its own system of nomenclature. Nor is it of much use to follow those British ornithologists of whom the President told us, who some years ago made a vow to adopt such and such fixed names for all the British birds; for the science of zoology is not confined to these islands, and those who withdraw from the main stream of progress will either find themselves left high and dry, or be forced to rejoin it as laggards and out-of-date. But the course that might be pursued is suggested to us by this very enterprise of the German Zoological Society. Let us suppose that, instead of shrinking from the magnitude of the undertaking, instead of insinuating its impossibility, and instead of drawing their purse-strings tighter, the zoologists of the world were to give a mandate to the German Zoological Society to proceed with the work, and were to assist them generously by every means in their power, then we should have a complete set of names for all living species of animals. This, it is true, would not be enough. To draw up such a correct list of names without consulting the palæontologists is impossible, and, even were such a list drawn up, it would, for the purpose we now intend, be valueless. But let us further suppose that some body, such as the German or the English Zoological Society, could be found to draw up a list of all animal species, fossil as well as recent, then it would at all events be perfectly possible for the zoologists of the world to accept that list, and to say, "Whether these names be right or wrong according to this or that code of nomenclature, we do not know and we do not care; but we bind ourselves to accept them in their entirety, and we hereby declare that the date when this list was closed for the press shall henceforward be the date adopted as the starting-point for our nomenclature."

We have put this proposition in a broad manner; there are, of course, numerous minor points to be taken into consideration. The preparation of a mere list would be an enormous undertaking: we learn from Dr. David Sharp and the workers on the *Zoological Record* that there are 386,000 recent species; no one has reckoned the number of extinct species. Some such work as the "Index generum et specierum animalium," now being compiled with a minimum of support and under constant difficulties by Mr. Charles Davies Sherborn, must form the basis of any such synopsis as that here proposed. The first duty of naturalists is to help Mr. Sherborn, who works at the British Museum under a Committee of the British Association. We also have to consider what is to be done when our list is completed. First of all, it must constantly be kept up to date. It seems to us that some restriction will have to be laid upon the place and manner of publication of new specific names, and we would suggest that, when the time comes, no specific name should be recognised unless it be entered by the author at some central office, together with a properly published copy of the work in which the description appears. The name would then be checked, dated, and placed at once in the Index.

It is not contended that the acceptance of our proposal would obviate the need for a code of nomenclature. But it would be a far simpler code, free from the doubt as to whether its rules were to be retrospective; and its action would be uniform and stringent. Nor is it contended that the validity of a name carries with it the validity of a species. For the stability of nomenclature, it would be advisable to include in the list as many names as possible, and to leave to specialists the duty of deciding on the distinctness and systematic position of species. But whether our aim be the completion of an Index, the compilation of a Synopsis, or the construction of a Code, it is necessary that there should be absolute and loyal co-operation between zoologists of every kind and every country, since by this means alone can the required sanction be obtained.

The Taming of the Shrews.

We have lately received, from the U.S. Department of Agriculture, "North American Fauna, No. 10," which contains a "Revision of the Shrews of the North American Genera Blarina and Notiosorex" and a "Synopsis of the American Shrews of the Genus Sorex," both written by Dr. C. Hart Merriam, Chief of the Division of Ornithology and Mammalogy; also a paper upon "The Long-tailed Shrews of the Eastern United States," by Mr. Gerrit S. Miller, junr., of Cambridge, Mass. Here, as in previous contributions that we have received, Dr. Merriam manifests his great ability, thoroughness, and fair dealing, together with his pleasant manner of making the dryer details interesting and a clear way of putting forward his views. He supposes the short-tailed shrews to have originated in the south, while the long-tailed shrews came from the north. He does not, we presume, postulate a separate primary origin for these genera of the sub-family Soricinæ. A boreal migration of austral forms leaving no trace behind them, save possibly part of their tails, for there are no shrews in South America, seems a strange surmise. Dr. Merriam must mean that the short-tailed forms first became specialised in the region of their now southernmost settlement, and that they have subsequently retreated northward. This may be so.

In looking through these publications, the conviction is forced upon one that "they know how to do things in America," and one wonders what work will be left for the poor fellows of the next generation. So far as North America is concerned, at any rate, there will be no new species to discover nor any work to be done in unravelling synonymy, for this is all done so thoroughly by the writers of these monographs. They know, too, how to print books in America; in this, as in their other Government publications, both the paper and type are all that can be desired, and might well be commended to the notice of the "Printers to the Queen's most excellent Majesty."

The Antarctic Fauna.

The affinities of the Antarctic Fauna have recently been discussed from two points of view. On the one hand, Haacke and Wallace, impressed by the primitive character of many of the inhabitants of the southern terminations of the continents, have argued that all the forms of life originated in the northern hemisphere, and thence gradually worked their way to the south. On the other hand, the advocates of a southern continent have pointed out resemblances between the animals of Australia, the Cape, and Patagonia, and explained these as due to descent from a common Antarctic fauna. To these Dr. John Murray has now added a third speculation, which he explained in his lecture at the Royal Institution on February 28. In a recent memoir published by the Royal Society of Edinburgh (*Transactions*, vol. xxxviii., pt. 2, no. 10, 1896, pp. 343–500, 1 map), he has given a full list of the deep- and shallow-water marine faunas of the Kerguelen Region of the Antarctic Ocean. This list shows that there are in the colder waters of the northern and southern hemispheres a considerable number of identical or closely-allied species, which are separated from each other by the tropics. As Dr. Murray puts it, "the marine faunas towards either pole are genetically more closely related to each other than to any intervening fauna"; but it is also held that very few of the deep-sea species are universally or even widely distributed, and the community of species between the Arctic and Antarctic Oceans is, therefore, a very striking fact. It is this difficulty which Dr. Murray's theory is founded to explain. According to this, throughout Palæozoic and early Mesozoic times, life was restricted to the shallower parts of the oceans, which had a uniform temperature throughout, probably of about 70° Fahr.

Then, towards the end of the Mesozoic period, cooling set in at the neighbourhood of the poles, causing colder water, containing a more abundant supply of oxygen, to flow into the deeper seas, which were thereby rendered habitable. At the same time, the cooling of the polar seas so changed the conditions that the fauna of the shallow waters was impoverished and rendered sluggish, causing evolution to take place there more slowly than in the tropics. It is thus that Dr. Murray explains many of the main facts in the distribution of polar marine life. The chapter of the memoir in which these views are announced is full of original and most suggestive ideas.

The theory of a gradually cooling globe has often been applied to explain the puzzles of zoological distribution, but we still doubt its value. When we turn to the list of ninety species which are common to both the extra-tropical regions, we find so many are primitive types—such as the eight sponges or the two echinoids, or are forms which live attached to floating wood—such as two of the three lamellibranchs; while, moreover, groups of which the range of species is proverbially world-wide, such as the Ostracoda and Bryozoa, are so largely represented (by eight and sixteen species respectively), that we feel less convinced by the argument. Dr. Murray is perfectly candid as to the fact that the occurrence of Palæozoic glaciations would have been fatal to his views. And no one who saw Professor Edgworth David's series of photographic lantern slides of the Permo-Carboniferous Glacial Deposits of Australia at a recent meeting of the Geological Society can have any doubts as to the authenticity of Palæozoic glaciations. Professor David's demonstration shows that we can expect no help from a gradually cooling globe in solving the distribution of life, since at least Carboniferous time.

Two Geographical Reconstructions.

The past and present distribution of European mammals, and the light thrown thereby on the ancient geography of the Mediterranean district, are discussed by Dr. R. F. Scharff in a valuable paper in the *Mémoires de la Société Zoologique de la France* (viii., pp. 436–474; 1895). Taking, in the first place, the living and extinct indigenous mammals of Ireland, the author shows that they all inhabited Great Britain during the Forest Bed Period, while one at least—the fox—was living here in the time of the Red Crag. The mammals which are found—recent or fossil—in Great Britain, but not in Ireland, began to arrive in our area at the time of the Forest Bed, and can be traced through the Pleistocene deposits. These facts are used by Dr. Scharff, with much force, in support of the view enunciated by him in a previous paper (*see* Natural Science, vol. vi., pp. 147, 148; March, 1895), that the Irish fauna reached that island in Pliocene times. For if, he argues, the prevalent view of a Pleistocene continental connection be held, how is it that none of the animals of the second division were able to reach Ireland?

It is interesting to note that Dr. Scharff traces nearly all the mammals he discusses to an ancestral home in Central or South-Western Asia. Only a few—as the reindeer and the varying hare—are believed by him to have originated in the high north. Maps of the Mediterranean area, as it is supposed to have been at the time of the migration of the animals into Western Europe, show a continuous land-connection from Spain through Morocco, Algeria, Tunis, Sardinia and Corsica, Sicily, Southern Italy, Greece, and Asia Minor, while a Saharan sea communicates with the Mediterranean across Tripoli. The Black Sea joins the Caspian, the Caucasus and the Crimea being united by an isthmus.

Turning to the broader relations of the European fauna, Dr. Scharff advocates a Holarctic Region as defined by Dr. Hart Merriam (*see* NATURAL SCIENCE, vol. v., pp. 53–57; July, 1894). The Holarctic fauna is shown to have much greater affinity with the Oriental than with the Ethiopian; many types now characteristically African are believed to have originated in the Oriental Region.

Meanwhile Mr. C. Hedley has been working at similar problems at the Antipodes (*Proc. R. Soc. N.S.W.*, 1895, and *Ann. Mag. Nat. Hist.*, 1896, pp. 113–120). While feeling bound to admit the affinity between the animals and plants of the far southern lands, he does not consider that the facts will bear so heavy a superstructure as the antarctic continent advocated by Mr. H. O. Forbes (NATURAL SCIENCE, vol. iii., pp. 54–7; July, 1893). Mr. Hedley rejects also Professor Hutton's Pacific Bridge from Chili to New Zealand, on the strong ground that the intermediate islands show no South American affinities. His own explanation is, "that during the Mesozoic or older Tertiary, a strip of land with a mild climate extended across the South Pole from Tasmania to Tierra del Fuego, and that Tertiary New Zealand reached sufficiently near to this antarctic land without joining it, to receive by flight or drift many plants and animals." He therefore takes a middle position between the continent-builders and the stern, unbending advocates of the permanence of oceans. Mr. Hedley's caution is a virtue that needs imitation by many recent advocates of "Antarctica," who have mingled with the valid reasons for their belief many that are untenable and contradictory. They are too apt to misapprehend or to ignore the evidence of palæontology, and do not recognise the inadequacy of most of the evidence supplied by groups whose past history is unknown. In these speculations, moreover, the time-element is too often neglected. To prove a former land-connection between distant continents, the occurrence in both areas of a number of more or less related animals and plants is cited; but these common forms may include flightless birds clearly of recent origin, mammals of early Cainozoic type, fish and reptiles of undoubted Mesozoic affinities, and invertebrates that may be of still remoter antiquity. Now, granting a former land-connection—when did it exist? Was it of Jurassic, Cretaceous, Eocene, or even later age? There are, we gladly admit, writers who recognise and allow for these difficulties, but the case for "Antarctica" has received little support of value since Dr. Blanford's presidential address to the Geological Society in 1890.

The Distribution of Plants.

THE foregoing criticism applies to distributionists (chorologists, some of them like to be called) in general, and to botanists quite as much as to zoologists. In this country, at all events, few botanists seem quite to realise that plants, like nations, have a past history, which must be studied by those who would understand the existing geographical distribution of species. Scandinavia, however, is in this respect far in advance of England, for many of her botanists make a point of enquiring into the bygone distribution of each species, to compare with its present limits. Norstedt & Sons, of Stockholm, have just published a little book by Dr. J. Gunnar Andersson, entitled "Svenska Växtvärldens Historia i korthet framställd," which contains 106 pages, a map, and 53 text-figures. Herein, Dr. Andersson, who has himself done good original work on the fossil flora of Sweden, gives a clear account of the leading points in the present and former distribution of various plants, illustrating the limits of certain of the species by maps. No doubt the relation of past to present distribution is a far more involved question in Britain; but before long we ought to be able to put together a similar, or even fuller, history of our flora. On comparing Dr. Andersson's lists of fossil plants found in Sweden with those found in England, one is tempted to speculate on the curious absence of certain species from one or the other country. It is, of course, dangerous in the present state of our knowledge to lay much stress on negative evidence; still, one cannot help noticing that some plants common in the fossil state in Sweden, seem to be absent in England, and others common in England are missing in Sweden. Before the period of naval enterprise the discordance probably was far greater than at present.

Flowers and Insects.

LATELY, we have all been interested in the wail that there are no "naturalists"—except deceased. On reading Professor Plateau's recent contribution to the *Bulletin de l'Académie de Belgique*, xxx., November, 1895, "Comment les Fleurs attirent les Insectes," one can almost believe that it is better not to be a naturalist—at least if one has to suffer many such processes of disillusioning as this memoir reveals. The Professor's experiments must be quite a shock to those who have been brought up in the idea that the lovely hues of flowers are due to insects, for he concludes that neither the form nor the colours of the blossoms are the means of attraction. There are naturalists and naturalists (we are sure Mr. Thiselton Dyer will forgive us for making so outrageous a statement), and some have for long maintained the conclusion Professor Plateau deduces from the experiments to which we refer. It is quite a comfort to find that we may still believe what we actually see, viz., that flowers *do* attract insects. After all, it is only "the vexillary function of Delpino" that disappears, and so we may hope that naturalists will continue to exist in spite of the views of the Director of Kew. The experiments of the Professor at Gand are somewhat of the nature of a reprieve.

A Poisonous Orchid.

Cypripedium spectabile, a relative of our rarest native orchid, the lady's slipper, and one of the prettiest of the family, as well as the oldest in cultivation, has recently been proved remarkable for something besides its geographical distribution. It has long been known from North America, where it grows in peat bogs and tamarack swamps, from Nova Scotia to Minnesota, and in all the States east of the Mississippi. Quite recently, however, it has been found in the western provinces of China, thus adding another to the list of species to which Asa Gray drew attention as indicating so striking a relationship between the floras of the Atlantic States of North America and Eastern Asia. In part vii. of the *Minnesota Botanical Studies*, issued by the Geological and Natural History Survey of the State, a short paper by D. T. MacDougal confirms the presence of poisonous properties in the leaves and stems of adult plants of this and two other Cypripediums. Experiment showed an irritant action on the skin similar to that caused by handling various species of *Rhus*, the poison ivy. The poison was found to reside in the glandular hairs, in which the secretion, of an oily nature, is deposited in the same manner as in the Chinese primrose, that is, between the cell-wall and the cuticle of the terminal cell of the hair, and is set free by the final rupture of the cuticle. It is suggested that the poisonous property is a device primarily for the protection of the reproductive portion of the plant, as the irritant action, and the amount of secretion, increase with the development of the plant, reaching a maximum during the formation of the seed-capsules. *À propos* of *Cypripedium*, the same issue contains some remarks on the genus, with an illustrated monograph of the species found in Minnesota, in which Natural Science is quoted as the authority for certain statements which, hailing originally from the *Orchid Review*, formed the subject of a "Note and Comment" in our Journal. The *Orchid Review* is apparently unknown so far west as Minnesota.

The Temperature of Plants.

"Tree Temperatures" is the title of another of the *Studies* referred to in our last Note. During the first six months of 1894, R. W. Squires made an exhaustive series of observations on the temperature of a trunk of the Box-elder (*Acer Negundo*) and the surrounding air. Records were made three times a day, namely, between 6 and 7 a.m., 12 and 1 p.m., and 6 and 7 p.m., from January 15 to June 3, a period including the season of continued cold, the spring season, and the early summer when the thermometer had nearly reached its maximum. A careful examination of the published tables, in the light of the varying phases of vital activity through which the tree passed during the period, should yield more important results than are presented in the few remarks which accompany them. Through the entire period the tree temperature was lower than that of the air in the morning and at noon, but higher in the evening. On four days in January the temperature of both tree and surrounding air fell below 25 deg. C. The mean temperature of the tree for January was 1·31 deg. C. higher than that of the air; in February the two were identical; in March that of the tree was nearly 1 deg. C. lower, in April ·85 deg. C. higher, and in May again 1·13 deg. C. lower than that of the air. The relatively high temperature of the tree during April is accounted for, at any rate in part, by the increased metabolic activity during the development of the reproductive organs.

Relations of another kind between plants and temperature are referred to in the January number of the *Kew Bulletin*, where some account is given of the havoc played among the plants of the Royal Gardens by the great frost of 1895. Several of the examples cited give evidence of the importance of individual constitution as a factor in the problem of plant-life. In more than one case plants under shelter were killed, while those in the open survived uninjured. Bulbs seem to have come off the worst, in many instances—*e.g.*, species of *Narcissus*—the whole planting being destroyed. Alpine plants also suffered much, evidently missing their wonted covering of snow. Some of our native plants—*e.g.*, the thyme, which suffered severely—did not withstand the cold so well as many from countries with a warmer climate than Britain. On one count the "Gardens" must be congratulated. They possess their own waterworks, and being able to keep up a supply during the whole period of frost, were thus not affected by the disastrous failure of the water companies.

Technical Education in New South Wales.

The Calendar for 1895 issued by the technical education branch of the Department of Public Instruction for New South Wales shows an admirable amount of energy expended both in direct education and in the installation of a Central Technological Museum. The museum has been removed from the temporary premises in the Outer Domain at Sydney, and is now situated in Harris Street, near Redferne railway station. It contains considerably over 30,000 specimens, and its officers impart to visitors all desired information with regard to the raw products and manufactures of New South Wales. The new building rises to a height of 75 feet, and is 183 feet long and 50 feet wide. There are three main floors, 15 feet high, divided transversely into bays 16 feet wide. The ground floor is devoted to economic geology, metallurgy, and metal work. Among the exhibits are specimens of meteoric iron, models of meteorites, specimens illustrating phenomenal geology, together with series of rocks, minerals, and fossils, for teaching purposes.

On the first floor are the economic products of the plant kingdom. Special prominence is given to those of native origin, and an earnest appeal is made for the improvement of this section, since, as the curator rather obviously remarks, "the value of our unknown vegetable wealth is incalculable." It is pointed out that the native plant-foods are of interest, first, because every year increases the difficulty of learning about the articles utilised by the aboriginals, and, secondly, because in the more inhospitable portions of the colony it is often desirable that people should be acquainted with the food-products of the bush, such as they are. Here is also to be seen a very popular innovation in the shape of a permanent exhibition of freshly-cut Australian native flowers. Each species is placed in a separate vase of water, and is properly labelled. The plants belonging to each natural order are placed together. Under proper care, the flowers remain fresh for a long time, and the collection is largely increased by daily gifts from visitors. As many as 300 species have been on view on one day. With the help of the Toynbee Hall Natural History Club, a similar exhibit has from time to time been prepared at the Whitechapel Museum, where it is much appreciated by the East Londoners. We commend this idea to the Botanical Department of our own Natural History Museum. Of its popularity there could be no doubt, since at least it would be necessary to reduce the temperature of one of the galleries.

The second floor of this museum contains the ethnological collection, which is limited to the weapons and dress of Australian natives and those of the South Seas. The reason for considering these specimens to be of economic importance is that the material of which they are made often suggests a utilisation which has not occurred to other men, while the method and quality of workmanship are often instructive. This floor also contains the economic products of the animal kingdom. New South Wales possesses many so-called native silk-worms, the commercial value of which requires to be properly tested. The small wild bee (*Trigona*) is an insect to which the attention of residents in the bush may profitably be directed. The wool section is naturally one of the most important features of this museum. It embraces an extensive collection of representative wools from almost every country, and in all stages of manufacture.

There has hitherto been a want of organised co-operation between the museums and the educational bodies of Sydney, but we are glad to see that, so far as technical education is concerned, the advantages of mutual assistance are fully recognised; not only are there local museums established at Goulburn, Bathurst, Newcastle, West Maitland, and Albury, and affiliated with the Central Museum, but the collections in the Central Museum and in the Technical College have been thoroughly fused, so that the lecturers of the latter are able to draw upon the resources of the well-stocked museum. The specimens of the museum, wherever practicable, are transferred to the class-rooms for longer or shorter periods, and when there are objections to the transference of the specimens, special facilities are granted to students for the examination of them in the Museum itself. The country museums differ from the central one in having a natural history side. They receive, from the Government, mining and geological maps of New South Wales, especially those which refer to their particular district.

The energy and enthusiasm of the curator, J. H. Maiden, and his assistant, R. T. Baker, are further shown in the publication of a series of hints for the collection and preservation of raw products suitable for technological museums; these are given at the end of this interesting report, and are also issued as a separate pamphlet.

The Illinois State Laboratory of Natural History.

The University and State of Illinois have undertaken an investigation of the natural history of the inland waters of the State. A handsome laboratory has been erected, a competent staff engaged, and a cabin-boat with all necessary appliances stationed on Quiver Lake. Europe has furnished two important precedents, (1) the investigation of the fresh waters of Bohemia by means of a portable zoological station, carried on by Dr. Anton Fritsch for the Bohemian Scientific Land-exploration (Landesdurchforschung), and (2), the biological station at Plön in Holstein, directed by Dr. Zacharias, and maintained by imperial and municipal contributions. Illinois has made a spirited entrance into the same field of inquiry. The most peculiar local features are the great rivers (Mississippi and Illinois), which are subject to extraordinary changes of level, forming by overflow extensive lakes, which at another time of the year shrink or even disappear. The directors expect, in the first place, to contribute to the scientific knowledge of the fresh waters of the State; secondly, to encourage economic applications of natural history, with special reference to fish-culture and river-pollution; lastly, to promote the teaching of natural history in schools and colleges.

Professor S. A. Forbes, Director of the Laboratory and State Entomologist, remarks on this last head:—"Not many years ago, biological instruction in American colleges was mostly derived from books; of late, it has been largely obtained in laboratories instead; but several years' experience of the output of the Zoological College Laboratory has convinced me that the mere bookworm is hardly narrower and more mechanical than the mere laboratory grub. Both have suffered, and almost equally, from a lack of opportunity to study nature alive."[1]

We have before us vol. iv. of the *Bulletin* issued by the State Laboratory. It is largely occupied by a first paper on the Entomology of the Illinois River and adjacent waters, by C. A. Hart. This consists of the notes, provisional classifications, and drawings of a working naturalist. There are many facts useful to the expert, but the paper must be looked upon as an instalment of a piece of work which is still tentative and exploratory. Mr. Hart seems to go about his business in a sensible way; he is quietly gaining knowledge; he is really studying live animals, and not merely cataloguing alcoholic specimens. Of course, the best part of his work is still in the future. We trust that he will gain experience without losing breadth, and that he will not fall into any of the mechanical ways of working which are deadly to scientific inquiry. Ten years of such work would furnish materials for a treatise of the greatest possible value to natural history. We look forward with high hopes to the future of this important enterprise.

America is taking the lead in State-encouragement of natural history. Her entomologists and agriculturists are collecting information and prosecuting experiments with unprecedented activity. It is instructive to note that public money is liberally provided, and that the money comes back in the form of devastation averted from valuable crops. The encouragement of agricultural, and especially of entomological, research by the United States is an object-lesson to the whole world.

The Coelomic Fluid of the Earthworm.

In a recent issue of the *Philosophical Transactions* of the Royal Society of London (vol. clxxxv., pp. 383–399), Dr. Lim Boon Keng has published the results of an interesting investigation he has made into the nature of the fluid occupying the body-cavity of the earthworm. The large cavity in the earthworm between the alimentary canal and the outer body-wall, and communicating with the exterior by the nephridial tubules and by a small dorsal pore in each segment, is filled with a milky alkaline fluid containing albuminous and saline substances in solution, and numerous amœboid corpuscles. Large numbers of bacteria, some protozoa, and little nematode worms are familiar inhabitants of the coelomic fluid. Many of the bacteria are apparently harmless. Pure cultures of one set of them had the characteristic smell of earthworms, and Dr. Lim Boon Keng suggests that these, at least, may be symbiotic bacteria. The amœboid cells were not usually found attacking the bacteria, but when anthrax bacilli were injected into the coelome, the cells at once set about destroying them. When attacking a large parasite, numbers of cells combined to form a huge plasmodium, within which the parasite was

[1] Biennial Report, Illinois State Laboratory, 1894.

destroyed slowly. The amœboid cells apparently were unable to retain hold on a nematode when that was wriggling actively, but as soon as it became quiescent the cells laid hold of it.

The dorsal pores are not simple apertures, but are crossed by strands of muscle which act as sphincters. It was found that the application of an irritant to any part of the skin at once resulted in the discharge of quantities of the coelomic fluid, containing numerous amœboid ceils. When exposed to too dry, hot, or cold a temperature, the earthworm, until its nervous system became paralysed, discharged quantities of the fluid. As Professor Baldwin Spencer has already suggested, Dr. Lim Boon Keng admits that simple lubrication may be part of the function of this discharge. But from the abundance and activity of the phagocytic cells in it, he thinks that its chief function is to prevent the intrusion of the microbes which must be abundant in the soil and humus inhabited by earthworms.

Microbes and Butter.

In his excellent handbook on the chemistry and bacteriology of the dairy ("Milk: Its Nature and Composition." London: A. & C. Black, 1895. Price 3s. 6d.) Dr. Aikman makes a just and suggestive comparison between the work Pasteur did for the brewing industry and the bacteriological work that is required in butter-making and other dairy-work. Notwithstanding the efforts of county councils and the dissemination of various excellent handbooks like this by Dr. Aikman, it seems difficult to impress on the British farmer the necessity and the commercial advantage of a knowledge of microbes. Before Pasteur worked at the yeasts of beer and wines, the same uncertainty reigned in breweries that now rules the dairy. Wort treated in apparently the same way, and made from identical qualities of material, sometimes would produce an agreeable beer, sometimes a ropy or stringy or sour decoction. Pasteur isolated the microbes that caused the different kinds of fermentation, and showed how to prepare pure cultures of the proper organisms, and brewing and wine-making suddenly developed into a certain and profitable industry. At the present time, when butter is to be made, the cream is soured or ripened. Sometimes the proper agreeable flavour appears, sometimes the cream becomes tasteless or rancid or otherwise unpleasant. The different processes that occur during the period of ripening are the work of different kinds of bacteria. Already one or two of them have been isolated, and it seems likely that pure cultures of butter-flavouring bacteria may soon come to be supplied, just as Pasteur produced the proper kinds of pure yeasts.

Diabrotica in North America.

In the *Journal of the New York Entomological Society* (November, 1895), Mr. F. M. Webster has an article about some forms of this genus. The species of *Diabrotica* are among those successful forms of insect-life that make even the entomologist sympathise with the feeling of the outsider who concludes that it is a great mistake on the part of Nature to have so many kinds of insects. There are hundreds of species of *Diabrotica*: usually they are very pale green or yellow beetles, shining with conspicuous black marks, and some, if not all of them, are believed to be nasty to smell, and, what is more important, to taste. It appears that one of these species, formerly rare, has lately become very numerous in North America, and is doing great damage to the crops of maize. Mr. Webster suspects that there is a nursery of species of *Diabrotica* somewhere in Mexico. He has some sensible remarks on their colours and taste, it being believed that the nasty taste (hypothetical, so far as we know, for probably no one has had the courage to chew them, as Professor Plateau did in the case of the currant-moth caterpillar, with the result of finding it not nasty to him) protects the *Diabrotica* from being eaten by birds, while the colours amount to an exclamation of "we are nasty, and delighted you should know it." We hope Mr. Webster's paper may induce entomologists to make a better acquaintance with the facts about these beetles, so as to ascertain how much truth there may be in the fancies. This seems to be the chief object of his article. He is rather surprised that some of the species appear to be of a more retiring character, and do not advertise their nastiness—hypothetical or real. It is believed that, in South America, some species of the genus *Lema* have taken advantage of the bad character of the Diabroticas by looking like them, and so getting the benefit of not being eaten, although they are nice (according to hypothesis). Mr. Webster seems somewhat to regret that no North American *Lema* has yet been clever enough to adopt this hypocritical form of coloration. But perhaps there is something in the "environment" in North America adverse to such a line of life.

Warning Colours and Mimicry.

In a recent number (1895) of the *Journal* of the Asiatic Society of Bengal, Mr. Frank Finn, the Deputy Superintendent of the Museum at Calcutta, publishes the first of what he intends to be a series of contributions to a theory of warning colours and mimicry. This excellent first paper is the best kind of "contribution" to a theory, as it consists entirely of experimental observations and not at all of theoretical interpretations. It is the more welcome, as the theory of warning colours has been conspicuous, even among biological theories, for the disproportion between the superstructure and the base of fact. Not long after his arrival in Calcutta, Mr. Finn began a series of experiments as to the palatability of the common warningly-coloured butterflies of the district. For the more agreeable part in the series of dramas he enacted, he cast the common Babbler (*Crateropus canorus*), a representative Indian insectivorous bird. To some of these, in freedom and in confinement, hungry and sated, he offered all sorts of brightly-coloured and hairy caterpillars and butterflies, sometimes alone and sometimes along with other less lurid creatures. This first contribution gives the results of a series of such experiments. Sometimes the birds certainly chose the plainly coloured, and presumably more palatable, forms offered them; sometimes they accepted and swallowed those which no bird of a really cultured disposition should have looked at. Perhaps, on the whole, the experiments showed a preponderating rejection of brightly-coloured caterpillars, which were frequently mauled but not swallowed. We look forward with interest to a continuation of Mr. Finn's work. We are specially glad that he has been able to correct observations upon birds in captivity by observations on those at large. It is a not unnatural supposition that birds in a cage should be in the position of the lady in the ditty who "wanted something to play with," and we do not think that it would upset the supposed relation of bright colour to unpalatability were captured birds to show a catholic taste.

THE EMBRYOLOGY OF PLATYPUS.

IN the ninth volume of the *Proceedings* of the Linnean Society of New South Wales, Messrs. J. P. Hill and C. J. Martin give an account of *Platypus* embryos, taken from the intra-uterine egg. It will be remembered by probably most people except Mr. Caldwell himself, that the material collected by Caldwell has afforded us very little information. The present observers obtained two eggs from the left uterus of a female, and they give a description and excellent figures of the results they got by surface examination and serial sections. The most novel feature seen in surface view was the extent to which segmentation had proceeded, although the embryo was still lying almost flat on the surface of the yolk. Seventeen somites were formed, and the only trace of pinching from the surface of the yolk was a very shallow head-fold. The hind-brain showed four well-marked neuromeres, corresponding to those described by Orr for the hind-brain of the lizard, with the difference that in the lizard the medullary folds have met when the neuromeres appear, while in *Platypus* the hind-brain is still flat at this stage. An interesting feature in the embryo was that the wolffian duct appeared to have an ectodermic origin.

I.

The Horizontal Pendulum.

SEISMOGRAPHS based on accurate and scientific principles have now been in use for about fifteen years, and we have learnt much from them regarding the movements of the ground during an earthquake shock. Far beyond the disturbed area, however, deflections of delicate instruments, such as magnetometers and levels, have occasionally been observed, and the times at which these disturbances have occurred leave little doubt as to their connection with severe but distant earthquakes. Chiefly within the last six years, instruments of still greater sensitiveness have been constructed, and by their aid it seems not impossible that we may be able to register the pulsations of violent earthquakes to whatever part of the world they may extend. One of the most valuable of these instruments is that known as the "horizontal pendulum," the fundamental principle of which has been

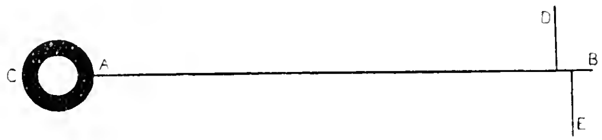

FIG. 1.—HENGELLER'S PENDULUM.

independently discovered no less than eight times within a period of sixty years.

The first occasion seems to have been in 1832, when the instrument represented in Fig. 1 was constructed by L. Hengeller, a student in Munich. The following is the description of it by his teacher, the astronomer Gruithuisen (14): "It consists of a horizontal lever, A B, of brass, on which is fixed at one end a brass ball, C, as a weight; D is a fine wire by which the lever is suspended; instead of the counterpoise, the other arm of the lever is fastened to the floor by the wire E; and the instrument becomes the more delicate the nearer the wire D comes to the wire E. The ball, C, can oscillate only horizontally, and," though the statement should perhaps be received with caution, "is visibly (according to Hengeller's experiments) attracted by a cannon ball."

Thirty years later, in 1862, a similar pendulum was devised by

Perrot (10). In 1869, again, an instrument closely resembling Hengeller's, but with improvements in detail, was made by Zöllner (16). To this astronomer is due the credit of first successfully proving and drawing public attention to the value and extraordinary delicacy of the horizontal pendulum.

It may be well, perhaps, at this stage to explain briefly the principle of the instrument. Let D and E (Fig. 2) be the two points of support, E H a vertical, and D H a horizontal line, the angle D E H being greatly exaggerated in the figure. It is obvious that the pendulum, in a state of rest, must always lie in a vertical plane passing through the axis of rotation D E; and also, in order to be in stable equilibrium, that the centre of gravity of the ball and rod must lie on the side of the vertical E H towards which the axis E D inclines.

Now, suppose the point D to receive a very slight displacement (small even compared with the length D H) in a direction perpendicular to the plane of the paper. Then the whole pendulum will turn through the same angle as the line D H does, and, obviously,

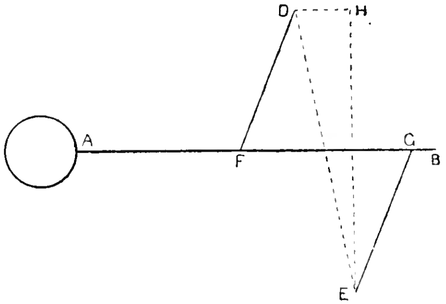

FIG. 2.—THE PRINCIPLE OF THE HORIZONTAL PENDULUM.

the smaller D H is the greater will be the angle of deflection corresponding to a given displacement of the point D. Again, the longer the vertical line H G (which is practically equal to D G) the greater will be the displacement of the point D due to a given tilt of the axis. Hence, the smaller the angle D E H, the greater will be the deflection of the pendulum caused by a given tilt of the ground; in other words, the greater will be the magnifying power of the instrument.

If the displacement of the point D is not perpendicular to the plane of the paper, it may be resolved into two components, one parallel and the other perpendicular to that plane. The former component merely alters very slightly the horizontal distance between the points of support, and therefore produces a minute, and in most cases hardly perceptible, change in the sensitiveness. The latter component is that which causes the pendulum to be deflected. Thus, the instrument is only adapted for measuring tilts of its axis in a direction perpendicular to the plane of rest. To measure a tilt completely, it is necessary to have two such pendulums placed with their planes at right angles to one another.

Returning to the history of the horizontal pendulum, another change was made, again without any knowledge of previous work, by the Rev. M. H. Close, of Dublin (1, 7). In 1869, shortly before Zöllner, this gentleman constructed the pendulum shown in outline in Fig. 3. A B is a rod, suspended by two fine wires A C and B D, the axis, C D, being, as before, very nearly vertical. The only difference in principle between this form and Hengeller's is that the centre of gravity of the rod lies between the two points of attachment, A B, of the wires, and consequently the points of supports, C D, are both above the rod. In Hengeller's pendulum, the centre of gravity lies outside the line joining the points of attachment, and the points of attachment are therefore on opposite sides of the rod. Precisely similar in principle to Mr. Close's form is the new bifilar pendulum of Mr. Horace Darwin (3, 4, 5), which is a modification of the celebrated instruments erected in the Cavendish Laboratory at Cambridge in 1880 and 1881 (2).

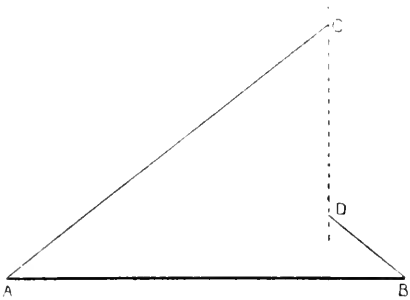

FIG. 3.—CLOSE'S PENDULUM.

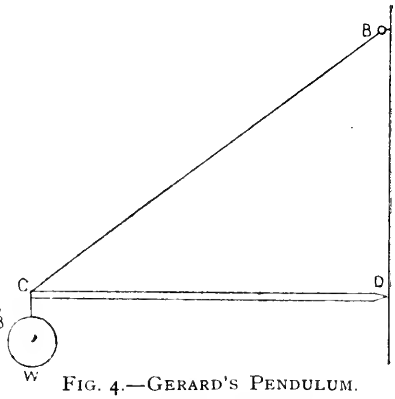

FIG. 4.—GERARD'S PENDULUM.

In the year 1851, Mr. A. Gerard, of Aberdeen[1] (6), devised another form of the horizontal pendulum, represented in Fig. 4. C D is a long beam, ending at D in a sharp point, which rests against the wall of the room in which the instrument is erected. B C is a copper wire, at one end carrying a heavy weight, W, and at the other fastened to a ring in the wall at B, so that the line B D is very nearly vertical. Forty years afterwards the same idea occurred to Professor J. Milne (8, 9), who has made much use of a similar, but smaller and more delicate, instrument, in connection with his admirable researches on earth tremors in Japan.

In 1888 and 1889 the horizontal pendulum underwent a further modification at the hands of the late Dr. E. von Rebeur-Paschwitz, of Merseburg, Saxony (4, 11, 12, 13), who removed the fine wires, or

[1] For the reference to Gerard's paper I am indebted to Kennedy's "A Few Chapters in Astronomy" (7), a valuable work which deserves to be better known.

springs, used by Zöllner, and replaced them by agate cups resting on steel points. As this instrument is one with which some most valuable investigations have been, and are still being, made, I propose to describe it in some detail. I will conclude this section with the following summarised classification of the different forms of the horizontal pendulum (quoted from the Report of the British Association Earth Tremors Committee for 1895):—

"1. The pendulum in which the rod or mirror is suspended by two wires. These may be again sub-divided: (*a*) The pendulums of Close and H. Darwin, and practically also of Delaunay, and Lord Kelvin and the Darwins, in which the centre of gravity of the rod or mirror lies between the two points of attachment of the suspending wires; (*b*) The pendulums of Hengeller, Perrot, and Zöllner, in which it lies outside them.

"2. The pendulums of Gerard and Milne, in which the rod is supported by one wire and on one steel point.

"3. The pendulum of von Rebeur-Paschwitz, which is supported on two steel points."

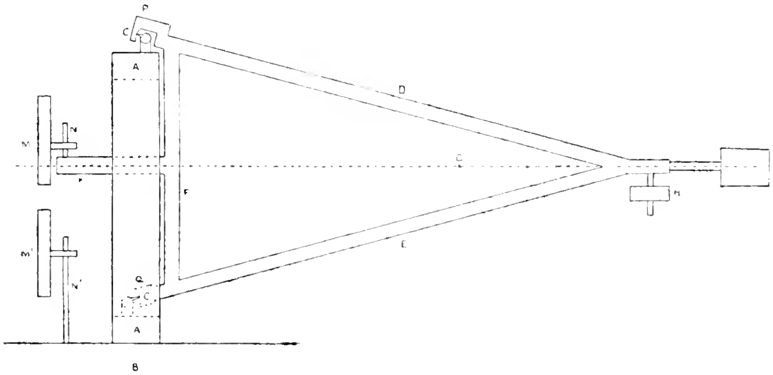

Fig. 5.—Pendulum of von Rebeur-Paschwitz.

It should be added that Professor Ewing's horizontal pendulum seismograph, though constructed (in 1880) for a different purpose, also serves for indicating slow tilts of the ground. It resembles closely the last-named instrument.

The Horizontal Pendulum of Dr. E. von Rebeur-Paschwitz.—An outline of the pendulum and stand which supports it is given in Fig. 5. The pendulum, D E F, is made of thin brass tubes, and is in the form of an isosceles triangle. Two of the tubes, D E, are prolonged beyond the base of the triangle, and to the ends, P Q, agate cups are attached. These rest against two extremely fine steel points, C C, projecting from cylinders which rotate very stiffly about horizontal axes. The cylinders are attached to a strong rectangular frame, A, screwed to the stand, B, of the whole instrument. The upper steel point is directed away from, and the lower one towards, the centre of gravity, G, of the pendulum, and there is thus no tendency to slipping between the steel points and the agate cups. The line joining the steel points, or axis of rotation, is 68 mm. in length, and though very nearly vertical, leans, of course, slightly in the direction towards the centre of gravity of the pendulum.

From the tube F, a rod, K, projects outwards through the frame, A, and carries a mirror, M, capable of rotating about the vertical rod, N. The mirror is shown in section in Fig. 5, and its plane is perpendicular to the axis of the pendulum. As it is situated somewhat above that axis, the centre of gravity of the pendulum is brought back to the axis by adjusting the movable weight, H.

In the direction of the axis, and about $4\frac{1}{2}$ metres from the pendulum, is placed a petroleum lamp, the light from which emerges through a vertical slit in the case enclosing the lamp. It then passes through a lens in front of the mirror, M, is reflected by the mirror, passes through the lens again, and by its means is brought to a focus on a graduated scale or photographic recording apparatus placed beside the lens. If the pendulum is deflected through any angle, the ray of light reflected by the mirror, M, is turned through twice that angle, and the distance through which the line of light is displaced along the scale is a measure of the pendulum's deflection.

If the movements of the pendulum are to be recorded continuously by means of photography (12), the scale is replaced by a cylinder with its axis horizontal and at right angles to that of the pendulum. Round this cylinder is wrapped a sheet of sensitive photographic paper on which the light is received after passing through a horizontal slit in the case enclosing the recording apparatus. The image of the source of light would naturally be a vertical line, but a cylindrical lens is placed in front of, and parallel to, the cylinder, and this reduces the line to a bright point of light. The cylinder revolves by clockwork, and the point traces its course as a narrow line on the sensitive paper.

To determine the form of this curve, a base-line is provided by means of a mirror, M^1 (Fig. 5), immediately below the other. This is attached to the stand, B, of the pendulum, but is at the same time capable of adjustment. The light proceeding from the slit of the lamp falls on both mirrors, M and M^1, and, the latter being fixed, the light reflected by it traces a straight line on the sensitive paper. The varying distance of the curved line from the base-line thus affords a measure of the pendulum's deflection. A small screen is placed immediately below the point of light from the fixed mirror, and is raised by the clock once every hour and kept up for five minutes. The base-line being in this way broken at hourly intervals, the time can be determined at which any particular disturbance of the pendulum has taken place.

The stand, B, of the pendulum rests on three foot-screws equidistant from one another. One of them is immediately beneath the axis of the pendulum, and the line joining the other two is at right angles to the axis. The screws are carefully worked and of known pitch, and are provided with large graduated heads. If one of the screws be turned through any angle, the magnitude and direction of the tilt given to the stand can be easily determined. The first screw tilts the axis of rotation in the plane of the pendulum, and its object is, therefore, to regulate the sensitiveness of the instrument. If either of the other two screws is turned through a known amount, the angle through which the axis of rotation is tilted in a perpendicular direction is ascertainable, and the corresponding deflection of the point of light on the scale or photographic paper can be measured.

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II.

On a Proposed Classification of the Pelecypoda.

OF all the groups of Mollusca, the Pelecypoda (or as some would spell it, Pelekypoda) have ever proved the most difficult to classify, being nearly as maddening as the Bryozoa, and one system after another has been tried, only to be laid aside as inadequate. The shape of the shell, the muscular impressions, first proposed by Lamarck (1), the openings in the mantle (Cuvier, 2), and the presence or absence of siphons (D'Orbigny, 3) have all been abandoned as bases for classification. The methods most in favour at the present day are, perhaps, those based on the characters of the hinge or on the structure of the gills. The former, which, it is interesting to note, formed the principle of one of the earliest arrangements proposed, that of Martini (4), is the one relied upon by Neumayr (5, 6), and now by Dall (7, 8), and naturally is regarded with favour by palæontologists.

The gill-structure was first suggested as a possible basis by Ray Lankester (9). Fischer (10) attempted to apply it; but, since he was misled by the superficial appearances of these organs, his method has proved, if possible, less satisfactory than that based on the presence or absence of siphons. Pelseneer (11–13), however, closely followed by Menegaux (14), carried the matter further, and basing his divisions on the intimate structure of the gills, while taking into account the other features of the anatomy, produced a scheme which appeals more especially to the biological student of recent Mollusca.

Primâ facie, one would be inclined to argue that the animal, which moulds the shell to its soft body, was a more important item than the test so formed, and although, as Dr. Dall points out in his preliminary paper (7), it is not correct to speak, as many do, of the shell as a mere secretion of the mantle—its development being quite as much influenced by the physical forces surrounding it as the mammalian tooth—at the same time the modifications of the hinge, being so obviously the outcome of the mechanical requirements of the animal to protect itself in its surroundings, can hardly be so reliable a guide to the true affinities as some of the vital organs of the mollusc itself. Who, for instance, acquainted with the shell alone of *Arctica*

[=*Cyprina*] *islandica* would separate it from the Veneracea? When, however, one of the foremost of living conchologists, and a careful naturalist of world-wide reputation like Dr. Dall, comes forward with a scheme founded primarily on the hinge-characters, it is natural to turn with expectancy to his paper in anticipation that some clue to the problem, and one satisfactory to the palæontologist, has been found. Dr. Dall, however, cannot, and does not, attempt to satisfy the demand for an infallible scheme based on the hard parts; all he can do is to adopt "such an arrangement as shall," in his opinion, "best express the relation of the groups, and at the same time take into account those characters which are available for the palæontologist"; and of his three principal groups, he says, "they were based, not on the forms of hinge-teeth as such, which would have brought together many incongruous forms and separated near relatives, but on the development of a general type in each case, to which, in spite of present superficial incongruities, the pedigree of existing genera could be referred."

At the same time, there is no doubt but that a very great deal more has yet to be made out concerning the morphology of the hinge in the Pelecypoda. To begin with, the nomenclature requires overhauling; there are instances in which teeth are set down as cardinal that would appear to be lateral in origin although cardinal in position, owing to the contraction of the hinge area, as in some of the Veneracea, while secondary laterals have in some cases been developed in order to prevent the valves from shifting when closed. This is partly recognised by Dall, who calls these latter, if well developed—"teeth," and, if less pronounced—"laminæ." Of course, it is at times extremely difficult to say where the line should be drawn between a slight thickening or shelly prominence and a tooth, for these vary even in the species of a genus, and hence the necessity for examining every species of a genus, as Dr. Dall has evidently in many instances done, and not the typical forms only.

[Since the above paragraph was written, a most valuable paper by M. Félix Bernard (15), of the Paris Museum, has come to hand, showing that he has recognised the importance of these very points, and is dealing with the hinge in its morphological aspect. *See* Nat. Sci., viii., p. 153.]

The necessity for a clear understanding on the terminology becomes all the more important when use is made of formulæ such as those of Steinmann, for unless carefully and consistently drawn up, they are apt to lead, when employed for purposes of comparison, to erroneous results. *À propos* of these formulæ, it is interesting to note that the principle is much older than Steinmann's work (19), having been put into practice by Professor H. G. Seeley in 1864 (16) as an extension of the idea foreshadowed in Woodward's Manual (18).

On the whole, Dr. Dall may be said, in his classification, to approach the question rather from the standpoint of the systematist, just as Pelseneer, with whose scheme it naturally stands in contrast, attacked the problem more from the general biologist's point of view; and had it not been that they thus advanced from opposite sides, the results obtained would probably have been more in accord, since both naturalists are equally emphatic in stating that, while their terms are borrowed from one particular feature, their classification is the result of a consideration of the totality of characters.

Dr. Dall's proposed classification was first shadowed forth in 1889 (7), in an article that deserved far more attention than it appears to have received. He has now (8) revised and elaborated it, yet retaining the general principles on which it was founded.

He begins by dividing the Pelecypoda into three main orders, which he considers proceeded more or less on parallel lines, viz.:— I. Prionodesmacea. II. Anomalodesmacea. III. Teleodesmacea. These he holds to be all descended from a prionodesmatic radical or prototype, the first and second orders retaining more evident traces of their origin than the third.

This triple ramification from a common stock certainly seems to be an advance on the more simple phylogenetic tree which satisfied the Belgian malacologist. and more in accord with the fossil evidence. At the same time, it is premature to assume that Pelseneer's tree can only rank as an "intellectual weed," to quote Dr. Sollas's happy characterisation of some such productions. Neumayr (5) started with an order, Palæoconchæ, that comprised an assemblage of ancient fossil forms of very various description, with which he apparently did not exactly know what to do, and from which he derived his other groups. Dall has no difficulty in showing that this group is nothing more than a convenient cloak for ignorance ; nevertheless, although he rightly avails himself of it as a matter of temporary convenience, he gives it no place in his scheme.

The Prionodesmacea correspond to the old section Asiphonida, as given in Woodward's Manual (18), with the addition of *Solemya*, and they thus include the oysters, scallops, arks, and all pearly shells.

The Anomalodesmacea embrace the Anatinacea, Eusiphonacea (or Clavigellidæ), and Poromyacea (or Pelseneer's Septibranchia, plus Verticordiidæ and Euciroïdæ).

The remaining forms are, of course, relegated to the third order, Teleodesmacea.

When the subdivisions of these three principal groups come to be examined, much matter for criticism is revealed.

The Prionodesmacea are first divided into (I.) those without teeth in the hinge, and (II.) those with teeth, the latter being further portioned out into :—

A. Taxodonta (Nuculacea, Arcacea).

B. Schizodonta (Pteriacea [=Aviculidæ], Ostracea, Naiadacea, Trigoniacea).

C. Isodonta (Pectinacea, Anomiacea).

It is a minor point that section I. comprises the Solemyidæ alone, which are thus made equivalent in importance to the whole of the rest put together, whereas their anatomical affinities are nearest those of the Nuculidæ, whence it would, perhaps, have been better to have let them rank as a group of equivalent value to those in section II., under some such name as "Lipodonta."

Coming to the next group, Taxodonta, we find two "super-families" (by which term our author appears to indicate something slightly less in importance than a suborder) linked together, yet differing so considerably, not only in their anatomy, but also in their hinge-characters, that the fact of both possessing a great number of teeth in a row seems, in the light of modern biological research, hardly sufficient justification.

A more startling surprise, though, is the association of such diverse forms as are here assembled under the section "Schizodonta." Similarity of hinge-characters there certainly is none, nor, perhaps wisely, has a definition of the section been vouchsafed. *Ostrea*, when having traces of dentition, is Taxodont; in the Unionidæ alone are three types of hinge. Nor is a bond to be found in the gill-structure, the Trigoniacea being Filibranchia, while in the Ostreacea and Pteriacea the gill is more or less reticulate, and in the Naiadacea exhibits a very complicated structure. In Pteriacea and Ostreacea the ventricle is ventral to the rectum, in the others it is traversed by the latter. In short, it is difficult to see what connecting link exists between them. The sole reason that seems to have actuated Dr. Dall would appear to be that *Philobrya*, which is "probably allied to *Avicula* . . . passes through a *Glochidium* stage, thus adding another link to those which connect the Aviculidæ with the Naiades," and that where the Unionidæ go Trigoniæ must follow. Among the Naiadacea it is to be noted that Dall tentatively places the Megalodontidæ, induced, seemingly, by their resemblance to some forms of North American *Unio*. The statement concerning *Philobrya*, which doubtless will be confirmed by future observation, is extremely interesting but not conclusive. Parasitism in the young stage does not necessarily imply affinity, any more than it does in the adult.

Concerning the Isodonta, despite those who lay stress on the prodissoconch, it may be observed that Pectinacea and Anomacea do not, on anatomical grounds, seem happily yoked together. It is worthy of remark that in the young state the byssus of Anomia issues from the *ventral* margin of the shell, as in *Arca*.

Dr. Dall points out, and we believe the observation is new, that in its juvenile stages *Spondylus* has a Taxodont hinge; but he does not, as in the similar case of Chamacea, propose its removal from its allies on that account.

The Dysodonta, containing the well-defined Mytilacea, call for no remark beyond the expression of belief that the restitution to them of the Dreissensiidæ, which Pelseneer banished to the company of the Unionidæ, is justified by their embryonic history.

The families placed under the order Anomalodesmacea would, anyhow, be near allies, and hence it is no great concern that Dall classes the Septibranchia with the Anatinidæ. It is an old quarrel; nevertheless the anatomists would seem to have the best of the argument, for the existence of the septum in the one group, be its morphological origin what it may, is surely sufficient justification for the separation of the two.

The third order, Teleodesmacea, practically corresponds to the Eulamellibranchiata of Pelseneer: its subdivisions, five in number, are, however, very different. Of these the Pantodonta (Allodesmidæ), the Cyclodonta (Cardiacea, Tridacnacea, and Isocardiacea), and the Asthenodonta (Myacea and Adesmacea [=Pholadidæ, etc.]) call for no comment. Nor do the Telodonta, beyond the remark that the Solenacea, here included with Veneracea, Tellinacea, and Mactracea, have hitherto usually been classed with the Myacea. The remaining group, Diogenodonta, comprises Pelseneer's Submytilacea (minus, of course, the Unionidæ and their allies, Ætheriidæ, removed to the Schizodonta, and Dreissensiidæ, with Modiolopsidæ referred to Dysodonta) and the Chamacea with their allies the Rudistæ.

The latter surprising innovation has been introduced by Dr. Dall on the ground that "*Echinochama* has a free nepionic stage, in which it has the form, hinge, and other characters of *Cardita*." Boehm (17), agreeing, he says, with Steinmann, considers, on the other hand, that the prodissoconch in question most nearly approaches the group of *Astarte studeri*. Granting that this nepionic stage proves the affinity of the Chamacea to the Carditacea (or Astartacea), it is still doubtful if this sanctions the wide separation of these two, and the Rudistæ, from their allied forms the Cyclodonta; might it not equally be held of sufficient force to warrant the inclusion of the Carditacea in the Cyclodonta? True, it would have spoilt the present definition of that group; but the assemblage itself would have been rendered no more anomalous than is Schizodonta. Moreover, it is worthy of note that the prodissoconch in *Chama* itself by no means resembles that of *Echinochama*. Suppose it should turn out that, in spite of the strong resemblance of the hinge-teeth in the adult forms, the nepionic stages should reveal a different line of descent for each of these two genera?

Destructive criticism is of course easy; but what alternative proposal can be made when doctors differ thus? Practically none, till more is known of the anatomy and life-history of the majority instead of the minority of the forms, and till our museums contain series of specimens of all ages with properly dissected examples of the animals, in lieu of the simple shell of two or three adult individuals of each species (so-called).

Dr. Dall himself freely admits his 'provisional classification,' as he wisely is careful to call it, to be far from perfect, but maintains "that the groups, whether well or ill, have been comparably defined," a point on which some may differ from him, and even quote against him certain passages out of his own work. Be that as it may, no one can fail to feel anything but gratitude towards him for his plucky attempt to deal with a most difficult subject—an attempt the comparative success or failure of which can only be rightly judged in the light of further researches. The subject, however, will only be properly dealt with when the systematist, the palæontologist, and the anatomist will consent to work hand in hand for the common object. It will then probably be found the safest course to name each of the larger groups after some one of its more conspicuous members, instead of fixing on conchological or anatomical features which, by their very employment, are apt, albeit quite unconsciously, to bias the opinion of whoever employs them.

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III.

Sharks as Ancestral Fishes.

PRIMÆVAL sharks are certainly to be looked upon with great interest by the student of fishes; for recent discoveries have seemed to warrant the belief that by a better knowledge of these ancient forms the clearest light is to be thrown on the problem of ancestral fishes. The study of living sharks has been in many ways an unsatisfactory one; for, while many of their adult structures are usually conceded to be generalised and therefore primitive, other and important structural characters must be regarded as much modified. Indeed, on this account, Kupffer, Beard, Pollard, Dollo, Retzius, and Klaatsch, among others, appear to have come to regard the sharks as perhaps a more divergent group than some of the archaic ganoids. Thus, sharks appear to have lost entirely their ancient mode of reproduction—the eggs are no longer fertilised externally, "claspers" being present in the male of every recent shark[1]; the eggs are now few in number, enormous in size, and elaborate in their range of protective capsules; their developmental characters, especially those of the earliest and of larval stages, are remarkable in their adaptations.

Whether the recent sharks, in spite of their many specialised characters, are yet to be regarded as representing most nearly the ancestral stem-form of the fishes, becomes, accordingly, a doubtful, if an interesting, question. Considered on broader grounds, they have certainly a strong claim to be looked upon as primitive; the characters of their integument and skeleton, of their circulatory, renal, and nervous systems, and end organs, together with their more numerous gills and body-segments, and the simpler condition of tail and fins, stand as weighty evidence in favour of their generalised position.

On the other hand, it becomes equally clear that this problem can be settled definitely only when evidence shall be forthcoming to demonstrate that the ancestors of the living sharks were, not only clearly shark-like (*i.e.*, not approaching in structural characters the stems of other groups), but were also clearly lacking in whatever might be interpreted as the specialised features of their descendants. The solution of the entire problem, accordingly, must naturally fall to the palæontologist, and we must await the discovery

[1] Professor Lütken, in a recent conversation with the writer, stated that he had determined functional claspers in *Læmargus*.

of Palæozoic sharks in a condition that shall render the study of their structure possible. At the present time, enough at least of the fossil forms have come to light to convince so critical a palæontologist as Mr. A. S. Woodward that "if the earliest true fish could be found, it would almost certainly fall within the sub-class Elasmobranchii."[1]

Three early sharks have, within the past few years, been somewhat definitely described. The earliest of these, *Cladoselache* (*Cladodus*), is, however, as late as the Lower Carboniferous. Next to this in antiquity is *Chondrenchelys*, from the Carboniferous; and the latest, best known in the Permian, is *Pleuracanthus* (and *Xenacanthus*). Previous to the description of these early types, the Acanthodians, members of a highly specialised group of the Elasmobranchii, had alone been structurally known.[2]

The features of these early forms may now be summarised with a view of determining what evidence they afford as to the ancient descent of the sharks.

Pleuracanthus, although the latest of these types, appears, nevertheless, as the structural studies of Cope, Fritsch, Brongniart, and Jaekel have shown, to have been decidedly unlike recent sharks in many of its features. It may, perhaps, represent the advancing stem of the Elasmobranch group, which may early have given rise to Teleostomi or to the Lung-fishes. At all events, *Pleuracanthus* gives us but little clue to the structures of the primitive sharks. We find, for example, that it had nearly lost its body-armouring of shagreen[3]: that it had evolved archipterygial fins, and a diphycercal tail; that it had produced a spine, elaborately specialised, and remarkable in its anterior position. Add to these characters the fact that no more than five gill arches were present, and that the upper element of the mandibular arch had become differentiated to a degree which rendered the skull amphistylic.[4] Moreover, the most important primitive

[1] Natural Science, vol. VI., p. 38. Jan., 1895.

[2] Add to these *Symmorium*, a Permian form recently described by Professor Cope.

[3] That it had a body-armour of shagreen seems evident from a study of Dr. Brongniart's material in Paris, for a patch of typical denticles occurs in the male, near the base of the claspers. *Cf.* also Jaekel, *SB. Gesell. nat. Freunde Berlin*, no. 4, p. 77; 1895.

[4] To these highly-evolved features of *Pleuracanthus* might perhaps be added (1) the unsegmented character of the main body of the gill-bars (as in Lung-fishes), (2) the presence of teeth in the pharynx, (3) the greatly calcified condition of the skeleton—a feature of more or less value in connection with other advancing or specialised conditions. Two other primitive features are noted by Jaekel (*op. cit.*, p. 72), (1) the paired character of the hypobranchial, and (2) the segmented condition of the shoulder girdle. The present writer, while inclined to accept the first of these conditions as primitive, must note, nevertheless, that the copulæ of the other arches are so widely differentiated that it is clearly possible that the paired hypobranchials might as well represent adaptive structures. With regard to the second point, having, through the kindness of Dr. Jaekel, examined the Berlin material, the present writer cannot but believe that the segmented nature of the shoulder girdle is due entirely to accidental fracture.

features which could be attributed to *Pleuracanthus* are certainly present among recent sharks—*e.g.*, the possession of a spiracle, and of a notochordal skeleton.

A study of the second Palæozoic shark, *Chondrenchelys*, Traquair, so far as our present knowledge goes, affords just as little satisfactory evidence as to the primitive characters of primæval sharks. This form may indeed have been rather of a pleuracanth type, with its elongate body and tapering tail; nevertheless, it was certainly well differentiated in its skeletal characters, possessing well-marked vertebral centra and arches.

It is accordingly to the third and oldest of these ancient sharks that we have finally to turn for more definite suggestions as to the primitive characters of Elasmobranchii. *Cladoselache* has already been mentioned several times in the pages of NATURAL SCIENCE in connection especially with the primitive characters of its fins. Its remaining structures, however, are found to prove equally important from the morphological standpoint; and in the present connection a summary of its general characters may be given.

Cladoselache is at the present time to be looked upon as representing a group of Palæozoic sharks included in a single genus (perhaps two genera), and so far as the present writer is aware, in about a dozen species. These are relatively small in size, varying from two to six feet in length. They were first brought into notice about 1888 by the late Professor J. S. Newberry, of Columbia College, New York, and they have subsequently been described by Professor E. W. Claypole, Mr. Arthur Smith Woodward, Dr. Otto Jaekel, and the present writer. The material from which these fossils were originally known has now been added to the collection of Columbia College; but an abundant material, including several dozen complete specimens, some of which are admirably preserved, is now in the private collections of Dr. Wm. Clark, of Berea, Ohio, and Rev. Wm. Kepler, of New London, to both of whom belongs the credit of its discovery.

The Cladoselachidæ have been found only in the Waverly Sandstone (at the base of the Lower Carboniferous) of Ohio; they here occur in heavy, oblong concretions, which are usually obtained when weathered out of the precipitous stream-margins. A concretion contains usually the entire fish, shown in nearly every case in ventral or dorsal aspect. The only part of the animal which was subject to widely varying conditions during the period of fossilisation was the body-width; the digestive tract and the visceral cavity seem here to have been considerably inflated with gases of decomposition, and justly account for the present position of the fossil. The antero-posterior dimensions of the fish are found to be constant in the same species.

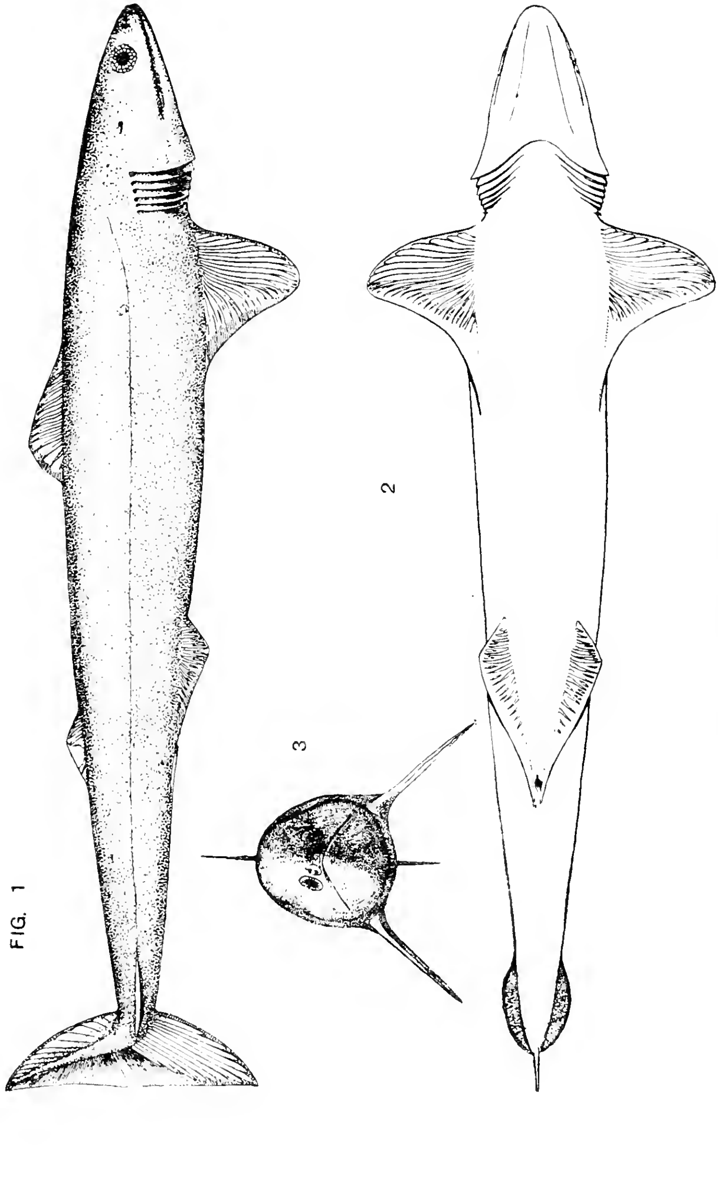
A careful series of measurements of well-preserved fossils has enabled the present writer to complete a restoration which he believes to represent *Cladoselache* in three aspects with fair accuracy, Figs. 1, 2, 3. In Fig. 2 the body-width has purposely been made narrower than in the fossils, and in Fig. 3 an attempt to present an idea of the head-view is believed by the writer to be trustworthy as to the down-turned position of the pectoral fins, and in general as to the vertical proportions. Outwardly, the subfusiform body would appear to resemble closely that of a modern shark; the fins, too, in their size and position, have somewhat of a modern look, and at the base of the tail occurs the small horizontal dermal keel of many living forms. Its paired fins served unquestionably as balancing organs, and could have had but little movement save at right angles to the plane of the fish's motion. The tail, homocercal in outline, and with its sharply-marked lateral keels, is too nearly of the outward character of the mackerel's to permit any other belief than that the swimming of the fish was active and rapid, and its shape certainly destroys the hypothesis of Jaekel, that *Cladoselache* was a form specialised to bottom-environment.

That *Cladoselache* was an exceedingly generalised shark, and that it, in fact, gives at the present time our clearest idea of the characters of the ancestral Elasmobranch, seems to be warranted by the study of the following structures:—

(*a*.) *Notochord, Vertebral Arches*.—From the mid-body region backward, a broad notochordal space may be traced in favourable fossils (*e.g.*, one discovered by Rev. Dr. Kepler, and given by him to the college at Delaware, O.); in the tail this is found to be underlaid by a well-defined tract interpretable as sub-notochordal rod. The neural and hæmal arches are also of interest; they prove to be of moderate size and thickness, extending no further outward than about one-half the vertical distance between notochord and integument. They are metameric in arrangement, *i.e.*, corresponding in number with the calcified remains of the muscle-plates, and closely resemble each other—each a tapering rod of cartilage forked at its base. Interneurals are absent, thus distinguishing *Cladoselache* from the Pleuracanthidæ and all other sharks.

(*b*.) *Branchial Arches, Jaws*.—Five gill-arches are clearly present (*cf*. Professor Claypole, *American Geologist*, vol. xv., Jan., 1895), and in a favourable specimen in Columbia College there appear to be traces of a sixth and seventh; they are interesting in their similar size, their stoutness, and in the transverse plane in which they lie. Their elements have not been clearly distinguished. The upper and lower jaws are similar in shape and size; their hinge is supported by an elongate hyo-mandibular, somewhat as in *Chlamydoselache* or *Scyllium*. In the wide space between this element and the palatoquadrate a spiracle may well have been present. The mouth was terminal; the gills possessed frilling integument, supported by fibrous rays, and the foremost of these dermal gill-frills appears to have been sufficiently large to have served as an operculum.

(*c*.) *Integument, Teeth*.—The integument, everywhere lacking in



FIGS. 1–3.—RESTORATION OF CLADOSELACHE.
A shark from the Lower Carboniferous of Ohio in side view (1), and from the inferior (2), and anterior (3) aspects.

membrane bones, is studded with minute lozenge-shaped denticles. No enamel appears to be present on the denticles of the body-region, and in a recent paper of Professor Claypole (*Proc. Amer. Micr. Soc.*, pp. 192–195; 1894) it is shown to be also absent on the teeth. The Cladodont teeth are arranged on each mandibular ramus in a dozen or more banks, each composed of about seven teeth. Of these the innermost are the largest, and of all the banks those most nearly symphysial include the stoutest and longest teeth. At the hinder mouth-margin, the shagreen denticles, here enlarged, approximate in size and shape to the smallest of the teeth (as in *Chlamydoselache*): they are also notably present in the enlarged shagreen-plates surrounding the orbits.

(*d*.) *Fins and Girdles.*—The paired fins of *Cladoselache* must be looked upon as lappet-shaped remnants of the continuous dermal fold, which is generally believed to be the ancestral condition in the history of the paired limbs. And it is certainly most interesting evidence in support of the lateral fold theory to find that in this most ancient of typical sharks the fin-conditions are precisely what one might have expected on purely *à priori* grounds. The pectorals and ventrals are entirely lacking in lobate bases. The fins lie in the plane of the fish's movement, the hinder limits of the ventrals drawing closely together in the region of the anus; their external supporting elements, the radials, extend metamerally from the body-wall to the fin-margin, and there is practically no dermal margin surrounding the fin.[1] The pectorals are clearly the more specialised: they are enlarged in size, their anterior supporting elements, thickened and blunted, forming a compact cut-water, and the elements of the fin include the compacted structures[2] of between thirty and forty metameres. The ventrals, on the other hand, retain, as Wiedersheim's work leads us naturally to expect, the more primitive characters; although they present a smaller number of metameral supports—twenty-two to thirty—they are but the elongated remains of the dermal fin-fold, whose margin is slightly blunted anteriorly, where the supporting elements have become compressed into a serviceable cut-water. In the mid-region of these fins, as also in the pectorals, it is doubtless the compression of the radials which has caused their tips to intercalate, as shown in the figures.

As to the supports of the paired fins, in the ventrals (Fig. 5) the basal cartilages, B, are as yet segmental and unfused, and no form of pelvic girdle appears to be present. The supporting elements of the pectorals are not as yet to be made out clearly; their probable dis-

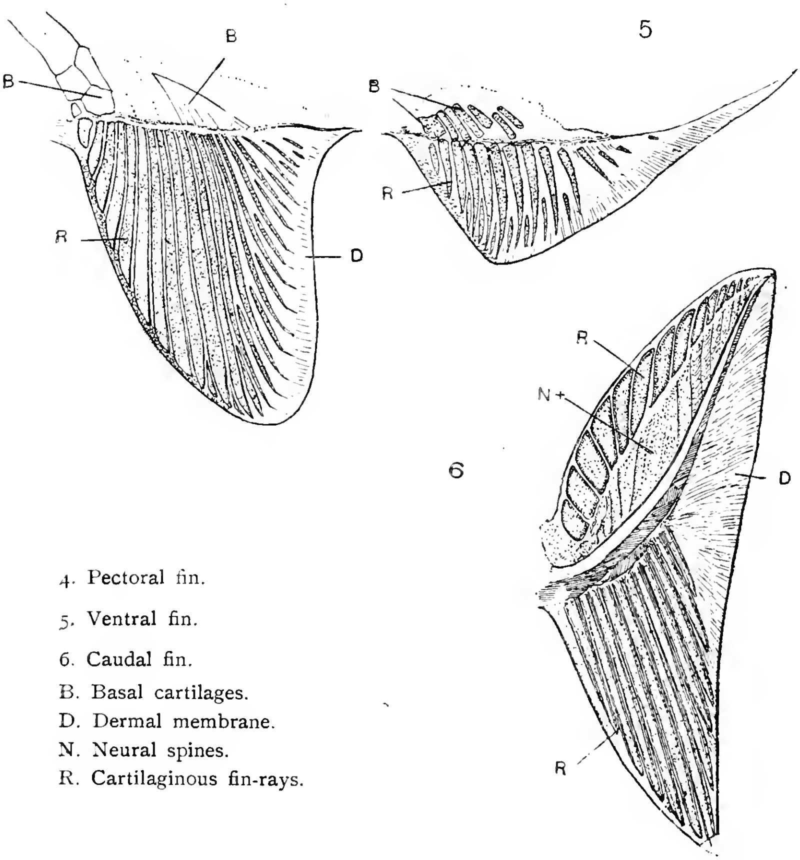
[1] This condition is nearly parallelled in the recent bottom-living Elasmobranchs; in these, however, the radials are invariably *jointed*, and their fins, great in size, are not directed downward, as the fossils indicate, to the plane of the pectorals of *Cladoselache*.

[2] The present writer has preparations which show that the intercalated radials traverse the entire fin; it is accordingly evident to him that these rays may justly be regarded in all cases as homologous structures

position is suggested in the adjoining figure (Fig. 4, B). The shoulder girdle appears to be represented in a pair of flattened "coracoid" elements.

The unpaired fins seem, as shown in a specimen in the Museum at Delaware, O., to have been outlined as in Fig. 1. Two dorsals are present, spineless, their shape corresponding somewhat to the ventrals, the foremost one slightly the larger. The latter includes the

FIG. .4



4. Pectoral fin.
5. Ventral fin.
6. Caudal fin.
B. Basal cartilages.
D. Dermal membrane.
N. Neural spines.
R. Cartilaginous fin-rays.

FIGS. 4-6.—FINS OF CLADOSELACHE.

supporting elements of about fifteen metameres, arranged similarly to the radials of the paired fins; their basal supports have not been determined.

The caudal fin is unique in its structure (Fig. 6). It is certainly of the elasmobranchian type, heterocercal, but its widely upturned tip has brought it to the limits of homocercy. Yet, although it has become specialised for its swift-swimming function, it seems evident that this fin is nevertheless of an exceedingly primitive type, more primitive than the caudal of the most generalised of modern sharks, inasmuch as its cartilaginous supports extend from the body-terminal as far as the extreme margin of the fin, and that the hypural region of the dorsal lobe is entirely without cartilaginous or other supports (save, perhaps, actinotrichia), precisely as in embryonic protocercy.

(*e.*) *Reproductive System.*—*Cladoselache* appears to have been lacking in claspers—a condition unknown among recent Elasmobranchia,[1] and exceedingly significant, therefore, in this ancient shark. The general character of the hinder margin of the ventral fin seems at once to preclude the presence of intromittent structures; in over a dozen examples of well-preserved pelvic fins nothing has been found which could possibly be interpreted as relating to these organs. It accordingly follows, with more than fair probability, that this primæval shark had not evolved the highly-modified reproductive methods of its living kindred, but, like ganoid and lung-fish, fertilised its eggs at the moment of extrusion. In this event, it would seem exceedingly probable, judging by many analogies, that the number of the eggs deposited must have been considerable; they might accordingly have been small in size and not over rich in their yolk-supply.

(*f.*) *Organs of Sense.*—The position of the olfactory capsule has been outlined in many specimens; the position of the external narial openings appears to have been dorsal, and the present writer believes, from the study of a well-preserved mouth-margin, that its conditions in general resembled those of Notidanidæ. Well-marked labial cartilages must have been absent, and there is certainly no evidence in support of the cirrhostomial theory (Pollard) to be derived from *Cladoselache*. No lateral flap-covered canal appears to have united the cavities of mouth and nose.

The eye capsule was scarcely larger, proportionately, than in recent sharks. Its dermal investment by concentric rings of enlarged shagreen plates has already been noted by Jaekel and others. The present writer notes that this method of the protection of the eye capsule may well be regarded as a primitive specialisation, inasmuch as the integument is functioning in the defence of the delicate optic sense-bulb, instead of the underlying tissue; in other words, the sclerotic of this ancient form may not have assumed its protective characters.

The lateral line has been traced as a well-defined space between rows of shagreen denticles, and it follows, therefore, that an open sensory groove persisted, as in *Chlamydoselache*. In the fossil form, however, judging from the characteristic tail structure, this condition could not have been due to bathybial environment.

In view of the structural characters which have just been summarised, it seems to follow that in *Cladoselache* has been discovered an Elasmobranch of an exceedingly primitive nature.

[1] This condition does not occur in *Læmargus*, as Professor Lütken at first believed.

Even its specialisations are evidently of a lowly order: the differentiation of the fins, their radial supports, with their range of size and shapes clustering in the anterior fin-margin, are of this class; also the shapes of the cladodont teeth, and the large shagreen denticles surrounding the orbits or strengthening the cut-water margins of the fins; as well as the curious differentiation of the caudal fin, in its extreme degree of heterocercy and in its dermal lateral keels. The sum of the generalised features of this most ancient shark cannot, moreover, fail to place it, judging from the standpoint of the morphologist, near the ancestral stem of the Elasmobranchii. Its primitive fin-characters and lack of clasping organs, moreover, break one of the strongest barriers that have separated the primitive phylum of the Elasmobranchii from that of the Teleostomi and lung-fish. Furthermore, it is with the characters of *Cladoselache* that the puzzling structures of the Acanthodians are now most reasonably to be compared. The fin-structures of the more generalised form of *Cladoselache* are found to be clearly approaching those of the Acanthodians. The fin-spines of the latter, although clearly encased *outwardly* with purely dermal structures,[1] are, nevertheless, to be regarded as of compound origin, representing morphologically the concrescence of the radial supports in the anterior margin of the fin; and it is significant that the fin of a Cladoselachid, which has been discovered by, and is now in the collection of, Dr. Clark,[2] is decidedly of a spine-like character, nearly thrice as long as wide, its supporting elements forming a compact and Acanthodian-like fin-support.

Up to the present time the discoveries among the primæval sharks can only be regarded as the beginnings of our knowledge of these remarkable forms. As beginnings, however, they must certainly be acknowledged as already of extreme interest, demonstrating the existence of elasmobranchs of primitive and generalised characters, and enabling us to form an idea of what may have been the direct ancestors ("*Proselachia*") of the recent sharks and rays, if not, indeed, of the remaining groups of fishes.

BASHFORD DEAN.

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[1] *Cf.* Smith Woodward, NATURAL SCIENCE, vi., pp. 38–44.

[2] By whose courtesy the writer is enabled to describe and figure it in a forthcoming number of the *Anatomischer Anzeiger*.

IV.

Rules of Nomenclature in Zoology.

THE code of the German Zoological Society for the moment holds the field. It is to govern the naming of all the known animals of the world in the forthcoming volumes of "Das Tierreich." There is still, however, a brief interval during which the code is liable to be modified. It may, therefore, be made better or it may be made worse. At a recent meeting of the Zoological Society of London only one point was made transparently clear, namely, that no body of regulations on the subject of scientific nomenclature can possibly give universal satisfaction. Some speak of the law of priority as "a fetish" and "a demon," while others hold that it governs almost *jure divino* in the vocabulary of science. Some persons are taunted with being extremists who look upon themselves as the pure models of logical consistency. Some think that we ought to bury the past and bind the future, while others believe that the more justice we render to our predecessors, the more surely will our own decisions be accepted by those who come after us. Some single out for censure the very points in the German code which others think exceptionally deserving of praise.

The first rule relieves the zoologist from the obligation of paying regard to the names of botanical genera. This is in accord with Sir William Jardine's Report, approved of and adopted by Section D of the British Association in 1865, on the motion of Mr. Gwyn Jeffreys, *seconded by Dr. Sclater*. Since that time the relief in question has generally been taken for granted, as a matter of such obvious convenience, as a blessing so unqualified, that it could need no further argument. With much surprise, therefore, did one hear or seem to hear Dr. Sclater himself maintaining the contrary opinion. He urged the chances of confusion between a genus of plants and a genus of animals, especially when we are dealing with the borderland between animal and vegetable life, and he pointed out that the recent "Index Kewensis" now made it easy for the zoologist to discover and avoid the names which have been used in botany. But the "Index Kewensis" is of no avail to the zoologist working at a distance from great libraries. He is certain not to possess it, and, were it ever so near to his hand, it would tell him nothing in regard to the continuous coinage of new botanical names. In any case, in order to avoid the infinitesimal risk of confounding a tadpole with a tulip, or even the crime of giving to a new protozoön a name already consecrated to a protophyte, it surely cannot be worth while to fetter all zoologists again with the botanical shackles from which they have shaken themselves free.

As for that part of Rule 5 which ordains that such a name as *Scomber scomber* Linn., should prevail over the later *Scomber vulgaris* Fleming, let those dispute who care. It seems to be a contest between Linnæus and Strickland, between a demigod and a hero. The repetition of sounds in *Scomber scomber* is said to be something quite excruciating to the ear. Yet in the solemn anthem, musicians have been known to favour such repetitions, the orator uses them, in poetry they occur without offence, and even our English aristocracy sometimes bears them as an added grace.

The seventh of the German rules adopts the tenth edition of the "Systema Naturæ" (1758) as the starting-point of zoological nomenclature. It is late in the day to oppose this, since here again the German Society is not leading opinion, but wisely following it. Sir William Jardine's Committee no doubt objected to the change from the twelfth to the tenth edition. They argued that the twelfth was the last and most complete edition of Linnæus's works, containing many species not found in the tenth, and that much confusion would result from the changes of names required upon an alteration of the date which had been accepted for twenty-three years. If men would measure time by some more adequate standard than the length of their own lives, they would not attribute an overweening importance to the lapse of something less than a quarter of a century. Apart from this, the objection is still upheld by some important authorities that it would be disrespectful to Linnæus to adopt the tenth edition of his work for our starting-point, inasmuch as in the later edition he himself introduced alterations in the names employed. Now, no rule is more properly and more generally accepted than this, that over names once published the author has no more authority than anyone else. Therefore, on the plea of reverence for Linnæus, the adoption of the twelfth in preference to the tenth edition of the "Systema" is simply to hold up Linnæus as an *exemplum ad vitandum*.

Those who look with horror upon the date of 1758 must be prepared for a further shock. Taken in an uncompromising manner, it is still not early enough. Professor T. Thorell ("On European Spiders," p. 8; 1870) says, "As regards *Spiders* in particular, Clerck has already 1757, in his famous work 'Svenska Spindlar, Aranei Suecici,' applied Linné's nomenclature in perfect consistency, and accordingly the denominations given by him in that work have right of priority in preference to the Linnæan." The Jardine Committee, with reference to the date of 1766, make similar exceptions as to the works of Artedi and Scopoli. Assuredly it would be easy to ascertain whether any other writings with similar claims to those of Clerck were published between the date of 1758 and that of 1751, "when

Linné's 'Philosophia Botanica' appeared, in which his new system of nomenclature was first fully and distinctly propounded." Though Linnæus on the whole towered above his contemporaries, it is a mistake to suppose that he was on a uniform level at all points of knowledge. In several special departments of zoology he was conspicuously below the specialists in those branches, and therefore in his favour to cancel the properly constructed systematic names which they were the first to give, can hardly square with the humblest, let alone any lofty, ideal of justice.

In the German rules there are some inconsistencies. A footnote to the second explains that the sentences in small print contain explanations, exemplifications, and recommendations. But the first sentence in small print attached to the third rule contains the ominous word "must," which may be explanatory, but does not read like the language of advice. The rule in question is that "Scientific names are to be regarded as Latin words." Then follows the exhortation in small print that "In words derived from the Greek the following transliterations must uniformly be employed." It is not twenty-three but fifty years ago that George Grote, the famous historian, taught us to welcome such words as Aristeides, Hêlios, Asklêpius, Korônis, and, in regard to this innovation, said, "I have approximated as nearly as I dared to the Greek letters in preference to the Latin." But the German ordinance, while not attempting to introduce the simple and much-needed service of distinguishing the long vowels from the short, would now compel us, as of old, to change EI into I, K into C, and so forth. If this is meant to be retrospective, the interference with established names will not be trifling. Such words as *Cheirocratus*, *Leptocheirus*, *Stylocheiron*, *Kallospongia*, *Kentrodorus*, will be tortured out of their accustomed form. In the interests of pronunciation an Englishman might well wish that, at least for scientific names, that silly C, the opprobrium of our alphabet, had been altogether discarded. As Grote says, "The ordinary practice of substituting, in a Greek name, the English C in place of the Greek K is indeed so obviously incorrect, that it admits of no rational justification. Our own K precisely and in every point coincides with the Greek K: we have thus the means of reproducing the Greek name to the eye as well as to the ear, yet we gratuitously take the wrong letter in preference to the right. And the precedent of the Latins is here against us rather than in our favour, for their C is really coincident with the Greek K, whereas our C entirely departs from it, and becomes an S before E, I, Æ, Œ, and Y." Further on he says, "We mar the unrivalled euphony of the Greek language by that multiplied sibilation which constitutes the least inviting feature in our own."

But, again, why should we be forced or induced in the name of Latinity (!) to use such forms as *Linnæusi* and *Möbiusispongia*, while nothing is done to prevent the naming of a genus *Platysiagum*, a form which is neither Greek nor Latin nor Latinised Greek? Why should we be asked to flout an excellent scholar like Henrik Kröyer by changing his *Lafystius* into *Laphystius* and worsening his *Protomedeia* into *Protomedia*? Why should we play the pedagogue to men who, without happening to be scholars, may have been first-rate naturalists? Is it not an impertinence, and a useless one, to correct their spelling which, as it stands, is characteristic and has a kind of biographical interest? Why, too, are we told that the termination -idæ in the names of zoological families is derived from the Greek -ειδης, whereas patronymics in Homer end in -ιδης, while -ειδης, signifying likeness, is more suggestive of a picture-gallery than a family?

The fourth rule says that "Names of the same origin and only differing from each other in the way they are written, are to be considered identical." This opens the way once more to mischievous interference with established names, but the examples offered combine to give it so perplexing a vagueness, that they may haply and happily lead to its being cancelled. Thus, *moluccensis* and *moluccanus* are allowed to stand side by side, but *Fischeria* is said to be equivalent to *Fisheria*, and yet Fischer is German, while Fisher is English, and perfectly distinct genera have been designated after each of these distinct surnames.

The fifth rule permits "orthographical correction when the word is without doubt wrongly written or incorrectly transcribed." From among numerous examples offered, *Oplophorus* may be cited, which is to be corrected into *Hoplophorus*. Can anything be more superfluous? The Latins themselves were uncertain whether H was a letter or only a breathing. They fluctuated between the spelling of Adria and Hadria, of Hannibal and Annibal. Why should we, then, be more Roman than the Romans? To the breathing itself it is sometimes alleged that some of us pay but scant attention, even in classic London, and the French, who avowedly waste little time over aspirates, with much consistency give such a word as *Oplophorus* the same initial which it has in Greek. There is nothing wrong in that, and, if it were ever so wrong, what advantage is derived from interfering? Someone will next be telling the distinguished editor of "Das Tierreich" that he does not know how to spell, and that the gigantic work he is editing ought to be called "Das Thierreich."

Rule 13 declares that a specific name is to depend grammatically upon the generic name. This implies that adjectival names of species must agree with the supposed gender of the generic name. It would be far simpler to regard all generic names of animals as masculine, and thus rescue naturalists from the effects of a superstition that in Greek and Latin all words ending in "a" are feminine.

Rule 14 enacts "That the same specific name can only be used once in the same genus," but in the small print it is explained that a name which was not valid when first published, because it infringed this law, may become valid by the removal of the earlier species of the same name to a different genus. By this ingenious contrivance a name may be valid and not valid at one and the same time, according to the classification which different authors may prefer. The name will die when it is born, and then by a stroke of luck come to life, killing some other name which has taken its place. Then perhaps it will be transferred into the genus to which its namesake has been earlier carried, and so perish once more. Can anyone contemplate with patience the possibility of these romantic adventures, when nothing is easier and simpler than to abide by the precept, actually appended to rule 5—once a synonym always a synonym?

Whatever opinion may be held about these various details, this at least should be remembered, that, however great and wise and powerful may be the Association, the Society, the Congress, which promulgates ordinances on this subject of zoological nomenclature, the enactments can never have the irresistibility of Natural Law. They are exposed to some of the weaknesses which affect Statute Law and still more International Law and all codes of honour and social etiquette. They must have public opinion on their side or they will not work. They should be calculated to win respect, to prevail, not by arbitrary power, but by deserved prestige. To those who are the organising forces in this matter I earnestly make this appeal. The regulation of trifles should be laid aside. Allow us to use small initials or capital letters *à discrétion*; allow us to transliterate our Greek and to leave out our aspirates, and in general to show our fancifulness or our want of scholarly education as we choose. In the great essentials make the rules as logical, as simple, as equitable as human wit can devise, and then stand steadfast, secure that the reasonable in all nations will eventually, if not at once, endorse your action.

THOMAS R. R. STEBBING.

IN view of the interest at present taken in this subject, we take the liberty of quoting the following weighty words from the presidential address entitled "The Formulation of the Natural Sciences," delivered to the American Society of Naturalists in Philadelphia by Professor E. D. Cope, and published in the *American Naturalist*, vol. xxx., pp. 101–112, February, 1896. The passage quoted begins on p. 109:— ED. NAT. SCI.

"Nomenclature is like pens, ink, and paper; it is not science, but it is essential to the pursuit of science. It is, of course, for convenience that we use it, but it does not follow from that that every kind of use of it is convenient. It is a rather common form of apology for misuse of it to state that as it is a matter of convenience, it makes no difference how many or how few names we recognise or use. An illustration of this bad method is the practice of subdividing a genus of many species into many genera, simply because it has many species. The author who does this ignores the fact that a genus has a definite value, no matter whether it has one or five hundred species. I do not mean to maintain that the genus or any other value has an absolute fixity in all cases. They undoubtedly grade into each other at particular places in the system, but these cases must be judged on their own merits. In general there is no such gradation.

"Nomenclature is then orderly because the things named have definite relations which it is the business of taxonomy, and nomenclature its spokesman, to state. Here we have a fixed basis of procedure. In order to reach entire fixity, a rule which decides between rival names for the same thing is in force. This is the natural and rational law of priority. With the exception of some conservative botanists, all naturalists are, so far as I am aware, in the habit of observing this rule. The result of a failure to do so is self-evident. There is, however, some difference of opinion as to what constitutes priority. Some of the aspects of the problem are simple, others more difficult. Thus there is little or no difference of opinion as to the rule that the name of a species is the first binomial which it received. This is not a single date for all species, since some early authors who used trinomials and polynomials occasionally used binomials. A second rule which is found in all the codes, is that a name in order to be a candidate for adoption, must be accompanied by a descriptive diagnosis or a plate. As divisions above species cannot be defined by a plate, a description is essential in every such case.

"It is on the question of description that a certain amount of difference of opinion exists. From the codes of the Association for the Advancement of Science, and of the Zoological Congresses, no difference of opinion can be inferred, but the practice of a number of naturalists both zoologists and palæontologists in America, and palæontologists in Europe, is not in accord with the rule requiring definition of all groups above species. It has always appeared to me remarkable that a rule of such self-evident necessity should not meet with universal adoption. However, the objections to it, such as they are, I will briefly consider. It is alleged that the definitions when first given are more or less imperfect, and have to be subsequently amended, hence it is argued they have no authority. However, the first definitions, if drawn up with reference to the principles enumerated in the first part of this address, need not be imperfect. Also an old-time diagnosis of a division which we have subsequently found it necessary to divide, is not imperfect on that account alone, but it may be, and often is, the definition of a higher group. But you are familiar with all this class of objections and the answers to them, so I will refer only to the positive reasons which have induced the majority of naturalists to adhere to the rule.

"It is self-evident that so soon as we abandon definitions for words, we have left science and have gone into a kind of literature. In pursuing such a course we load ourselves with rubbish, and place ourselves in a position to have more of it placed upon us. The load of necessary names is quite sufficient, and we must have a reason for every one of them, in order to feel that it is necessary to carry it. Next, it is essential that every line of scientific writing should be intelligible. A man should be required to give a sufficient reason for everything that he does in science. Thus much on behalf of clearness and precision. There is another aspect of the case which is ethical. I am aware that some students do not think that ethical considerations should enter into scientific work. To this I answer that I do not know of any field of human labour into which ethical considerations do not necessarily enter. The reasons for sustaining the law of priority are partly ethical, forwe instinctively wish to see every man credited with his own work, and not some other man. The law of priority in nomenclature goes no further in this direction than the nature of each case requires. Nomenclature may be an index of much meritorious work, or it may represent comparatively little work; but it is to the interest of all of us that it be not used to sustain a false pretence of work that has not been done at all. By insisting on this essential test of honest intentions we retain the taxonomic and phylogenetic work within the circle of a class of men who are competent to it, and cease to hold out rewards to picture-makers and cataloguers.

"Another contention of some of the nomenclators who use systematic names proposed without description, is, that the spelling in which they were first printed must not be corrected if they contain orthographical and typographical errors. That this view should be sustained by men who have not had the advantage of a classical education, might not be surprising, although one would think they would prefer to avoid publicly displaying the fact, and would be willing to travel some distance in order to find some person who could help them in the matter of spelling. But when well educated men support such a doctrine, one feels that they have created out of the law of priority a fetish which they worship with a devotion quite too narrow. The form of our nomenclature being Latin, the rules of Latin orthography and grammar are as incumbent on us to observe, as are the corresponding rules of English grammar in our ordinary speech. This cult, so far as I know, exists only in the United States and among certain members of the American Ornithologists Union. The preservation of names which their authors never defined; of names which their proposers misspelled; of names from the Greek in Greek instead of Latin form; of English hyphens in Latin composition; and of hybrid combinations of Greek and Latin, are objects hardly worth contending for. Some few authors are quite independent of rules in the use of gender terminations, but I notice the A. O. U. requires these to be printed correctly. Apart from this, I notice in the second edition of their check list of North American Birds just issued, only eighteen misspellings out of a total number of 768 specific and subspecific names, and the generic and other names accompanying. These are, of course, not due to ignorance on the part of the members of this body, some of whom are distinguished for scholarship, but because of an extreme view of the law of priority.

"In closing, I wish to utter a plea for euphony and brevity in the construction of names. In some quarters the making of such names is an unknown art. The simple and appropriate names of Linneus and Cuvier can be still duplicated if students would look into the matter. A great number of such names can be devised by the use of significant Greek prefixes attached to substantiatives which may or may not have been often used. Personal names in Greek have much significance, and they are generally short and euphonious. The unappropriated wealth in this direction is so great that there is really no necessity for poverty in this direction. It should be rarely necessary, for instance, to construct generic names by adding prefixes and suffixes of no meaning to a standard generic name already in use.

E. D. Cope."

V.

The Wing of Archæopteryx.

THAT the wing of *Archæopteryx* possessed five digits has now been urged upon the readers of NATURAL SCIENCE on two separate occasions (1, 2).

The object of this paper is to bring forward a few additional facts which appear fatal to that hypothesis. Although primarily concerned with the wing, it incidentally refers to certain other parts of the skeleton. I write now, not, as formerly (4), from the evidence of photographs, but from a study of the actual fossils in the London and Berlin museums.

With regard to the carpus, it has been contended (2) that only the proximal row of carpals of *Archæopteryx* has been recognised; that this is represented by two bones, one being the radiale, the other the ulnare; and that the former is visible in both fossils, the latter in only

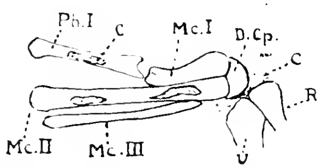

FIG. 1.—CARPUS AND METACARPUS OF THE LEFT WING OF ARCHÆOPTERYX, Dorsal view.

C., Crystalline matter; D.Cp., Distal row of fused carpals; Mc. I, II, III, Metacarpals, I, II, and III; Ph.I, Phalanx I of digit I; R, Radius; U, Ulna.

the London specimen. On this view, the London fossil should present both a radiale and an ulnare. As a matter of fact, however, it has but one bone that can possibly be regarded as a carpal, and this was figured by Owen as the radiale, but is identified by Dr. Hurst (2) as the ulnare. The only visible carpal in the Berlin fossil is certainly *not* a radiale, and it is quite possible that the so-called "ulnare" of the London fossil is not a carpal at all.

The "ulnare" just referred to must be regarded as of prime importance to the hypothesis under discussion. I suggest that it may represent the proximal articular surface of the metacarpals of the right wing, masked by the incrustation of mineral matter.

Only one carpal can be traced in the Berlin fossil, and this has been identified by Dr. Hurst as the "radiale." Fig. 1, which has been drawn carefully from the actual fossil, would seem to point otherwise. Surely the bone marked Cp. should be regarded, not as the radiale, but as representing more or fewer of the distal carpals fused into one mass, as in living birds. A fine suture line shows that this must have fitted very closely to the metacarpals I and II, if, indeed, it was not actually anchylosed with them. The facts that this bone is strictly confined to the bases of metacarpals I and II, and that metacarpal III was not produced backwards to the level of the bases of I and II, suggest that an additional and separate carpal was present, serving for the articulation of digit III. That there is a stage in the development of the carpus in modern birds (3) precisely agreeing with this permanent condition in *Archæopteryx*, seems to be a point in favour of this interpretation.

Of the five digits which, it is contended, composed the manus of *Archæopteryx*, nos. I, II, and III are supposed to be represented in the Berlin fossil, and nos. IV and V in the London one. The proximal halves (of D. IV, V) are said to have had "ridges which, when the two were fitted together, would have prevented their movement one on the other." I claim to have shown previously, that the bones in question were almost certainly parts of II and III; a further examination suggests that these fragments are encrusted with calcium carbonate, causing these "ridges," which are, in reality, nothing more than striations.

It has been held that the position of these bones "with reference to the feathers of the wing, in spite of the dislocation of other bones, is just that of the large metacarpals in an ordinary bird's wing; and the fact that these feathers are still in their normal position in this wing (the left) justifies the belief that when the animal finally settled down, . . . those feathers were still bound to those metacarpals by ligament." Now, I do not doubt for one moment that if these two bones are metacarpals, they supported those feathers; but to claim for the London fossil that these feathers are still in their normal position strikes one as a stretch of the imagination.

The London fossil has been held by Dr. Hurst to afford the strongest support to his hypothesis. But the stoutness of the two metacarpals may be due to the incrustation of calcite. Furthermore, seeing that the London fossil is, as Dr. Hurst clearly showed, that of a larger bird than the Berlin example—and, therefore, possibly of a different species—there seems to be no reason why the two should, of necessity, agree in detail, or even represent a precisely similar stage of development as regards the skeleton of the wing.

The phalanges of the three digits of the Berlin fossil are stated to have been furnished with tubercles for the insertion of the flexor muscles. This showed that these digits were "used to grasp parts of trees," which they could not have done had they borne long quill-feathers. Though I looked carefully for these tubercles I could only satisfy myself of the existence of anything like a tubercle in the case of the base of the claw of digit II and the proximal end of the pollex of the left wing.

It is certainly open to question whether the metacarpal bones were "free," as has hitherto been stated; and this is a point which is surely of considerable importance in the present discussion. As to this we have but the evidence of the Berlin fossil. Metacarpals I, II are so closely approximated that only a very faint trace of a suture can be seen. The proximal end of digit III is a little damaged, but it is nevertheless seen to be closely fitted to the base of Mc. II. Distally the II and III metacarpals seem to be slightly separated one from another. I am convinced, however, that this is but an apparent, not a real, separation, and that the two bones are really joined by an osseous bridge, which, being somewhat concave, has become filled up with rock.

If my interpretation of the manus of *Archæopteryx* proves to be correct, then it will, I think, be no longer possible to entertain the hypothesis that these three digits were used for climbing. Thus it will follow that they (or at least the II and III) supported the remiges, so that we shall be able to return once again to our old love the tridactyle avian manus.

I have already urged (4) that if the digits I, II, III were used for climbing, and if the remiges were supported by two additional digits, then the manus of *Archæopteryx* must have undergone an extreme specialisation in two directions, to fit it for two different modes of locomotion—flight and climbing. So far this objection has not been met to my satisfaction.

The fact that the digits of the Berlin fossil appear to lie on the feathers of the wing, and not under them, as we should have expected, has been held as proof that they could not have been concerned in the support of these remiges. This is by no means so serious an objection as it appears. In the London fossil, the author of the above objection assures us, the remiges are still in their *normal* position with regard to the bones which supported them. Now since in both fossils the bones of the digits lie above and not below the level of the remiges, it is hard to see how the same relations can be made to prove both ways.

Professor Dames, I believe, thinks it possible that what is preserved in the Berlin fossil is rather a combination of impressions of the feathers of both dorsal and ventral surfaces of the wing, the feathers themselves having quite disappeared. The remarkably fine impression of the primary remiges, however, would seem to oppose this view. The feathers are so perfectly preserved that even the overlap can be distinctly made out. This, as I suggested, and as Dr. Hurst afterwards maintained, is "distal"—*i.e.*, the outer edge of every remex is free and overlaps the inner edge of the one next in front. This can be well made out in the fossil, where, as photographs first suggested to me, the mud has drifted under some of these feathers, and so has raised the free or "distal" edges distinctly above the level of that portion of the vane of the feather immediately underneath.

It is significant that, in the Berlin fossil, the bones of the cubitus lie above the level of the remiges, and that the bases of *all* these feathers are completely obliterated. This latter fact suggests that they have suffered disintegration owing to their intimate connection with the decomposing muscles and tendons in which they were imbedded.

Looking at the fossil, one feels tempted to regard a peculiar triangular area between the humerus and cubitus of the left wing as an impression of the patagium.

Dr. Hurst has described "a series of feathers, which may perhaps be classed as rectrices, along the sides of the hinder part of the trunk, . . . these lateral rows of feathers constitute with the tail-feathers a continuous aëroplane, extending forwards as far as the posterior edge of the extended wings." Though I looked most carefully, I entirely failed to see anything approaching such an aëroplane. The tail-feathers I made out to decrease in length from behind forwards, and, at about the fourteenth caudal vertebra, to pass almost insensibly into larger, somewhat backwardly curved, and *decidedly* weaker feathers which cease in the region corresponding with the level of the preaxial border of the femur. Of the tibial *quills* which have been described, I can only say that I saw a mass of feathers which by no stretch of the imagination could I liken to the clearly-defined rectrices and remiges; rather do they resemble a precisely similar series to be found on the tibio-tarsus of some modern birds, *e.g.*, Accipitres.

That the humerus lacked a pectoral crest, and that the bones were *not* pneumatic, are statements that have more than once been made. A reference to the numerous photographs, or better still, to the fossils, shows at once that the pectoral crest was in reality fairly developed. That the long bones were pneumatic cannot be definitely disproved, inasmuch as in both the London and the Berlin fossil, wherever these bones are broken they are seen to be filled with crystal (calcium carbonate), the bone having the appearance of a thin investing sheath just as in fossil bones that are admittedly pneumatic. The existence of the pneumatic foramen has been denied, on the ground that there is no trace of it in either fossil. That there should be any such trace was hardly to be expected, since the crista inferior which lodges this foramen is yet imbedded in the stone.

Whence comes the evidence that the pelvis of *Archæopteryx* was conspicuously unlike that of modern birds in the matter of width? In these latter, the pelvis is supposed to have widened considerably to allow for the backward displacement of the viscera. Since the width of the pelvis is largely determined by that of the sacrum, the little evidence we have, if of any value at all, shows rather that the width of the pelvis of *Archæopteryx* was greater, not less, than in living birds; inasmuch as, according to Owen, the sacrum was "nearly 1 inch in breadth," while that of a common fowl measured across the widest part is only three-quarters of an inch.

I may conclude by offering a

SUMMARY OF THE CHARACTERS OF *Archæopteryx*.

Reptilian.—Skull: Upper jaw and mandible armed with teeth, apparently set in sockets (Thecodont dentition).

Vertebral column: Centra of vertebræ with flat articular surfaces (Dames *apud* Hurst). Caudal vertebræ numerous, forming

FIG. 2.—ARCHÆOPTERYX LITHOGRAPHICA, RESTORED AFTER THE FOSSIL IN THE BERLIN MUSEUM.

a long lizard-like tail, and each vertebra furnished with a pair of rectrices.

Ribs: The dorsal ribs have been described as wanting uncinate processes; an unsafe conclusion, since these are often absent in the skeletons of existing birds, having been lost in maceration. The cervical ribs appear to have been much more slender than in modern birds, and to have remained moveably articulated throughout life. "Abdominal ribs," resembling rather those of the Crocodilia than of the Chameleonida, appear to have been present.

Manus: Digit III had four phalanges, the last of which was armed with a claw.

The characters just enumerated have passed more or less entirely out of the life-history of modern birds, but the following yet obtain, either as transitory developmental features or throughout life.

Avian.—Carpus: Probably agreed with that of modern birds; except that the distal mass of fused bones remained distinct throughout life, and that digit III was provided with a separate carpal bone.

Manus: Agrees with that of modern birds, in that it is made up of three digits; also in that digit I had two phalanges and digit II three phalanges, the last phalanx in either case forming a claw. Digit III was also armed with a claw, a feature very rare among existing birds, while it is also peculiar in being made up of four phalanges.

Hind limb: Bird-like throughout; with mesotarsal articulation, distally reduced fibula, three metatarsal bones, elongated and strongly anchylosed one with another—but showing traces of their separate nature in the form of suture lines. Reduction of toes to four, all terminating in a clawed phalanx. Hallux with a short, free, backwardly directed metatarsal (Gadow).

Pelvis: Imperfectly known, but in that its component parts were apparently distinct, resembling that of the Tinamous or the "Ratitæ" among modern birds. So much of the ilium as can be seen is characteristically avian.

Feathers: Their presence on the wings, tail, legs, and in the region of the neck renders it almost certain that feathers clothed the whole body, save the tarso-metatarsus, which was clothed with scales as in existing birds.

The restoration of the entire fossil given in Fig. 2 was undertaken at the suggestion of Professor E. Ray Lankester. My grateful thanks are due to Mr. A. S. Woodward and Mr. C. W. Andrews, of the British Museum, for help and suggestions in examining the London fossil; and to Professor Dames, Dr. Jäkel, and Dr. Böhm for the many and great facilities they afforded me while studying the Berlin fossil, as well as for much kind help and advice.

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Oxford. W. P. Pycraft.

SOME NEW BOOKS.

THE WHOLE HISTORY OF FISHES.

FISHES, LIVING AND FOSSIL: An Outline of their Forms and Probable Relationships. By Bashford Dean, Ph.D. Pp. xiv., 300, with 344 woodcuts and frontispiece. New York and London: Macmillan & Co., Ltd., 1895. Price 10s. 6d. nett.

FOR the first time in the history of Ichthyology, students are now provided with an elementary handbook affording a general view of the whole subject. This has not come to displace the still-invaluable "Introduction to the Study of Fishes," published by Dr. Günther nearly sixteen years ago. The latter aims chiefly at a systematic survey of the fishes existing at the present day, with only casual references to their ancestry. The new work for elementary students by Dr. Bashford Dean, of Columbia College, New York, deals rather with the fundamental problems of morphology than with the present-day aspect and distribution of fishes, and, as such, takes a distinct place. The time-honoured perch is deposed from his usual position as *the* fish of all fishes—the standard for comparison with other types of the class. Dr. Dean's view of piscine morphology is much more general, and in conformity with modern research. To describe the skeleton of a perch as that of a typical fish is about as misleading as would be the description of the household of a prince or a millionaire as typical of the ordinary establishment of a civilised man. Dr. Dean recognises this fact and arranges his elementary treatise accordingly.

The brief introductory chapter deals in a novel manner with the adaptation of fishes to life in a watery medium, and then recapitulates a few of the principal results of modern research in reference to their evolution, distribution in time, and classification. The Class Pisces (true fishes with paired limbs and a lower jaw) is divided into the four sub-classes of Elasmobranchii, Holocephali, Dipnoi, and Teleostomi; the last again subdivided into the orders Crossopterygii and Actinopterygii. The table showing "The Distribution of Fishes in Geological Time" is based chiefly upon Zittel's "Handbuch," and needs much revision. More details as to the evolution of structures characteristic of fishes are added in chapter ii., which occupies over forty pages; and these observations are illustrated by numerous instructive diagrams relating to the gills, air-bladder, dermal defences, teeth, fins, and the sense-organs of the lateral line. Most of the exposition will be admitted by all morphologists, and so far as it goes it is very clear; but there is scope for considerable difference of opinion with reference to the section on fins, which is based partly upon the author's own researches, and very largely on those of Thacher, Balfour, Mivart, Dohrn, and Wiedersheim. The concluding remarks on the "pineal eye" are particularly interesting; for Dr. Dean himself has devoted much attention to the subject, and he remarks "that the pineal structures of the true fishes do not tend to confirm the theory that the epiphysis of the ancestral vertebrates was connected with a median unpaired eye; it would appear, on the other hand, that both in their recent and fossil forms, the epiphysis was connected in its median opening with the innervation of the sensory canals of the head."

The lampreys and their allies, as usual, are treated as a separate class (Marsipobranchii) below the fishes, and form the subject of chapter iii. The Devonian *Palæospondylus* here takes its apparently proper place; while the curious Silurian and Devonian Ostracoderma are also provisionally arranged in the same class. The figures of the latter are not so well chosen as they might have been, but the text is thoroughly up-to-date.

The sub-classes of true fishes are treated in four successive chapters, each arranged on the same plan. First are enumerated the principal structural characters of the members of the sub-class, with at least one figure of the soft parts and one of the skeleton. Next, the more important extinct types are noticed, and then, similarly, the leading surviving types. Finally, the probable affinities and interrelationships of the sub-class are briefly tabulated, in two cases also graphically represented in a diagram.

Among fossil sharks, the Devonian *Cladoselache* occupies the first place as the most primitive, as also the oldest known, genus. As Dr. Dean has proved elsewhere, it represents an otherwise unknown order of Elasmobranchii. The Acanthodians are noticed next, with a restoration of *Acanthodes* which has much too small an orbit. Then follow the Pleuracanthidæ, with a slightly modified copy of Dr. Fritsch's restoration of *Pleuracanthus decheni*, and a very misleading figure by Davis representing an absolutely indeterminable fossil, though labelled "dermal bones of the head roof of *Pleuracanthus*." After a few other remarks on extinct sharks, the brief enumeration of the principal types of existing elasmobranchs begins with *Chlamydoselache* and *Notidanus*, and ends with the rays, which Dr. Dean thinks arose "in early Mesozoic time from the main shark stem, not from Cestracionts, Pristids, Pristiophorids, or even (?) Rhinids." He concludes that, "of all known stems, that of the shark is most nearly ancestral in the line of jaw-bearing vertebrates."

Chapter v., on Chimæroids, is necessarily short, and chiefly remarkable for the beautiful figures of the deep-sea genus *Harriotta*, now first reproduced in a text-book. Fossil remains are also well represented.

The general characters of the Dipnoi are illustrated by a partial modification of W. N. Parker's figure of the soft parts of *Protopterus*, and by a beautiful new drawing of the skeleton of the same genus. There are also new restorations of the Devonian genera *Dipterus* and *Phaneropleuron*. The Devonian Arthrodira, or *Coccosteus*-like fishes, are doubtfully placed at the end of the Dipnoan series, and Dr. Dean's account of the American forms is of importance as being based on personal observation. A series of drawings of the mandibular bone in several of these remarkable fishes is particularly interesting, as also is the new photograph of the skull of *Dinichthys* forming the frontispiece of the book.

The account of the Teleostomi, or "ganoids" and "teleosteans," is compressed within forty pages, and is thus extremely sketchy. All the main features in the development of the group, however, appear to be mentioned; only those readers will be disappointed who seek for a formal arrangement of this sub-class, which comprises the vast majority of known fishes. The Crossopterygian and Actinopterygian orders are separately treated, but otherwise there is no definite systematic classification. A good series of figures of representative recent fishes are copied chiefly from Günther and Goode; while most of the figures of fossil forms are well-chosen, excluding only those of *Gyroptychius*, *Osteolepis*, *Elonichthys*, *Caturus*, and *Leptolepis*, which are very erroneous, having been drawn by Pander and Agassiz many years ago, when comparatively little was known of the genera they represent.

Chapter viii., on the Development of Fishes, is especially valuable as containing much new matter with good illustrations, and as being the first general synopsis of its kind. The development of the egg and early embryo is successively described in the lamprey, the shark, *Ceratodus*, *Acipenser*, and a Teleostean. This line of research, however, affords much less important information concerning the evolution of fishes than was formerly expected from it. Dr. Dean rightly laments that all deductions from the embryology of fishes are as yet very inconclusive. "The majority of the forms, including some of the most important, are developmentally unknown; yet sufficient is known of the representative members of the groups to show the most perplexing characters. On the one hand, the developmental processes of forms which are regarded by the morphologist as closely akin seem often widely distinct; and, on the other hand, the fishes which should, *à priori*, exhibit an archaic mode of development, actually present complex processes of early growth which can only be interpreted as highly specialised. In fact, there are far greater differences in the developmental plans of the closely-related Ganoid and Teleost, than in those of a Reptile and a Bird; and even among the members of the single group, Teleosts, there are more striking embryological differences than those between Reptiles and Mammals. Adaptive characters have entered so largely into the plan of the development of fishes that they obscure many of the features which might otherwise be made of value for comparison. And until the controversies regarding some of the most fundamental principles in embryology—*e.g.*, the importance of the loss or gain of food yolk—shall be decided, it seems impracticable to use the plan of development as in any strict sense a guide in phylogeny."

The last sixty pages of the volume are devoted to a list of derivations of proper names, a copious bibliography, and a series of illustrated tabular statements of the anatomical characters of the great groups of fishes. These sections bear signs of having been prepared most carefully and laboriously, and form an admirable appendix for purposes of reference. There will be much difference of opinion among specialists as to the value of some of the tables and the judgment pronounced by the author; but we have detected a very small proportion of errors for so bold an enterprise, and students of the lower vertebrata are much indebted to Dr. Dean for an invaluable compendium. To criticise the result in detail would be ungrateful, and we would only allude to two points. Like too many authors of the present generation, Dr. Dean entirely ignores the unrivalled mine of information contained in Owen's "Anatomy of Vertebrates" and his Catalogues published by the Royal College of Surgeons; even Stannius is unaccountably omitted from the list of general works on the anatomy of fishes. Secondly, the drawings ought all to be strict copies of nature, and not provided with embellishments to favour any particular theory, such as happens in the case of fig. 313 (skull of *Ceratodus*) where a non-existent suture is introduced to justify the nomenclature adopted.

In conclusion, we may express the hope that, having made so admirable a beginning, the Columbia University will continue the elementary treatment of the Vertebrata in the same style in four other volumes. A series of handbooks on the plan adopted by Dr. Dean could not fail to attract more students to the subject, and lead to even more rapid progress than now characterises this branch of research.

A. S. W.

Butterflies and Moths.

A Handbook of British Lepidoptera. By Edward Meyrick, B.A., F.Z.S., F.E.S. Pp. vi., 843. London: Macmillan & Co., Ltd., 1895. Price 10s. nett.

Handbuch der Paläarktischen Gross-Schmetterlinge für Forscher und Sammler. By Dr. M. Standfuss. Pp. xii., 392, 8 pls. Jena: Fischer, 1896. Price M. 14.

Die Artbildung und Verwandtschaft bei den Schmetterlingen. II. Theil. Eine systematische Darstellung der Abänderungen, Abarten und Arten der Schwalbenschwanz-ähnlichen Formen der Gattung *Papilio*. Von Dr. G. H. T. Eimer, unter Mitwirkung von Dr. K. Fickert. Text, 8vo. Pp. viii., 153. Tafeln 4, 4to. Jena: G. Fischer, 1895. Price M. 14.

In Mr. Barrett's work on the British Lepidoptera, the second volume of which was noticed in these pages some months since, we have a treatise from the standpoint of a conservative entomologist, who would retain a system of classification which modern research shows us should be abandoned for one more natural. Mr. Meyrick's volume, on the other hand, is the work of an extreme radical. Consternation will surely be felt by many an old lover of the scale-winged insects who may open Mr. Meyrick's book to see what the author has written about the Swallowtail butterfly. Such a reader will naturally turn to the beginning of the systematic portion, but he will find there no account of *Papilio machaon*, or of any other butterfly. The honour of first place in the series is bestowed on the tiger moths (Arctiadæ), and page 325 has to be reached before the "Papilionina" are found, inserted between the Lasiocampidæ and the Pyrales. Aghast at such an innovation, our would-be student, it is to be feared, will refuse to have anything more to do with so revolutionary a book, and will not stop to consider Mr. Meyrick's suggestion that the butterflies are an offshoot of a primitive pyralid stock. Seriously, it might have been better if Mr. Meyrick, in a work intended for British lepidopterists, had shown a little more consideration for the deeply-ingrained conservatism of the class for whose benefit he was writing. Though there is a very high probability that the butterflies and the higher moths have been independently developed from the more primitive Lepidoptera, the first-named group has attained so marked and isolated a standard that its retention at the head of the Lepidoptera would be fully justified. But it is to be hoped that most students will not be hindered by Mr. Meyrick's revolutionary classification from a careful study of a book that will suggest many fruitful ideas and give much matter for thought.

In the seventeen pages of introduction, the structure and life-history of lepidopterous insects, their variation, principles of classification, phylogeny, and nomenclature, are dealt with in as satisfactory a way as such extreme condensation allows. With much reason, Mr. Meyrick defends the use of wing-neuration for systematic purposes, on the ground that it is a non-adaptive character. While similarity in the preparatory stages is doubtless often of value in indicating relationship, the extreme importance of larval life to the species should lead us to exercise care in relying on it for classificatory characters. Mr. Meyrick often refers to the comparative mobility of the pupal segments in the various groups, recently pointed out by Dr. Chapman; and it seems likely that this character, in conjunction with wing-neuration, will give us approximate indications of the true relationships.

According to Mr. Meyrick's classification, the Lepidoptera are divided into nine main groups, for the names of which the author has, unfortunately, chosen the termination "*-ina*"; there is a general agreement among zoologists that "*-inæ*" shall be a termination distinctive of sub-families. The Caradrinina, which stand at the head of the series, comprise four families—the Arctiadæ, Caradrinidæ (trifid section of the Noctuids), Plusiadæ (quadrifid noctuids and deltoids), and Ocneriadæ (Lymantriidæ of authors). Next comes the Notodont group, including the Geometers (divided into five families), Polyplocidæ (Cymatophoridæ), Sphingidæ, Notodontidæ, and Saturniadæ. Then follow the Lasiocampina, with only three families—Drepanidæ, Endromididæ, and Lasiocampidæ. The butterflies come next, arranged in the usual modern sequence, with the Nymphalidæ at the head and the Hesperiadæ last. Dr. Chapman's recent work on the pupæ of these insects, showing an unexpected relationship between the Pierids and Nymphalids and the isolation of the Lycænids, probably appeared too late for Mr. Meyrick's use. The fifth group of the series is the Pyralina, including the moths usually known by that name (divided into five families), as well as the Pterophoridæ and Orneodidæ (Alucitidæ). Next we find the Psychina comprising the Psychidæ (in which only the three species of *Psyche* are retained, the other genera being removed to the Tineidæ), Zeuzeridæ (without *Cossus*), Zygænidæ, and Heterogeneidæ. The Tortricina form the seventh group, and include the Tortrices (in three families), and the Trypanidæ (*Cossus*). The Tineine group follows, comprising the Ægeriadæ and the Tineæ divided into five families. Mr. Meyrick's arrangement of this most difficult section differs considerably from Stainton's. The degradation of the wing-neuration, owing to the small size of many of the insects, renders that character often unreliable. Probably an approach to a natural system has been secured by comparing the degree of development of the maxillary palps with the number of movable segments in the pupa, and such apparently non-adaptive characters as the roughness or smoothness of head and thighs. The ninth, and last, section is the Micropterygina—(Hepialidæ and Micropterygidæ)—the Jugatæ of Professor Comstock, now generally admitted to represent the primitive lepidopterous stock, and to bridge partially the gap between that order and the Trichoptera or caddis-flies.

The synopses given will be welcome aids to the student seeking to identify specimens. In his definitions of genera, Mr. Meyrick is disposed to be comprehensive. Unfortunately, he has thought it necessary to disinter a multitude of Hübner's generic titles published without description, and to set aside in their favour names in use for the last half-century. The descriptions of the species are concise and clear, but it would have been well to devote a little more space to the varieties which the collector may reasonably be expected to meet. The only illustrations are figures of wing-neuration and profiles of heads and palps, which will be of much use for discriminating genera and directing attention to structure as the basis of classification. A short summary of the geographical distribution of each species in the British Isles and abroad is given, but so far as Ireland is concerned this information is not altogether trustworthy.

In 1891, Dr. Standfuss published a small " Handbuch für Sammler der europäischen Gross-Schmetterlinge." The work now sent us is an enlarged second edition, but with so much valuable matter added as to make it practically a new book.

The first section of the work deals with the collection of lepidoptera in all stages; the student is told how, when, and where to find and capture eggs, caterpillars, pupæ, and moths. The second section, which occupies by far the greater part of the book, is devoted to the breeding of lepidoptera from both the practical and the theoretical point of view. One of the leading features of this division is the part dealing with crossing and hybrids. A valuable summary is given of the recorded instances of pairing between insects of different species, with notes as to whether any progeny resulted. The author remarks that the hybrid obtained by the crossing of two species differs from the progeny of the same two species if the sexes be reversed. Several of the figures in the very excellent coloured plates illustrate results obtained by the author in a series of experimental crossings with three species of *Saturnia*. Specially interesting are two successful crossings of a male hybrid with the female of one of its parent species. The comparative ease with which these moths interbreed and the fertility of some of their hybrid offspring suggest that the species have not long been separated from each other. From a comparison of the larval and imaginal characters of the three, Dr. Standfuss concludes that *S. spini* is the oldest form and that *S. pavonia* (the only one we have in these islands) is older than *S. pyri*.

Detailed directions are given about the rearing of caterpillars, and warnings as to the various sicknesses to which they are subject. An interesting statistical table shows the relative numbers of the two sexes bred in forty species of butterflies and moths of various families. In every case the males preponderate, the average being nearly 107 males to 100 females. The variation of colour and markings in the Lepidoptera is discussed at some length, and British entomologists will be interested to see references to some of the melanic forms which are so prominent a feature in our own moth-fauna. Dr. Standfuss points out that the Shetland males of *Hepialus humuli* (var. *hethlandica*) must represent the ancestral form of the species—the ordinary white male of this moth being evidently a newer development. He therefore oddly suggests that *H. hethlandica*, Knaggs, should stand as the specific name, *H. humuli*, L., being relegated to varietal rank. Similarly, he holds that the *var. rustica* of *Spilosoma mendicum*, in which the male is white instead of black, represents the ancestral form of that species; while some experiments in crossing the type with the variety show that the latter has the stronger influence on the progeny. It is remarkable that the *var. rustica* should almost entirely replace the typical *S. mendicum* in Ireland, while on the continent it is a south-eastern form, being recorded from Hungary, Roumania, Asia Minor, and Armenia.

A list of species which exhibit seasonal dimorphism is given, with some account of the experiments which Weismann and others have made to elucidate the question. A very complete summary of experiments by the author and others on the influence of heat or cold on the markings of butterflies of the genus *Vanessa* and allies is perhaps the most valuable feature in the whole book. Concluding that the more a species is affected by such experiments the more newly developed it must be, Dr. Standfuss arrives at a phylogeny of the group which, in the main, agrees with that put forward by Dr. Dixey some years ago, from a minute comparison of the wing-markings. Comparing the Palæarctic species with those of other regions, he would derive *V. atalanta* from its Oriental congeners, and the other species from American forms. On the question of the origin of species, Dr. Standfuss is in agreement with Dr. Eimer's theory of development through external influences.

It is six years since the issue of the first part of Dr. Eimer's work, dealing with the phylogeny of *Papilio podalirius* and its related species. This second instalment traces the presumed development of the Papilios of the *turnus*, *machaon*, and *asterias* groups. The modifications of a typical wing-pattern presented by a related series of butterflies have before offered a tempting field for evolutionary speculation. Here Dr. Eimer brings to our notice a series ranging from the male *P. daunas* with the broad expanse of its creamy-yellow wings crossed by comparatively narrow black bars, through forms (such as our own *P. machaon*) in which the black markings are broader and tend to become joined together, on to species like *P. asterias* and *P. troilus*, whose wings present a wide expanse of black with the cream colour reduced to a few spots. And it is instructive to find at almost the extreme terms of the series the yellow male of *P. turnus* and the dark *var. glauca* of its female.

These butterflies are used by Dr. Eimer as the text for theorising on some of the burning biological problems of to-day. Those who recall the first part of this work, and his book, a year earlier, on the Origin of Species by the inheritance of acquired characters, will expect him to find in the butterflies arguments against Weismann's views. And they will find that, not Weismann only, but the fundamental Darwinian position is attacked. We are told again and again that natural selection is powerless to originate species; it can but preserve species which have already been developed by the action of the physiological laws of growth and modification in organisms, and the influence of environment. Dr. Eimer insists that changes of the markings in butterflies which indicate specific differences cannot be of use to the insects, while they can be initiated by changes in temperature or food-supply. He apparently believes that the living species we have now before us are links in the direct line of a development which may proceed by slow degrees or, exceptionally, by sudden jumps. Curiously, he considers that the *var. glauca* of *P. turnus* was produced in the latter way. As the action of a changed environment on the physiological forces of the organism induces the production of a new variety or species, so constancy of conditions will fix the new form as a species; this principle is called "genepistasis." Then the intercrossing of the new stock with the parent form (if their geographical ranges overlap) is prevented by the action of "Kyesamechany"—that is Romanes' principle of physiological selection, though Dr. Eimer claims to have enunciated the idea twelve years earlier than our lamented Oxford naturalist. As might be expected, Dr. Eimer disbelieves in the mimicry theory, and would explain the facts of resemblance by the action of similar conditions producing similar effects in parallel series. It may be doubted if the argument for natural selection is much weakened by Dr. Eimer's considerations. Though a change in the wing-patterns may of itself be of no use to an insect, yet that change may be the necessary accompaniment of some variation in structure or habit of the greatest possible use.

GEO. H. CARPENTER.

A Real Naturalist.

The Natural History of Aquatic Insects. By Professor L. C. Miall, F.R.S., with illustrations by A. R. Hammond, F.L.S. Pp. xii., 395. London: Macmillan & Co., Ltd., 1895. Price 6s.

In the waste of books dealing with popular natural history, and especially with entomology, Professor Miall's volume is the greenest oasis. In one of the early pages he made us his friend for ever by dissuading the young naturalist from collecting or trying to become a systematist. "The man," says Professor Miall, "who can name many insects can seldom do anything but name them (there are some conspicuous exceptions!)." Of course Professor Miall, like every other scientific man, knows the retort that the systematist will make. The systematist, like the bibliographer, is necessary, and there are faculties that may be trained by the pursuit of either industry. But the faculties trained by schoolboy collectors are as readily trained by the collecting of stamps or buttons, and the collector soon comes to see in his bird or beetle no more than a new specimen, in his case to be prized for its rarity rather than for his knowledge of it. Under Professor Miall's guidance, the schoolboy or other budding naturalist will be led to a pursuit that will train his highest faculties, that will not aid the wholesale extinction of all the rarer creatures, and in which success cannot possibly be accomplished by money.

Professor Miall begins with a general introduction, in which he discusses water as a sphere of life. He supports the view that aquatic insects have taken to the water secondarily. In this he disagrees with the ingenious theory due, if we remember rightly, to Sir John Lubbock, that insects were primitively aquatic, the wings being modifications of tracheal gills. Many of the most generalised insects are terrestrial and aërial, while tracheæ, which are found alike in land and in aquatic forms, would seem to be typically structures of air-breathing terrestrial creatures. Many of the peculiar features described by Professor Miall are most easily explained as adaptations of the tracheæ of terrestrial creatures to aquatic conditions. The author in his introduction, and repeatedly in his book, discusses those curious properties of the surface-film to which he was the first to call attention. The use of the word "film," and still more the relations of the film to the creatures living upon it or under it, suggest that a layer of different tenacity, and perhaps of different composition, forms on the surface; but the author is careful to state that the film is merely a physical condition of the surface of a liquid in contact with air. He shows how most aquatic creatures live either on the upper surface of the film, never really being wetted, or on the under surface not coming in contact with air. The various devices used to take advantage of the resistance of the film, and to break it by force when necessary, are explained in the most interesting and careful way. The greater part of the book deals with the aquatic representatives of the different orders, beginning with beetles and ending with bugs and spring-tails. From these chapters we could quote suggestive and interesting novelties almost without limit, but we prefer to advise our readers to turn to the volume itself.

Plants of Réunion.

Flore de l'Île de la Réunion, avec l'indication des propriétés économiques et industrielles des plantes. Par E. Jacob de Cordemoy. 8vo. Pp. xxvii., 574. Paris: Klincksieck, 1895.

The little island of Réunion or Bourbon, situated to the S.W. of Mauritius, has furnished Mr. Cordemoy with material for a goodsized flora. In his preface the author discusses the geological history of the island before proceeding to his remarks on its climate and vegetation. The climate is largely determined by the direction of the wind, the mountain chain which follows the longer axis of the island sheltering one side from the S.E. wind, and inducing a dryness which is only interrupted by rains brought by the N.W. cyclone. These differences in climate are reflected in the vegetation. In the south-east it is luxuriant, a bright green carpet covering the ground, which is abundantly watered. The alluvial soil on the coast is extensively cultivated with sugar-cane, maize, manioc, vanilla, tropical fruits, and spices; and screw-pines, bamboos, and palms abound. In the north-west and west, on the contrary, the littoral zone is dry and indigenous species are rare, but the date-palm and other introduced plants will thrive. At a certain altitude, however, the soil is remarkably fertile and plant-life vigorous, thanks to the abundant dews. The damp forests, their trees draped with mosses, ferns, and orchids, characteristic of the soil on the S.E., are absent. As regards the island as a whole, it has, in the writer's opinion, owing to its general outline, differences in altitude, and climate, one of the most varied and interesting floras which could be studied. Commerson seems to have been the first to explore Bourbon botanically. He acted as naturalist to Bougainville's expedition round the world, and afterwards spent five years in Madagascar, Bourbon, and Mauritius, where he died in 1773. He collected a large number of plants and left many notes and sketches. Other well-known botanists who have studied the flora of the island were Du Petit Thouars, Bory de St. Vincent, Gaudichaud, Perrotet, and Boivin. More recently, Charles Frappier, whom Mr. Cordemoy describes as a close and intelligent observer, devoted during thirty years (1853–1883) a large amount of time to the plants of certain districts. Orchids were his special study, and he had undertaken to prepare this order for the flora, but the work was unfortunately interrupted by his death.

Mr. Cordemoy enumerates 1,155 species of flowering plants which are indigenous to or naturalised in the island; there are also 221 ferns and fern-allies, 360 mosses and liverworts, 128 lichens, and 83 algæ. The Fungi have not been worked up. A fair sprinkling of the species are here described for the first time. The usefulness of the descriptions would be greater if some diagnosis had been included; in many cases they occupy a whole page, through which the reader must search for characters of importance. In the part relating to the grasses, the work of Mr. C. J. de Cordemoy, the opposite extreme is reached, for the descriptions of new species are often from their brevity quite useless for purposes of comparison.

Plants of North America.

Synoptical Flora of North America. By Asa Gray, LL.D., and Sereno Watson, Ph.D., continued and edited by B. L. Robinson, Ph.D. Vol. i., part i., fascicle i. Imp. 8vo. Pp. ix., 208. Oct. 10, 1895. Harvard Univ. Price 11s.

"The aim of this comprehensive work is to give a critical treatment of the Flowering Plants of North America, with concise but clear descriptions, synonymy, bibliography, and geographic range of all species and varieties, growing without cultivation on this continent, north of Mexico; also, ordinal, generic, and specific keys to facilitate the identification of plants included.

"Of this extended treatise Dr. Asa Gray published, in 1878 and 1884, two parts including all the Gamopetalous Orders. These parts (re-issued in 1886 by the Smithsonian Institution, Miscel. Coll., vol. xxxi.) amount to nearly 1,000 pages, imperial octavo. For some time before his death Professor Gray, continuing this work, was engaged in monographing the earlier Polypetalous Orders. After the death of Professor Gray the preparation of the Synoptical Flora was carried on by Dr. Sereno Watson, Curator of the Gray Herbarium of Harvard University, and, after his death in 1892, by his successor, Dr. B. L. Robinson. Following the original plan of the Flora, the treatment of the Polypetalous Orders will form, when completed, vol. i., part i."

Such is the history of the work of which the first fascicle has lately been issued. This includes the orders of the group Polypetalæ from Ranunculaceæ to the Frankeniaciæ. A second fascicle is, we are told, in advanced preparation; this will continue the group as far as Polygalaceæ. The time which has elapsed since the commencement of the work has necessitated many additions to and some revision of the manuscript of Drs. Gray and Watson. Such alterations have been indicated in the text by an asterisk—rather an unnecessary proceeding, as it adds another to the already sufficiently large number of signs and abbreviations. The mark of many meanings (!) occurs in some of the diagnoses, but there is no indication as to which meaning is here intended. The work has been carefully done and its appearance will be welcomed by all interested in American botany; also by the neo-nomenclaturists as affording a new subject for their criticism, since Dr. Robinson has not always seen fit to follow their rules for the time being.

Another Attack on Darwinism.

Nature *versus* Natural Selection. By Charles Clement Coe. Pp. xx., 591. London: Swan Sonnenschein & Co., 1895. Price 10s. 6d.

These six hundred pages are agreeably lightened by quotations from lay authors, such as Tennyson, Shakespeare, Canon Kingsley, George Eliot, Goldsmith, St. Paul, and Oliver Wendell Holmes, and we are bound to confess that this happy knack of the author made it easier for us to wade through his barren argument. But we are not in a position to recommend those who are not reviewers to tackle the volume. In a question of theology, or of metaphysic, a gentleman may sit in his library and turn out laborious treatises full of sound scholarship and ripe learning. The interpretation of a clause, or a new light on a subjunctive mood may be elaborated in a study, and, thrown into the world, may prove a wall of separation between nations. But the arguments upon which natural selection depend are of another order. The most studious poring over what others have written, the widest collation, and the most ingenious quotation avail you nothing. You must be a naturalist of the laboratory or of the field even to follow the arguments, which, indeed, are frequently doubtfully expressed in the books. Above all, you must be a naturalist, submitting new facts from the natural world, or new sides of old facts, to gain a hearing. Mr. Coe, we fear, has not grasped the nature of the problems he is dealing with. Naturalists who come across his book will see that he has nothing but words to offer them, and will pass by to some wretched little pamphlet, describing a new nodule on the shell of a snail, or some exact statistics as to the breeding of a louse.

New Serials.

We have received the first part of the *Ornithologist*, a monthly magazine of ornithology and oology, edited by H. K. Swann, with the assistance of six other naturalists. It is published by Elliot Stock, London, and H. R. Taylor, New York, at a price of 6d. a part. The first number contains 20 small octavo pages and a half-tone block, illustrating a wheatear's nest built in an old tin can.

There has appeared the first part of *Bulletin de la Laboratoire Biologique de St. Pétersbourg* ("Izvyestiya S. Peterburghicheskiĭ Biologhīcheskiĭ Laboratoriya"), 1896. It is written in Russian and contains papers on the mechanism of the maxillary joint by A. Anīchkīn, and on the mechanism of the movements of the tongue, by P. Lesghaft, who is also the editor.

The Field Columbian Museum, Chicago, commenced author last year with "An Historical and Descriptive Account of the Field Columbian Museum." This has been followed by five separately issued publications, including "Handbook and Catalogue of the Meteorite Collection," by O. C. Farrington; "Contribution to the Flora of Yucatan," by C. F. Millspaugh; "On the Structure and Development of the Vertebral Column of Amia," by O. P. Hay. We have already mentioned W. H. Holmes's "Studies among the Ancient Cities of Yucatan." These beautifully produced pamphlets are not priced, since they "are for gratuitous distribution to libraries and scientific institutions and societies. They may be obtained upon application to the Director."

A somewhat similar publication is the "Mittheilungen aus dem Roemer-Museum, Hildesheim," of which the following parts have already appeared: (1) "Systema Lepidopterorum Hildisiæ," by A. Radcliffe Grote, 4 pp.; (2) "Ein neuer *Actinocamax* aus der Quadratenkreide von Braunschweig," by Professor A. Andreæ, 4 pp. and 1 collotype plate; (3) "Die Apateliden," by A. R. Grote, 18 pp. and 2 collotype plates.

The Société des Americanistes de Paris, which was founded not long ago, has issued, in luxurious style, as large quarto, the first part of its *Bulletin*.

The Société de Spélaeologie, whose foundation we noticed in vol. vi., p. 132, has already issued the three first parts of a publication entitled *Spelunca*. In this are described the explorations of numerous caverns in Europe and other parts of the world, including Australia. The Society also intends to publish Memoirs, one of which is to be by Dr. Filhol on the remains of panthers found in caves.

From Tokyo comes the first number, issued in October, of *Konchū Gaku Zasshi* ("Journal of Insect Science"). It is written in Japanese, except for the explanation of the plate. We commend it to the notice of the editor of the *Zoological Record*.

Literature Received.

Life and Letters of Agassiz, 2 vols., J. Marcou: Macmillan. The Glaciers of the Alps, J. Tyndall: Longmans. Elements of Botany, J. Y. Bergen: Ginn. The Whence and the Whither of Man, J. M. Tyler: Scribner's Sons. Hymenoptera Aculeata of the British Isles, E. Saunders: Reeve.

Notes on Seal and Whale Fishery, Southwell: *Zoologist*. Evolution of Modern Scientific Laboratories, W. H. Welch: *Johns Hopkins Hospital Bulletin*. Upper Palæozoic Rocks of Central Kansas, C. S. Prosser: *Journ. Geol.* Sixteenth Report, Dantzig Museum. Catalogue xvii., Mammifères: Dollfus. Huxley and his Work, T. Gill: *Science*. Foreign Book Circular, Scientific Series, no. 63: Williams and Norgate.

Journ. Coll. Science, Tokyo, vol. viii., pt. ii., vol. ix., pt. i. Land and Water, Feb. Proceedings, 1894–95: Royal Physical Society. Nature, Feb. 20, 27, Mar. 5. Knowledge, March. Review of Reviews, March. Literary Digest, Feb. 15, 22, 29. Revue Scientifique, Feb. 22, 29, Mar. 7, 14. Irish Naturalist, March. Revue générale des Sciences, Feb. 15. Feuille des jeunes Naturalistes, March. Naturen, Feb. Nature Notes, March. American Journ. Science, March. Naturæ Novitates, Feb. (3 & 4). Victorian Naturalist, Dec. Science, Feb. 7, Mar. 6. Scottish Geographical Mag., March. The Naturalist, March. Westminster Review, March. Journ. Marine Biol. Ass., vol. iv., no. 2. Botanical Gazette, Feb. Biology Notes, Feb. Scientific African, Feb. Psychological Review, Jan. Oxford Univ. Jr. Scientific Club Journal, nos. 24, 33, 34, 35, 36. Johns Hopkins Univ. Circular, Feb. American Geologist, March. L'Anthropologie, T. vii., no. 1 Timehri, Dec.

OBITUARY.

GIULIO ANDREA PIRONA.

Born at Dignana Nov. 20, 1822. Died at Udine Dec. 28, 1895.

BOTANIST, geologist, zoologist, and philologist, Professor Pirona was an excellent type of the old school of naturalists. Having received his youthful education in Udine, at the hands of the professor abate Jacopo Pirona, he passed to the University of Padua, where he took his degree in medicine, and served for some years as assistant to the professor. He then became professor of natural history at the Lyceum of Udine, and, while yet young, was elected a member of the Venetian Institute of Science, Literature, and Art, of which he was the president during the last two years, and in the *Atti* of which many of his works were published.

The greater part of Pirona's work was connected with his beloved native district of Friuli. He began as botanist, and his "Synopsis" of the Friuli flora, and "Vocabolario botanico friulano" summarise the labours of many excursions, patient determinations, discoveries of new species, and observations of facts of distribution. His rambles through the country led him naturally to the investigation of its rocks, and his early studies in this direction were benefited by the companionship of the Austrian geologist, Foetterle. Thus originated the "Lettere geognostiche sul Friuli," "Cenni geognostiche" (1861), and a sketch geological map that formed a secure foundation for the more detailed work of subsequent observers. He also elucidated the structure of the Euganean Hills, collaborated in a monograph on the Bellunese Earthquake of 1873, and, in conjunction with Professors Taramelli and Tommasi, studied the earthquake of Tolmezzo in 1889, and the water-supply of Udine. Here, too, may be mentioned his "Monografia delle acque minerali del Veneto" (1862-3). His examination of the rocks led to an important series of papers on their fossil contents, and especially on those curious molluscs known as Hippurites. Both as accurate collector and learned describer he made valuable contributions to the Jurassic and Cretaceous palæontology of Italy. But Pirona's knowledge of molluscs was not confined to their extinct representatives, as we learn from his "Prospetto dei Molluschi terrestri e fluviatili finora raccolti nel Friuli" (1864-5). His claim to the title of philologist is based on the "Vocabolario della Lingua Friulana," which gained a prize from the Government. His scientific attainments, and the share that he took in the municipal life of Udine, gained for Pirona, in 1870, the post of Conservator of the Civic Library and Museum, a post which he held till his death.

Pirona may be summed up in the words contributed by his eminent colleague, Professor Torquato Taramelli, to *La Patria del*

Friuli[1] on the last day of 1895. "From time to time, with admirable clearness and harmonious arrangement, he collected in welcome publications all that concerned the natural history of his Friuli, always enhancing its interest by the purity of his style, and presenting the more certain of the results gained by his own labours or by those of others. He was a naturalist of genius, who for the sake of a flower did not overlook the hard rock below; who did not despise the snail and the butterfly."

CHARLES WACHSMUTH.

Born at Hanover, Sept. 13, 1829. Died at Burlington, Ia., Feb. 7, 1896.

In June of last year Natural Science described the Monograph of the Camerate or vaulted Crinoidea of North America, the result of many years of labour on the part of Charles Wachsmuth and Frank Springer, now on the point of publication by the Museum of Comparative Zoology at Harvard; and that note gave some account of the labours of the chief author, who, everyone will regret to learn, has died before the end has crowned his work. The only son of Christian Wachsmuth, an eminent lawyer and member of the Prussian Parliament, Charles was born and educated for his father's profession in his father's city. Failing health caused him to relinquish law for commerce, and in 1852 he was sent to New York by a Hamburg firm in the interest of German emigration, and in that city he stayed for two years. His duties completed, health caused his migration to Burlington, where he set up in business and made a home for the wife whom he married in 1855. Hitherto he had paid no attention to natural science, but unimproved health forced him to give up business in 1857, and to seek outdoor exercise in the collecting of fossils. Being attracted by the beautiful crinoid remains for which Burlington is famous, and realising that he could do his best work by restricting his energies to some special corner of the field of science, he threw himself with enthusiasm into the study of the Crinoidea. A visit to Agassiz at Cambridge, Mass., and then to Europe, in 1865, inspired him to fresh efforts. He did not, however, venture on independent publication, but assisted W. H. Niles in a paper on the Burlington Limestone (1866), as well as Meek and Worthen in the *Report* of the Illinois Geological Survey. Wachsmuth's collection grew in numbers and historical importance till he was at last induced to part with it for $6,000 to Louis Agassiz, at whose request he accompanied the museum to Cambridge, and spent some time arranging it for exhibition. On his return to Burlington, he set to work to renew his collection, doing this with such success that he was enabled to part with a great portion of it to the Trustees of the British

[1] As quoted in *Rivista ital. di Paleont.*, i., p. 262, where C. Fornasini has a notice from which some of the above facts are taken.

Museum in 1874 for the sum of £80. About this time Mr. and Mrs. Wachsmuth made a prolonged tour through the whole of the Old World, during which he studied the crinoid collection in many foreign museums, and visited the most notable scenes in Italy, Greece, Turkey, Arabia, and Africa. It was Wachsmuth's custom to spend some months every summer on collecting excursions together with his wife; ransacking thus the principal localities of North America, some of which he discovered for himself, and obtaining other specimens by means of collectors, such as the late Charles Beachler, and purchasing yet others with the co-operation of his friend, Mr. Frank Springer, he for a third time gathered together one of the finest collections of crinoids in the world, to receive which he built a special fire-proof museum. Though retiring in his habits, the dead palæontologist was one of the leading citizens of Burlington, a trustee of the free public library, and the vice-president of its board.

Mr. Wachsmuth's health had been declining for three years, and writing to me on January 13 he said, "I doubt if I shall be able again to do scientific work"; his end, therefore, was hardly unexpected. Had he lived but a few months longer, it was hoped that the Geological Society of London would have marked the publication of his Monograph by electing him a Foreign Member. English geologists will regret that their roll of fame must continue to lack so bright an ornament as the name of Charles Wachsmuth. F. A. B.

SEKIYA SEIKEI.

Born 1855. Died January 9, 1896.

THE death of Professor Sekiya leaves a serious gap. His published memoirs are few in number (we can speak only of those written in English), but several of these are of lasting value. Among them may be specially mentioned his two papers on the Japanese earthquakes of 1885, and that on "Earthquake Measurements of Recent Years, especially relating to Vertical Motion." In conjunction with Mr. Kikuchi he wrote an account of the eruption of Bandai-san in 1888; and, with Mr. Omori, a valuable "Comparison of Earthquake Measurements made in a Pit and on the Surface Ground." Beginning his scientific career about the time when accurate seismographs were invented, and living in the country where they were first erected and most frequently put into use, it is only natural that Sekiya's attention should have been attracted to their indications, and some of his most valuable work consists in the unravelling of their records. Outside the ranks of specialists, he is most widely known by his model showing the motion of an earth-particle during an earthquake. By this happy device he has furnished the best illustration we possess of the complicated movements of the ground during a severe shock. In 1886 Mr. Sekiya was appointed the first Professor of Seismology in the Imperial University of Japan.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced :—Mr. Leonard Hill, to be Lecturer in Physiology at the London Hospital Medical School; Dr. Purcell, to be Assistant at the South African Museum; W. A. Rogers, to be Assistant Geologist to the Geological Commission of Cape Colony; F. E. Willey, of Kew, to be Superintendent of the Botanical Station at Sierra Leone; Professor E. Topsent, of Reims, to the Chair of Zoology at Rennes University; Professor F. Hochstetter, of Vienna, to the Anatomical Chair in Innsbruck University; Dr. Siedentopf, from Bremen, to be Assistant at the Mineralogical Institute of Göttingen University; Dr. L. Buscalioni, of Turin, to be Assistant in the Pflanzenphysiologische Institut at Göttingen; Dr. A. Looss, to be Professor Extraordinarius of Zoology at Leipzig; Dr. Th. Ebert, to be Professor of Palæontology, and Dr. Müller, to be Professor of Regional Geology, in the Prussian Geological Institut; Dr. F. v. Wagner, of Graz, to be Assistant in the Zoological Institute of Giessen University; Dr. R. Bonnet, of Giessen, to be Professor of Anatomy at Greifswald; Dr. W. Kurchinsky, of Kiev, to be Extraordinary Professor of Physiology at Dorpat; C. A. Lindström, to be Professor in Anatomy, Erik Müller, to be Professor in Histology, and J. V. Hultkrantz, to be Prosector in Anatomy, at the Karolinska Institute, in Stockholm; Professor G. B. Grassi, of Catania, to be Professor of Comparative Anatomy at Rome University; Dr. P. Voglino, to be Lecturer in Botany at the University of Turin; W. A. Lucy, of Lake Forest, Ill., to be Professor of Zoology at the North-Western University, Evanston, Ill.; J. M. Coulter, President of Lake Forest University, to be Head Professor of Botany at Chicago University.

MR. H. V. DICKENS, the present Assistant-Registrar of London University, has been appointed Registrar, in succession to Mr. Milman, retired. Mr. Dickens was specially associated with the scientific part of the London University Examinations, and all those who, as candidates and examiners, have come in contact with his excellent arrangements will be pleased to hear of his promotion.

DR. FRIDOLIN V. SANDBERGER, Professor of Mineralogy at the University of Würzburg, who lately celebrated the jubilee of his doctorate, is about to resign from teaching.

PROFESSOR A. N. BEKETOW, of St. Petersburg, on resigning his chair, and Dr. J. Hall, of Albany, have been elected honorary members, and Professor Dareste de la Chavanne, of Paris, Dr. C. D. Walcott, of Washington, and Professor G. Retzius, of Stockholm, have been elected corresponding members of the Royal Academy of Science of St. Petersburg.

THE Oxford Delegacy for the Extension of University Teaching propose to reduce their list of lecturers, on account of its congested state. The movement has been productive of a considerable amount of good, but the present tendency seems to be that the more solid part of the work is being transferred to permanent local institutions, several of which have been created by the movement, and that the lighter part is decreasing in importance.

THE Summer School of Art and Science will be held in Edinburgh during August. Tickets may be procured for either the first or the last fortnight, or for the whole session. Mr. G. F. Scott Elliot is to lecture in the section of geography and geology, and Mr. Elisée Reclus will again be present. Further information may be obtained from the secretary, Mr. T. R. Marr, University Hall.

For the first time in its history the House of Commons has passed a resolution in favour of the opening of the National Museums and Art Galleries in London on Sundays, though only "for a limited number of hours after 2 p.m.," and "upon condition that no officer shall be required to attend on more than six days, and that any who have conscientious objections shall be exempt from Sunday duty." The amendment moved by Sir Mark Stewart, that opening should take place on three week-day evenings of each week instead of on Sunday, was rejected by 178 votes to 93. The smallness of the numbers indicates that many members kept away in order to escape the possible censure of their constituencies, for no one exactly seems to know what are the real wishes of the mass of the people on this question. Those who spoke in favour of Mr. Massey-Mainwaring's motion were Mr. Lough, Sir S Montagu, who claimed to give the views of the poorest classes of London, Sir G. Trevelyan, who put in a word for the professional middle-classes, Mr. Holborn, who came from "sabbatarian Scotland," Mr. Goschen, speaking as a private member, Mr. Burns, who may fairly claim to represent labour, Mr. Lowles, and Sir John Lubbock, who said that "the Trustees of the British Museum were anxious to open that building in accordance with the resolution before the House." Those who spoke against the motion were Colonel Sandys, Colonel Ward, and Lord Warkworth, all of whose objections, based avowedly upon theological grounds are, as *The Times* says, "to be treated with all respect, but have never been a dominant factor in the situation." It does not follow from the passing of this resolution that our London Museums are to be opened this year, next year, or ever. The authorities of the museums and of the Treasury have to be in accord with the resolution and with one another. Mr. Balfour has informed the House that the authorities of the institutions concerned are being consulted; but up to the time of our going to press those authorities had not even received formal intimation of the resolution. A special meeting of the Trustees of the British Museum, convened to consider the question, had, therefore, to be adjourned. The other museums at South Kensington, the Museum of Practical Geology, and the Bethnal Green Museum must receive their orders from the Science and Art Department, and their opening will no doubt resolve itself into a mere question of money. It is greatly to be hoped that the good resolution passed by the House of Commons may not be consigned, from want of the necessary means, to form another paving-stone in a country beyond the scope of this magazine.

The monthly evening lectures at the Whitechapel Museum are to be given, in April, by Mr. Chalmers Mitchell, on "The Food-Supply of the World"; in May, by Dr. Gregory, on some subject connected with his African expedition; in June, by Dr. A. Keith, on "Whitechapel Ears."

The Kelvingrove Museum, Glasgow, has purchased from Professor Westerlund 2,000 species and varieties of palæarctic land and fresh-water shells. The Corporation has acquired the Mansion House of Camp Hill, and it is intended to use the main floor as a local exhibition gallery for the southern district of Glasgow. Other galleries are being built at Glasgow, and will doubtless prove of interest to the members of the Museums Association, which will meet in that town during this year, under the presidency of Mr. James Paton, the superintendent of the museum and galleries.

The American Museum of Natural History sent a collecting expedition last year to the Uintah beds of N.E. Utah, then between the eastern escarpment of the Uintah range and the Green River to the Washakie Beds of S.W. Wyoming. The most important result geologically was the determination that the Brown Park deposit was of much later age than the Uintah.

From the sixteenth annual report of the Director of the U.S. Geological Survey, Dr. C. D. Walcott, we learn that certain changes in organisation have been made The work of the Survey is now distributed under the four heads, Geologic, Topographic, Publication, and Administration, the first of these being again divided into Geology, Palæontology, Chemistry, Hydrography, and Mineral Resources. During the year ending June 30, 1895, twenty-six field parties were sent out by the Survey. Considerable fresh information concerning the Devonian and Silurian rocks has been obtained by a party investigating the coal regions of West Virginia and Maryland, while it has been found that the Pottsville coal series of Pennsylvania is increased by the addition of lower beds as it passes southwards into West Virginia. The iron-bearing formations in the Lake Superior region have been traced over an obscure area by the help of the magnetic needle. The director himself journeyed through the mining fields of the western States, and increased the local interest in the Survey. A collection of 80,000 specimens of Coal-measure plants was recently presented to the National Museum by Mr. R. D. Lacoe. It contains nearly two-thirds of the original specimens described and figured from the Carboniferous flora of the United States, and is now being arranged by Mr. David White. This museum, says *Science*, has also obtained a number of fossils from the Peace Creek phosphate deposit, including numerous remains of the mammoth, showing it to have had a large average size in Florida, others of *Bison latifrons*, indicating that it was about 9 inches taller than *Bison americanus*, and two molars probably belonging to *Auchenia minimus*. Another skeleton of a huge extinct bison has lately been found in W. Kansas.

THE Field Columbian Museum of Chicago is sending a scientific expedition, under the leadership of Professor Daniel G. Elliot, into South Central Africa, in order to collect rare birds and mammals. Fort Salisbury will be the headquarters of the expedition, which from June to December next intends to explore Mashonaland and the country lying to the north and west thereof.

THE following are some of the lectures to be given at the Royal Institution after Easter:—Professor James Sully, three lectures on Child-Study and Education; Mr. C. Vernon Boys, three lectures on Ripples in Air and on Water; Professor T. G. Bonney, two lectures on the Building and Sculpture of Western Europe, beginning April 16; Dr. Robert Munro, two lectures on Lake Dwellings, beginning May 28. The Friday evening meetings will be resumed on April 17, when a discourse will be given by Mr. G. Lippmann on Colour Photography.

THE following is the list of sectional presidents for this year's meeting of the British Association, to be held at Liverpool, September 16–23, under the presidency of Sir Joseph Lister, the new President of the Royal Society. A, mathematics and physics, Professor J. J. Thomson; B, chemistry, Dr. Ludwig Mond; C, geology, Mr. John Edward Marr; D, zoology, Professor E. B. Poulton; E, geography, Major Leonard Darwin; F, economics, the Rt. Hon. Leonard Courtney, M.P.; G, mechanical science, Sir Charles Douglas Fox; H, anthropology, Mr. Arthur Evans; I, physiology and pathology, Dr. Walter Holbrook Gaskell; K, botany, Dr. D. H. Scott. The evening discourses will be given by Professor Flinders Petrie, and, probably, by Sir Andrew Noble; the lecture to working men by Professor Fleming.

AT the anniversary meeting of the Geological Society, held on February 21, Dr. Henry Hicks was selected president for the current year, in succession to Dr. Henry Woodward. The subject of the retiring president's address was "The Life-History of the Crustacea in later Palæozoic and Neozoic Times."

THE Natural History Society of New Brunswick has the excellent habit of conducting each year a lengthy visit to some locality for the purpose of botanical geological, and zoological investigation. In July of last year the neighbourhood of the Lepreau Basin was thus visited. The basin is a land-locked sheet of water, closed in from the sea by a gravel beach and low cliffs of sandstone. At low tide there are extensive sand-flats on the basin, which are traversed by interrupted creeks and ponds, affording a refuge to the marine animals which the rising tide brings into the basin. Unfortunately, the zoological results were mostly negative;

the basin itself is disappointing, for it is rather barren of any forms except the economic clam. Star-fishes and sea-urchins hardly occur there at all, a fact supposed to be due to the long time the basin is empty at each tide, and the consequent warmth of the water in the pools.

The thirteenth bulletin of this Society, which has just been published, contains an important article on the ichthyology of New Brunswick, together with a catalogue of the marine and fresh-water fishes of the province, by Dr. Philip Cox, who has lately considerably enriched the museum at St. John by a collection of the same. We may also record the fact that a short time ago this society acquired the so-called Gesner Museum, which was the first museum established in New Brunswick, and contained a collection of arms and implements of various nations, together with numerous natural history objects. The founder of this museum, Abraham Gesner, published a volume on New Brunswick, in 1847, in London. The Society's museum is strong in native birds, geology, botany, and marine molluscs, and does credit to the labours of numerous local workers, such as Montague Chamberlain, C. F. Hartt, Professor Fowler, G. W. Hay, and W. F. Ganong. There is, besides, a very good collection illustrating the stone age in New Brunswick. The president of the Society for 1896 is G. H. Hay; the secretary, Geoffrey Stead; and the curators, Thos. Stothart, F. E. Holman, and J. V. Ellis, junr.

It is interesting to note that the Indiana Academy of Science elected forty-two new members at its annual meeting last December. This Academy has taken Turkey Lake as a station for the exhaustive study of the effects of environment on, and the variation of, its inhabitants. Several reports on the first season's work were laid before the meeting.

In our last number we alluded to the course of study in marine biology which Mr. Garstang will conduct at Plymouth during the Easter vacation. We learn that Mr. A. H. Church, of Jesus College, Oxford, is prepared to conduct a similar class in marine botany, on which subject he has recently been working at the Plymouth laboratory. The Marine Biological Association has secured the steam yacht "Busy Bee" of Fowey. To complete the purchase a sum of £600 is required, of which £100 has already been promised by Mr. J. P. Thomasson.

The Committee in charge of the marine station at Millport on the west coast of Scotland has sent us its report for 1895. During that year nine scientific workers carried on their investigations at the laboratory, which was also frequented by some members of the Committee, and by several young students who were engaged in general collecting and mounting. An attempt is being made to increase the museum accommodation, which is specially required, since Dr. David Robertson has agreed to place a great part of his valuable collection at the disposal of the Committee so soon as suitable premises are provided. Only a few hundred pounds is needed, and to raise this the Committee appeals to all interested in promoting the study of natural science in the west of Scotland. The station is well provided with dredges, a small beam-trawl, a Cambridge rocking microtome, and several useful books, and is considered by practical naturalists to be admirable for the study of the fauna and flora of the Clyde sea-area.

Dr. F. Dahl, Professor of Zoology in Kiel, is going to Kaiser-Wilhelms-Land, in New Guinea, to investigate its fauna and flora. We also learn from *Naturæ Novitates* that Dr. H. Schauinsland, Director of the Bremen Museum, is going for ten months to Laysan Island, in the South Sea, to investigate its fauna and flora. For a similar purpose Mr. Zenker is going to Kribi in the interior of the South Cameroons, and Dr. P. Taubert, of Berlin, to the mountains between Brazil and Venezuela.

By the enterprise of Messrs. Barbier, numerous representatives of various races from Africa, Madagascar, and the western world are to be exhibited in the Champs de Mars during the summer of this year.

CORRESPONDENCE.

Huxley's Eyes.

Permit me to correct Professor T. Jeffery Parker's slip in speaking of Huxley's "grey eyes." Huxley's eyes—that is, the iris thereof—were what is called black—really a very dark brown. It would have been inconsistent with his strongly melanochroic character that his eyes should be grey.

In Huxley's old age a strongly marked *arcus senilis* developed, so as to obscure somewhat the pigment of the iris, and his eyebrows, long as black as ebony, became grey; but that his late assistant should call his eye "grey" is a curious lapse of memory.
E. Ray Lankester.

"Peripatus" and the "Cambridge Natural History."

It appears to me that the difference of opinion between Professor Sedgwick and myself touching the advisability of assigning names to the genera of Peripatidæ that he has characterised is a subject scarcely worthy of serious discussion.

To hold with him that the action I took in the matter "brings no benefit, and only adds unnecessarily to the nomenclature of the group," evinces a surprising lack of appreciation of the significance and utility of nomenclature. I maintain, on the contrary, that the ascription of a number of species so diversified in distribution, development, and anatomy to one genus represents their relationship in a light that is altogether false; and that the benefit gained by adopting a separate generic title for each of the three sections into which the species fall is strictly comparable to that gained by adopting such titles for the Anthropomorphous Apes, or for the "groups" of fresh-water crayfishes. It is, however, reassuring to be told of Professor Sedgwick's horror of adding unnecessarily to the nomenclature of the Peripatidæ, for one certainly would not have looked for any unwillingness on that score in an author who deliberately published two new and wholly unnecessary names for a couple of species which he was perfectly well aware had already been named by his predecessors.

The next statement in Professor Sedgwick's "Apologia" that concerns me runs as follows: "I read Mr. Pocock's paper when it came out, and so far from finding that he added to our knowledge of the genus, it appeared to me that his own knowledge of the facts already established was not up-to-date in at least one important particular." Before committing himself to the first part of this indictment, it is a pity Professor Sedgwick did not study my paper with a little more care. For, since it fell to my lot to point out almost all that we do know of the specific characters of specimens of *Peripatus* from St. Vincent, referable to *P. iuliformis*, Guilding, which had been lost sight of nearly half-a-century, his attempt to make his readers believe that my paper contained no contribution to our knowledge—putting upon it the most charitable construction possible, and acquitting its author of all malicious intent—amounts to nothing more than a confession of carelessness on his part for not finding in my paper this addition, and others that could be pointed out.

The second part of the charge contains Professor Sedgwick's alleged excuse for not mentioning my work. Well, I am quite willing to do penance for any sins I may have committed, if Professor Sedgwick will have the kindness to point out on what substratum of fact my appearance or appearances of ignorance rest. But I would submit that even if an author's knowledge of established facts be demonstrably, and not merely apparently, behind the times in "at least one important particular," that is to my mind no valid excuse for ignoring all the facts established and suggestions put forward in his paper. I do not presume to dispute Professor Sedgwick's right to think otherwise, if he pleases; all that I wish to point out is that such behaviour is in keeping neither with my experience of what is customary nor with my notions of what is courteous. R. I. Pocock.

British Museum (Natural History), S. Kensington.

Mr. Romanes' Guinea-pigs.

I should like to call your attention to a statement occurring in the review, in the current number of Natural Science, of Romanes' "Darwin and After Darwin," part II. The statement refers to Romanes' repetition of Brown-Séquard's experiments, and stands thus: "He had not got nearly far enough to show positive or negative evidence of any validity." Now with regard to the sixth class of Brown-Séquard's experiments, Romanes obtained very distinct confirmation. He states that in progeny of guinea-pigs in which dry gangrene of the ears had been produced by injury to the restiform body, a similarly morbid state of the ears was frequently observed, and that this morbid state was *never observed* in animals which had neither been operated upon themselves nor were the progeny of parents which had been operated upon. Further, the letter from Mr. Leonard Hill, quoted in the volume, records the drooping of the left eyelid in *two* young guinea-pigs produced from parents in which a similar droop was caused by division of the left cervical sympathetic. Romanes himself says that he has not been able to furnish any approach to a full corroboration of Brown-Séquard's results; but that is very different from the assertion that the results I have indicated are of no validity. I am inclined to believe that no evidence, however strong, would convince some people of the inheritance of an acquired character, although Weismann himself has had to modify his theory so far as to include the possibility of such inheritance. But the duty of a reviewer is to give a correct impression of the value of a book, and no ordinary reader would imagine from your reviewer's language that Romanes had obtained any definite positive results at all. Most people who read the evidence in question would admit that the results I have mentioned add very distinctly to the strength of the positive proof which has accumulated around Brown-Séquard's experiments, while the most minute criticism and searching tests have failed to shake the validity of positive results confirmed by several experimenters.—Yours faithfully,

College of Surgeons, J. T. Cunningham.

March 4, 1896.

[After reading Mr. Cunningham's letter, and re-reading my review and the sections of "Darwin and After Darwin" to which he refers, I agree with him that my phrase concerning the validity of experiments was misleading. Every experiment carefully conducted is valid. What I should have said was that the results of the particular experiments referred to proved or disproved nothing. Romanes was repeating Brown-Séquard's experiments, the interpretation of which as instances of inheritance of acquired characters is, to say the least, debatable. To use Romanes' own words, "on the whole" he was unable "to furnish any approach to a full corroboration." The interpretation of the two or three cases in which he was able to corroborate Brown-Séquard remain as doubtful as before.

The Reviewer.]

Embryology of Cirripedes.

I should like to say a word or two with reference to the notice of my work contained in your February number (p. 84).

It was with some surprise that I read Professor Chun's paper, and noticed the implied criticisms of my own observations on the characters of the appendages of the Cirripedian Nauplii. The larvæ studied by Professor Chun all belong to the latest Nauplius stage, while the Nauplii described in my first paper belong exclusively to the first and second stages. In this communication I showed that the appendages, while agreeing closely in the different species at the same stage, showed differences when the two stages of each species were compared, and in a forthcoming memoir I shall further show that in the later development the appendages become more and more complex in the successive stages. Professor Chun has apparently omitted to take into consideration the possibility of change at successive stages, and nowhere mentions the circumstances that the larvæ compared were of different ages. As a matter of fact, the differences between his observations and my own nearly completely disappear when the corresponding sixth stages are compared, but not quite, for actual differences do exist in the different species at this stage. I see no reason to depart from the view I maintained, that there is an almost perfect agreement between the different species during the first two stages.

With reference to Dr. Giesbrecht's remarks, which I saw soon after the publication of his beautiful monograph, it seemed to me unnecessary to reply to them, as I thought it would be perfectly apparent to anybody reading the communication by Dr. Loeb and myself that the above-mentioned observer had not read the paper, at any rate with the care that adverse criticism ought to presuppose, for his remarks show a complete misapprehension of our statements.

In the first place, with regard to the statement that the part of a cylindrical vessel filled with water is brightest on the side remote from the source of light, I may say that we took some pains to make it clear that it was not necessarily towards or away from the most brightly-illuminated spots that the Nauplii moved, but *in the direction of the rays of light*, and that a Nauplius in the positively heliotropic condition (*i.e.*, moving towards the source of light) might be made to pass from a more brightly to a less brightly-illuminated region, and *vice versâ*.

In the second place, the rays of light did not always pass through the convex glass front of the vessel, but in many experiments obliquely from above through the water only.

Thirdly, the vessels used were by no means always cylindrical; receptacles of all shapes were employed, including long cylindrical glass troughs with upright sides.

I may lastly add that a later experimenter (Viguier), while severely criticising our views, confirms our observations as to the existence of positive and negative conditions of heliotropism in Cirripede Nauplii. THEODORE GROOM.

Royal Agricultural College, Cirencester.
February 10, 1896.

[Though it is not our business to take up the cudgels for Mr. Groom's opponents, still we suggest that it is inaccurate to say that Professor Chun "nowhere mentions the circumstance that the larvæ compared were of different ages," for, having stated on p. 81 that the Nauplii under his observation had "obviously undergone the last moult before passing into the Cypris-stage," on p. 87 he says, "the first antennæ (*antennulæ*) always, as is well known, uniramous, I find in agreement with the statements of Dohrn (1870, p. 603), and Willemoes Suhm (1875, p. 143), in all observed Nauplii composed of six joints. Buchholz (1869, p. 30) and Groom (1894, p. 179) give the number of their joints in the younger Nauplii of the Lepads and Balani as only four, while Lang (1876, p. 109), found them in the Balanid-Nauplii five-jointed." To the second antennæ Chun assigns an eight-jointed exopod and a four-jointed endopod, nine and three being the corresponding numbers given by Groom, while to the mandibular feet Chun assigns a four-jointed exopod and three-jointed endopod, in contrast with the numbers five and two given by Groom.

It was surely impolitic on Mr. Groom's part to ignore a criticism appearing in such a work as the "Pelagische Copepoden." If we rightly understand the explanation now offered, it is in the nature of a plea of "confession and avoidance," not rebutting Dr. Giesbrecht's accusation, but claiming that, under the circumstances, the error imputed was of no consequence.—ED. NAT. SCI.]

GEOLOGICAL MAPS.

THE colour-printing of Geological Survey Maps alluded to in your February number (p. 142) is certainly a welcome departure; for, on account of the price, the amateur, as distinct from the professional, geologist has hitherto had to colour his own maps from such copies as he could beg or borrow.

But, though colour is all very well for demonstration purposes, and sometimes for use in the field, it has many disadvantages. The darker colours obscure the detail, so as to render it illegible, and in hand-painted maps the colour runs after a wet day in the field. Maps are not always accurate, and it is difficult to alter a coloured map. Again, it may happen that one wishes to colour on a different plan, or for some different object, and yet to be able to have the geological lines visible in the same sheet: this cannot be done in a coloured map. Therefore, it ought to be possible for anyone to purchase plain one-inch maps with the geological boundary lines engraved; and on the inside of such boundary lines the designatory letters should be placed at sufficiently convenient intervals _g5.______________g5._ after the plan of contour-lines on the six-inch map. These maps could be produced as cheaply as the present plain maps, and the student could get half-a-dozen of these for the price of a coloured one. From my experience in the field I venture to say that such maps are all the field-worker requires, and that coloured maps are a plague to him. S. S. Buckman.

[While sympathising with Mr. Buckman's request, we may point out that some of the charges he brings, such as illegibility and running of colour, do not apply to the new colour-printed maps.—Ed. Nat. Sci.]

A Correction.

In your note on the University of Minnesota (vol. viii., p. 67), for *die*-testing read *ore*-testing. This misprint is not your fault, but came, as you stated, from *Science*.

Your review of Miss J. E. Tilden's "Bibliography of Algæ" was objectionable. You grumbled because it was incomplete. But it is entitled a *Contribution* to the Bibliography, etc., and was avowedly incomplete. Further instalments will be published, a large one being now almost ready. The intention is finally to correct it up and issue on cards.

I like Natural Science immensely. It is indispensable.—Yours truly,

University of Minnesota, Conway MacMillan.
January 21, 1896. Head Professor of Botany.

"A Rowing Indicator."

Mr. E. C. Atkinson desires to point out that on page 132, line 39, the words "in cases 3 and 7 in excess or defect" should be "in some cases 1 or 2 in excess or defect." The photograph reproduced in Fig. 1 was kindly taken by P. Elford, Esq., St. John's College, Oxford.

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22, St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

The "Challenger" Number.—*In reply to enquiries, we remind our readers that, although the* First *edition of this ran out of print immediately, there are still some copies of the* Second *edition to be obtained at the usual price*—One Shilling. *No more will now be printed, so orders should be sent at once.*

NATURAL SCIENCE:

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NOTES AND COMMENTS.

Mechanical Symmetry in Living Matter.

IN the various attempts to explain the shapes and structures of animals, one of the most curious recurrences is a comparison between crystalline structure and organic form. The forms of crystals depend upon the forms of the individual molecules, or groups of molecules, of which the crystalline bodies are composed, and upon the strains and stresses by which the molecules adhere together. The symmetry is the necessary outgrowth of the constitution and nature of the crystalline matter. Repeated attempts have been made to show that there may be a connection between the forms of animals and the constitution and nature of the supposed equivalent molecules, or groups of molecules, of which they may be composed. Some time ago we noticed an interesting volume by Dr. Haacke (Natural Science, vol. v., p. 66), in which he tried to show that the different shapes of animals depended upon different kinds of protoplasmic molecules. We have now received from Arturo Soria y Mata a pamphlet in which a similar theory is ingeniously elaborated. It is entitled *Origen Poliédrico de las Especies* (Madrid: Succesores de Rivadeneyra, Paseo de San Vicente, 20, 1894), and it attempts to show that organic forms may be reduced to aggregates of regular and irregular polyhedra.

We cannot follow the author at length into his curious enquiry. It seems to us to have been established that protoplasm, the basis of living things, is not a substance, but a mixture, and from the physical point of view we regard it as certain that no living body is composed of equivalent particles. It must be remembered, however, that the appearance of symmetrical patterns may come by the arrangement of dissimilar materials. A kaleidoscope elaborates regular and complicated patterns from dissimilar fragments of paper, glass, tinsel, and so forth. The pattern is produced by the complicated optical repetitions of the dissimilar units, each unit and the whole irregular group being repeated by mirrors. Now cell-multiplication produces a result closely similar. The multiplication of cells from a growing-point forces out repetitions of the original cell in radiating directions, and, by the simple mechanical result of growth, points grow into stars or lines, masses grow into larger masses disposed about a centre. The formation of symmetrical patterns is retarded or distorted in many cases by the interference of adjoining patterns from adjoining centres of symmetry, and by the limitation of growth in fixed directions necessary to the production of definite organs. But in any structure built up by the repetition of parts an appearance of symmetry must be present. We are inclined to think that many of the theories of relation between body-form and protoplasmic molecule owe their origin to a neglect of the fact that pattern comes from arrangement, as well as from identity, of component parts.

Regeneration and Involution.

From their intrinsic interest, and from their importance as bearing upon problems of growth and heredity, the phenomena of the regeneration of lost parts and of the degraded forms of organs are of great interest. The additional attention that is now paid them may be seen from the bibliography for 1894, compiled by Dietrich Barfurth, and issued in the 1894 volume of Merkel and Bonnet's *Ergebnisse der Anatomie und Entwickelungsgeschichte.* Mr. Barfurth remarks on the presence of bitterness in the disputations, and on their occasional conduct with weapons unsuited to the parlour (nicht immer mit salonmässigen Waffen). In the work done in 1894 upon embryological regeneration conflicting results have been obtained. In most cases, observers found that isolated cells of the two-, four-, or eight-celled stages of the segmenting egg gave rise to complete embryos. These results, like the original experiments of Driesch, Hertwig, and Wilson, seem against the evolutionary views of Roux and Weismann. If, for instance, the first division of an egg divides it into a future right and left half, one would not expect a separated left half to reproduce the whole. Zoja, however, working on eggs of *Strongylocentrotus lividus*, found that isolated blastomeres gave rise to semi-morulæ, although Driesch, working on an allied family, found that they gave rise to complete morulæ. The most important of these papers is, perhaps, a critical summary of recent work by Roux, published in the *Archiv für Entwickelungsmechanik.* This valuable publication, we learn from the *Zoological Record*, may be consulted in the Linnean Society's library. Barfurth himself made an important series of investigations upon the regeneration of lost parts. He found, in the case of the young *Axolotl*, that complicated wounding and amputating of the limbs might result, not merely in regeneration, but in regeneration accompanied by the addition of supernumerary parts. The tendency to "super-regeneration" he found to be greater the nearer the proximal end of the limb the amputation was made. It is, so far as we know, the first case of polydactylism produced artificially.

The Transplantation of Living Tissues.

The original experiments of Hunter, in which he transplanted structures from one animal to another, probably led to the modern attempts at bone- and skin-grafting. A few years ago, surgeons were confident that grafts of bone from rabbits and calves might be transferred to human bodies, while it was a current belief that skin might easily be grafted, or blood transfused. Mr. H. G. Wells, whose scientific novels have been a feature of the last two years, has based the plot of his recent "Island of Dr. Moreau" on the artificial production of semi-human beings from animals. Dr. Moreau is a ferocious vivisector, with something of the hypnotist thrown in, and, by carving living animals (without anæsthetics) for many consecutive weeks, he has produced, and turned loose on his island, a set of amusing creatures, such as wolf-hyæna-men, ox-hog-men, goat-vixen-ladies, and a puma-dog-lady who escaped in an incomplete condition, to the subsequent destruction of her artificer. The story is gruesome and exciting to a high degree; but we have no doubt that our readers, who have missed great delights if they have not read the earlier scientific novels and stories of Mr. Wells, will form their own opinion of the qualities of the "Island of Dr. Moreau." From the scientific side, however, Mr. Wells seems to us to have allowed his imagination too free a run in his new story. In the *resumé* alluded to in our last Note, Mr. Barfurth sums up recent work on transplantation and transfusion conclusively against the success of operations conducted upon animals of different species. Transplantations from one species to another almost invariably have proved unsuccessful. Most often the transplanted pieces become centres of suppuration; in the most favourable cases, they serve as inert centres around which new growth takes place. Histological examination shows that they die. So extreme is the aversion of a body to extrinsic material, that transplantations from other individuals, even of the same species, rarely hold; they are treated as foreign bodies. The successes are almost entirely confined to plastic operations in which material from one part of a body is adapted to another part of the same body.

The Vestige of the Yolk-Sack.

Mr. Barfurth's section upon involution shows that rather less work has been published in 1894 than in many earlier years. One of the most interesting investigations was made upon the fate of the yolk-sack, by Strahl and Bersch. In the case of the blind-worm, it was found that the yolk-sack had completely disappeared six months after birth. In the wall-lizard, they found that the yolk-sack disappeared as a diverticulum of the gut, but was represented in the adult by a little mass of black pigment—another instance of the curious connection between degeneration tissues and the deposition of pigment. We do not recall any other observations on the vestige of the yolk-sack among reptiles. Owen described it in a number of birds, declaring that the retention of a large rudiment was characteristic of water-birds. More recently, Mr. Chalmers Mitchell has shown that it is present in the adult forms of the greater number of the avian groups, and that it bears a constant relation to the disposition of the intestinal folds. There are few records of its occurrence among adult quadrupeds; but human anatomists are familiar with it as a not infrequent abnormality known as Meckel's diverticulum.

The Evolution of Adaptations.

We have received from Mr. G. D. Haviland a pamphlet entitled "Some Factors in the Evolution of Adaptations" (London: R. H. Porter, price sixpence). He endeavours to apply deductive reasoning to a set of propositions concerning asexual and sexual reproduction. So far as we can see, there is no flaw in his ingenious exercise; but as it happens, deductive reasoning is the last thing we want in biology. Everyone of us, though perhaps seldom with Mr. Haviland's skill, might sit down and deduce factors of evolution until the undertaker's man called for us, and science would be none the better for our labour. One of Mr. Haviland's "three axioms," for instance, is that the characters dealt with in his paper "exhibit heredity of deviation." If the writer were to spend a very small part of the leisure he is able to devote to this pastime of deduction upon the collection of new facts and the collation of old facts regarding the meaning and manner of the process he cheerfully calls an axiom, he might write something worth reading. When the axiom that two straight lines do not enclose a space is stated, a definite fact is stated. This axiom of Mr. Haviland, on the other hand, is a generalisation of the vaguest kind, based upon observations which range from absolute non-inheritance of particular deviations to complete inheritance. We want facts, not inferences, observations, not theories, for a long time to come.

The Anatomical Society.

We hear that it is intended to hold a summer meeting of the Anatomical Society of Great Britain and Ireland at Oxford on Saturday, July 4. This Society, which was founded in 1887, meets, as a rule, four times a year, three of the meetings being held at the London medical schools in rotation, and the other at one of the provincial universities or schools. The aims of the Anatomical Society may fairly be said to come within the province of Natural Science, since it is instrumental in publishing a considerable number of papers on vertebrate morphology, as well as on pure anthropotomy. Among the papers which are likely to interest, or to have been of interest, to our own circle of readers, we may refer to the following: The Structure of the Vertebrate Liver, by T. W. Shore and Lewis

Jones; The Cerebral Hemispheres of *Ornithorhynchus paradoxus*, by Professor Sir William Turner; A Contribution to the Comparative Anatomy of the Ankle Joint, by Professor Cleland; The Pelvis of the Mammalia, with special reference to that of the young *Ornithorhynchus*, by Professor Howes; The Spine of the Young Gorilla, by Professor Symington.

In addition to publishing its own proceedings, the Society has an arrangement with the proprietors of the *Journal of Anatomy* by which its chief papers are published *in extenso* in that work, and are illustrated in a more complete way than would otherwise be possible. The Collective Investigation Reports, which should prove valuable to workers on variation, are also conducted by the Society; but perhaps the undertaking which is most likely to earn the gratitude of workers in zoology is the publication of a very complete index to the *Journal of Anatomy and Physiology*, an index which is already published for the first twenty volumes, and of which the remainder will be ready at the end of the present year.

Economic Work of the Marine Biological Association.

The recent number of the *Journal of the Marine Biological Association* (February, 1896) shows that an increasing amount of work of direct economic importance is being issued from the laboratory, in addition to the large output of abstract scientific work. It is, of course, impossible to distinguish exactly between researches that bear directly upon economic matters and researches conducted in the pure spirit of scientific inquiry; for the same methods and the same trained workers are required for both, and investigations apparently most remote from commercial questions may come to have an unexpected value. Mr. Bidder, for instance, has been pursuing investigations upon the embryology and anatomy of the Porifera for many years, and men of business might have looked coldly upon his nice discriminations between epiblast and hypoblast, or on his curious inquiries into the morphological nature of embryos. Yet when the Colonial Office applied to the Marine Biological Association for an opinion on the advisability of projects for improving the value of sponge-fisheries, Mr. Bidder's contributions to the report proved of the highest practical value. The whole report as presented to the Colonial Office is reprinted in the current number of the Association's journal. The Director and Mr. Bidder, on the whole, sum up against the proposals to improve sponge-fisheries by planting cuttings. They think that there is not sufficient evidence as to the rate of growth of the sponge of commerce, and that, unless the cuttings were exposed to conditions much more favourable by the construction of special stages, it is unlikely that a greater weight of sponge would be got in the same time from the cuttings of a sponge than from the original undisturbed sponge. They suggest that fishing in deeper water should be tried, and that the importation of living sponges from the Mediterranean should be attempted.

In the same issue of the *Journal*, Mr. Cunningham continues the report of his valuable North Sea investigations. He deals with the size of mature plaice, turbot, and brill on different fishing grounds; with special observations upon the fish taken at Grimsby, Scarborough, Hull, and Lowestoft; with the causes of distribution of different-sized fish in different regions of the German Ocean; and with the influence of proposed restrictions on the sale of undersized fish. The report contains a large bulk of matter of great interest to naturalists and to the fishery trade. If we might venture to make a suggestion to Mr. Cunningham, it would be that he should attempt to sum up separately the conclusions which he sees to be of practical value. Practical people prefer results treated categorically, rather than philosophically.

Mr. Albrecht Bethe gives a preliminary note, with a figure, of an interestingly abnormal crab. To the left side of the fifth segment of the abdomen there was attached a walking-leg. Mr. Bethe promises a detailed account, with theoretical explanation of the abnormality, in a "German journal."

Preserving Fluids.

In reference to our Note last month on the preservation of molluscs, Mr. H. Hanna writes to us from Belfast that the use of cocaine, and of graduated alcohol after the production of complete anæsthesia, is not the only reliable method for molluscs. He has found a less complicated course "simply perfect, both as regards completeness of expansion and preservation of natural colour." An *Aplysia* was put from sea-water directly into a small basin filled with a 10 per cent. solution of chromic acid, and allowed to remain in that for from one to two hours. It was then removed and washed repeatedly, to get rid of the chromic acid, and passed through graduated alcohols. He has a specimen in spirit, treated as above last August, and now displaying the natural colours and fully expanded state of the living animal.

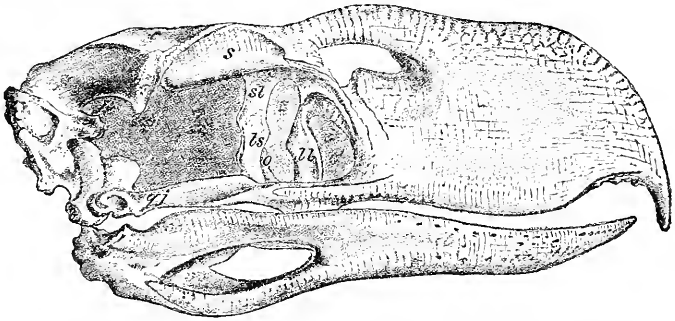
We learn that the use of formalin is becoming very general. It has been employed with success, both as an injecting and a preserving agency, in the Prosector's Laboratory at the Zoological Society's Gardens. It is used in the anatomy rooms and in the pathological departments of several hospitals in London, with varying success. It is reported as being unsatisfactory for the preservation of brains, as it renders them very brittle, and as it makes almost impossible the removal of the *pia mater* from the preserved specimens. Two practical objections are urged against its use. It has unpleasant effects upon the hands, as we ourselves are able to testify. It makes the skin hard and dry, and wrinkles the ends of the fingers, while it engrains dirt in an undesirable fashion. Moreover, we have heard several complaints of its having set up throat irritation, less severe, but more prolonged, than that caused by chlorine fumes.

Papers on formalin are becoming numerous. Among them we notice one by O. A. Sayce, published in the *Victorian Naturalist* for December, 1895, pp. 101–104. The author has used formalin for the preservation of plants, and finds that the chlorophyll is not dissolved out as it is with alcohol. To facilitate the penetration of formalin into animals with a thick integument, he has adopted two plans with success, one is to kill by immersion in glacial acetic acid for a minute or two, or less, according to circumstances, and, without washing the acid out, to place the specimen at once in 5 per cent. formalin, washing the acid out on the following day with fresh 5 per cent. formalin. The other method is to heat the solution, which, however, weakens it by driving off the formic aldehyde.

Phororhacos at the British Museum.

Some months ago (Natural Science, vol. vii., p. 166; September, 1895) we drew attention to a paper by Dr. F. Ameghino describing a number of very remarkable fossil birds from the Santa Cruz beds of Patagonia. The whole of this collection has recently been purchased by the Trustees of the British Museum, and is now in part exhibited at the Natural History Museum, where it forms one of the most valuable and interesting additions that have been made to the collections during the last few years. Besides the remains of *Phororhacos* and several other "Stereornithes," it includes a considerable number of ordinary carinate birds of smaller size belonging to several families. Of the gigantic forms, *Phororhacos* is by far the best known, the greater part of the skeleton being represented in the collection. The mandible of *Phororhacos longissimus*, the largest species, is certainly one of the most remarkable specimens in the Museum, and it can easily be understood how Ameghino, with only a fragment to go upon, imagined that he was dealing with the mandible of a large edentate mammal. The nearly complete specimen measures about 56 cm. (22 inches) in length and 7 cm. ($2\frac{3}{4}$ inches) across the widest part of the symphysis; the whole is exceedingly massive. The skull found with it was about 2 feet in length, but unfortunately was so fragile that only some fragments were preserved. Of the smaller species, a complete skull and mandible, together with a great part of the rest of the skeleton, are shown. The skull (for a figure of which we are indebted to the editor of *The Ibis*) resembles that of a raptorial bird in its general aspect, and particularly in its powerful hooked beak, which, however, differs from that of Accipitrine birds in its great depth and compression. The quadrate of this specimen shows clearly the presence of two heads for articulation with the skull, and this character, together with many others in other parts of the skeleton, is evidence that these birds were not Ratitæ but Carinatæ in which the power of flight had been lost. From the Ratitæ they also differ widely in the relative proportions of the head and body, for in the struthious birds the head is in all cases extremely small in comparison with the whole bulk of the body, while in *Phororhacos* it is proportionately very large. Probably the Shoe-billed Stork (*Balæniceps*) gives the best idea of these proportions in *Phororhacos*; the two are, however, in no way related, and the shape of their heads is quite different.

The bones of the fore-limb were all very short, but at the same time stout and strong, so that although these birds were almost certainly incapable of flight, they still possessed, for some purpose or other, a powerful wing. The pelvis has been to some extent crushed, so that the extreme narrowness of its post-acetabular region, as shown in Ameghino's figure, is somewhat exaggerated. All the bones of the hind-limb are known in this species, so that the height of the bird at the middle of the pelvis can be estimated to have been less than 1 metre. The skull is 34 cm. (about $13\frac{1}{2}$ inches) long.



Skull of *Phororhacos inflatus*, Ameghino. One-fourth natural size. (After Ameghino.)

As to the affinities of these birds there is still much doubt. It is clearly impossible to regard them as struthious, and their great specialisation renders it very difficult to ascertain their place among the Carinatæ. In a recent paper in *The Ibis*, Mr. C. W. Andrews has suggested that their nearest living ally is that curious South American bird the Cariama (*Dicholophus*), which, though much resembling the Secretary-bird, is now usually regarded as a very aberrant crane. To this, in some respects, as for example in the structure of the metatarsus, the resemblance of *Phororhacos* is very great. If this surmise be correct, it is a matter of some interest to find that some of the birds, like many of the mammals, now living in South America, have extinct representatives of gigantic size and a high degree of specialisation.

Prosser on Permian Problems.

Considerable doubt has prevailed as to the relations of the Permian beds in the Western States of America, if, indeed, the

Permian were represented there at all. Dr. Newberry, at all events, considered that the so-called Permian could not be separated from the Coal-measures. A careful and detailed paper by Professor Charles S. Prosser, of Union College, Schenectady (*Journal of Geology*, vol. iii., pp. 682–705, and 764–800; 1895), shows on incontrovertible fossil evidence that true Permian rocks do occur in Central Kansas. Waagen, in correlating the Upper Palæozoic strata of the Salt-Range (*Palæontologia Indica*, ser. xiii., vol. iv., pt. ii., p. 238), drew the dividing line between the Carboniferous and Permian systems of North America at the top of the "Upper Productive Coal-measures." Mr. Prosser considers that this line was placed too low, since the Wabaunsee formation of Kansas, which occurs above it, contains a fauna practically identical with that of the Upper Coal-measures. To that series he would refer both Wabaunsee and Cottonwood formations. The Neosho and Chase formations are transitional, but would be included by most European geologists in the Permian, while the Marion formation, which in Kansas is succeeded by Cretaceous beds, contains none but characteristically Permian fossils. The paper, owing to its minute detail and abundance of unfamiliar names, will not prove exhilarating reading for European geologists; but it will be of value to those of them whom necessity or inclination lead to make closer acquaintance with American stratigraphy.

Gneiss, Gold, Galena, and Garnets.

In an extract of 85 pages from the Sixteenth *Annual Report* of the Director of the U.S. Geological Survey, Part II., Mineral Resources of the United States, 1894, Dr. G. F. Becker gives a general reconnaissance of the gold-fields of the Southern Appalachians. The area contains three productive belts, the Georgian, the South Mountain, and the Carolinian. Of the two first, the rocks are chiefly Archæan gneisses and schists, sometimes intersected by granite dykes. The conditions in the Carolinian belt are more complex. Here the rocks are metamorphosed sediments (chiefly clay-slates) containing irregular patches of volcanic rocks with intruded basic dykes.

To the banded gneisses of the Georgian belt the author ascribes an eruptive origin, and considers that, as in the banded Tertiary gabbros of Scotland described by Geikie and Teall, the banding arises from the intrusion of heterogeneous magmas. The auriferous veins are in cracks running approximately parallel to the schistosity. The fact that galena is a common associate of the gold rather negatives the idea that the ore was brought by an alkaline solvent. The original source of the gold is still to seek, but in many cases there is evidence to show that the igneous dykes are connected with the deposition of ore. An interesting point is that the garnets in some of the garnetiferous schists are auriferous. As these garnets crystallised in the schists after the schistose structure was developed, the author sounds a note of warning as to good idiomorphism being an infallible sign of the early genesis of crystals in igneous rocks.

Alpine Flora.

The study of present conditions in the Arctic Regions is so necessary if one wishes to understand the bygone history of our flora and fauna, that we are glad to see that Mr. H. D. Geldart takes this view in his presidential address to the Norfolk Naturalists' Society. Comparing the existing flora of Greenland with the flora of Britain during the Glacial Epoch, he is no doubt right as to the power of part of the arctic and alpine flora to survive, however cold it may be. We may point out, however, that it can only survive if there still exist tracts of land bare of snow and ice during the summer. The British alpine species may have lived throughout the Glacial Epoch in the South of England or on the ice-free summits of our north country; they cannot well have lingered in the flatter districts of East Anglia, where the ice-sheet seems to have been continuous. Mr. Geldart thinks that the Greenland flora likewise inhabited Greenland through the Glacial Epoch; but he does not allow for the former greater thickness and extent of the ice, which then, in all probability, entirely hid the small areas now free from snow during the summer. The marks of glaciation in Greenland usually extend far beyond and above the present limits of the ice.

The Antarctic Continent.

In our issue of last month we dealt with recent views upon the former greater extension of the Antarctic Continent. A correspondent has pointed out to us the important evidence in favour of this view that is furnished by a study of the earthworms of the Southern Hemisphere. These animals are, generally speaking, entirely wedded to the soil; they are impatient of sea-water, and possess but few facilities for assisted migration; hence they are valuable as a help towards determining the probabilities of earlier land-connections. It is a striking fact that there is the closest similarity between the earthworms of Patagonia, New Zealand, and such of the intervening islands as have been explored. It appears from the papers containing descriptions of the earthworms of the "antarctic area" by Michaelsen, Rosa, and Beddard, that the bulk of the indigenous Oligochætous inhabitants of these regions of the world are members of the genera *Acanthodrilus* and *Microscolex*. Indeed, in Patagonia and the Falkland Islands no other species at all have been met with. In New Zealand, there are only two earthworms which are not of either of those two genera or which do not belong to the three genera *Octochætus*, *Deinodrilus*, and *Plagiochæta*, closely allied to *Acanthodrilus*. South Georgia, Kerguelen, Marion Island, and MacQuarie Island also possess two or three species of the genus *Acanthodrilus*. Only six species of *Acanthodrilus* and something like the same number of *Microscolex* exist outside of this area. The iceberg theory of migration might be called in, perhaps, to explain the phenomena ; but it offers great difficulties. It may be granted that the cocoons might be detached with a quantity of the earth in which they are usually deposited and find their way on to a glacier, and so, with its broken end, float out to sea. Plenty of dangers are run during these preliminary steps, but the real dangers only begin when the berg is well out to sea, and, while gradually diminishing in size, is exposed to the splashing of the waves of that stormy ocean. This would be almost certain to destroy some of the embryos contained within the cocoons. If these perils are escaped it can be but seldom ; such rare occurrences would surely hardly account for the close similarity of the earthworm faunas that has been referred to. If the extension of the land be denied, some explanation is much wanted for these facts.

Distribution of Earthworms.

The California Academy of Sciences is to be congratulated, not only on the excellence of its publications in the matter of type and lithography, but on the good work done by its contributors. One of the latest numbers of the quarto memoirs of this Academy is before us, and deals with a large series of new species of earthworms from California, by Dr. Gustav Eisen. It is the second part of his "Pacific Coast Oligochæta." For some years past Dr. Eisen has been engaged in the study of the American Oligochæta, both freshwater and terrestrial, of which there is a greater variety than in Europe. In this latest publication, Dr. Eisen has described five or six species of the Acanthodrilidæ, *Benhamia* and *Acanthodrilus*, and four new species of *Sparganophilus*. This latter genus was originally found in the Thames by Dr. Benham, but the occurrence of so many distinct forms in the North American continent seems to point to that area as its proper habitat. One species of the genus, of which, unfortunately, no other details are at present forthcoming, was found to possess eyes, at present a unique example among the earthworms. Eyes, as is known, occur in certain Naidæ, but no trace of them has as yet been met with in any terrestrial worm. *Sparganophilus*, however, though belonging to a family, Geoscolicidæ, which is chiefly terrestrial in habit, is itself aquatic, as are indeed a few other genera of the same family. The distribution of *Benhamia* is the most puzzling fact in the distribution of the entire order. Dr. Eisen, unfortunately, adds to the difficulties by describing what appear to be unquestionably indigenous forms from California. It is a genus which is eminently tropical in range, though a few (? imported) species have been found in extra-tropical regions, *e.g.*, in Germany. Dr. Michaelsen regards tropical Africa as its home, and in that continent are undoubtedly the largest number of species of the genus, which is always met with in gatherings from Africa; but it also occurs, though to a less extent, through the East, and now we have a quantity of American forms. Dr. Michaelsen thinks that these species, which live out of Africa, have been introduced by commerce, and that they are not really indigenous elsewhere than in Africa; but there remains the fact that quite different species are inhabitants of America and the East. One of Dr. Eisen's new genera is also a member of the same family; he has named it *Aleodrilus*; it is mainly to be distinguished from other genera by the more posteriorly situated male generative pores. In this it agrees with the North American *Diplocardia*, of which further researches may show that it is only a distinct species. *Phœnicodrilus* is allied to a small worm, largely aquatic in habit, described by Beddard from tropical Africa, and named *Nannodrilus* on account of its pigmy proportions. Besides *Benhamia*, *Ocnerodrilus* is another genus which is common to the warmer parts of America and to tropical Africa. Resemblances between Africa and America have been pointed out in other groups of animals, and there is certainly some reason for comparing them in the matter of their earthworms; but it must be borne in mind that the common forms are small and of an accommodating way of life, so that accidental transference must not be lost sight of.

THE PRELIMINARY NOTICE.

OUR Note on this subject (this vol., p. 73) has brought us a certain amount of correspondence. The principle of our criticism seems generally approved, though many workers are disposed to make reservations in one or another direction, and to

> "Compound for sins they are inclined to
> By damning those they have no mind to."

Mr. T. D. A. Cockerell is so bold as to send us "a little paper of his own" to serve as a test-case. Its very title is aggressive—"Preliminary Diagnoses of New Coccidæ." It is published in the *Supplement to Psyche*, February, 1896. "The writer," it begins, "having lately prepared descriptions of various new Coccidæ, which will appear in sundry bulletins, reports, proceedings of local societies, and so forth, it is deemed expedient to bring together some account of them here. This is done for the convenience of students, who sometimes complain of the difficulty of keeping track of scattered descriptions; and also to secure earlier publication, as some of the fuller accounts may be (indeed, have already been) much delayed." The diagnoses are short, but Mr. Cockerell assures us that they are "full enough for recognition," and that they are "actual abstracts of *full* diagnoses previously arranged for publication." The species come from Mexico, Japan, San Francisco, Trinidad, and elsewhere. Full particulars of most will be given in a forthcoming *Bulletin* of the U.S. Department of Agriculture. "The West Indian forms will probably receive full publication in Trinidad."

Mr. Cockerell asks for our criticism; he shall have it. And our remarks will be found applicable to many similar publications. We accept Mr. Cockerell at his own valuation, and say nothing as to the intelligibility or validity of his diagnoses. But, by the way, what is the difference between a diagnosis and a "*full* diagnosis"; in other words, how can one abstract a diagnosis? A diagnosis is, or should be, itself an abstract as condensed as is consistent with intelligibility. More than this cannot be diagnostic; and nothing that is diagnostic should be omitted even from a preliminary notice. However, this may pass as due to an incorrect use of language. The real question is as to the necessity for this little paper of Mr. Cockerell's. It is, he says, to obviate the difficulties arising from scattered publication. But there is no necessity, we presume, laid on this author to shower his coccids broadcast like carnival *confetti*. The desire for notoriety that leads some authors to publish ten papers where one would do, and to send them to all parts of the world for publication, is in itself reprehensible, but doubly so if it leads to the additional publication of one or more preliminary notices. We do not grasp the plea—"the convenience of students"; students ourselves, we are incessantly irritated, either by turning up preliminary notices that are devoid of detail and illustration, and without reference to the place where such may be found, or else, when we have relied for name and date on an illustrated and detailed account, by suddenly finding our synonymic tables upset owing to some obscure preliminary note that is not referred to in the completed paper.

We do not know whether Mr. Cockerell intends to give proper references to this little paper of his in the promised *Bulletin*, or whether he intends to re-introduce his species as n. spp. But instances of the latter form of annoyance are not rare: another correspondent points out that a new genus and species of holothurians, *Pelagothuria natatrix*, was introduced by Professor Ludwig in *Zoologischer Anzeiger*, xvi., p. 183, 1893, that a figure of it appeared in Lang's "Lehrbuch der vergleichenden Anatomie," August, 1894, yet that it was again published in Ludwig's Holothurioidea of the "Albatross," in October, 1894, as *nov. gen. et sp.*; he also complains that Dr. Hartlaub published a large paper on the Comatulidæ of the Indian Archipelago, in which a number of species were described as new, which turned out to have been described in a Vorlaüfige Mittheilung in the preceding year. If such be the treatment meted to it by its own authors, the preliminary notice would appear deprived of its last excuse, that of securing early or prior publication. No one will seriously contend that, amid the increasing press of publication and multiplication of unnecessary writings, scientific men should be encouraged in these vain repetitions and immature essays, whose chief use seems, after all, to be to enable their authors to receive criticism on the mistakes to which their hurried preparation naturally exposes them.

PRIORITY IN NOMENCLATURE, AND OUR PROPOSAL.

THE remarks on Zoological Nomenclature kindly sent to us by Mr. Cunningham present the views of the morphologist and practical naturalist, to whom changes in nomenclature are a needless nuisance, rather than of the systematist, to whom they are an unwelcome necessity. We admit that the Law of Priority can never, of itself, lead to finality, owing to the existence of a number of doubtful cases like those quoted by Mr. Cunningham. But his proposed substitute for the law, viz., "Choose what you consider the most correct description and classification," would lead to mere anarchy and chaos, for "tot homines, quot sententiæ" is still true in zoology. On the other hand, Mr. Cunningham's rule for the giving of new names—"no one should give a new name to a conception already named"—is merely the Law of Priority in other words. Obviously, some such law is a necessity, if we are to avoid the multiplication of synonyms or to have any attempt at a world-wide set of names. The difficulties in the application of the law are of two kinds. First, is it to be retrospective? and, if not, where is the line to be drawn, and who is to draw it? Secondly, when authors have published unintelligible or doubtful descriptions, who is to be the judge? These matters cannot be left to the individual caprice of naturalists, even so distinguished as Mr. Cunningham. It is for this reason that we made the proposal published in our last number. We say,—let the Law of Priority work! in most cases it will answer. Then let the doubtful cases be adjudicated on by specialists appointed *ad hoc*, and let their decision be accepted. Fixity of nomenclature of course is not anticipated, for that could be the result only of the stagnation of systematic zoology. Nevertheless, the acceptance of our proposal would do away with the changeableness that depends on mere whim, or on literature rather than on fact. We realise, indeed we have insisted, that the full carrying out of our ideas cannot be yet; the index to all published names must first be completed. But we are glad to learn, through communications with many zoologists, that our proposal is regarded with favour in various influential quarters. We shall be pleased to receive suggestions as to the best mode of carrying it out.

CAPE COLONY GEOLOGICAL COMMISSION.

IN our last November number (vol. vii., p. 366) we announced the appointment by the Government of Cape Colony of a Geological Commission, which is to report to the Secretary for Agriculture. The Commission has now appointed the following gentlemen to begin the work of surveying and mapping the country: geologist, G. S. Corstorphine, B.Sc. (Edin.), Ph.D. (Munich); assistant geologists, A. W. Rogers, B.A. (Cantab.), and E. H. L. Schwarz, A.R.C.S. The Commission also intends to publish in June a bibliography of South African geology, which has been compiled by Mr. Harry Saunders, the secretary to the Commission. During the last ten years some £35,000 has been spent by the Government of Cape Colony for geological purposes; but complaints have been made that although science may have been advanced by the contribution of a scattered paper or two to English publications, or by the enrichment of the British Museum with a skeleton of *Pareiasaurus*, still the Colony itself has nothing tangible to show. For the present Commission an appropriation of £1,500 has been made for the months December, 1895—June, 1896. It is hoped that the future work of the Commission will be carried on by annual grants of £2,000. Although South Africa abounds in mining engineers, prospectors, and such-like practical geologists, of more or less competence, still not much advance in our purely scientific knowledge of its geology has been made since the days of A. G. Bain. The Commission intends to devote its energies purely to the scientific aspects of the science, and to steer as clear as possible of the ordinary speculator. By this means a secure foundation will be laid for the geology of Cape Colony. The Commission will be glad to receive copies of any geological publications, in return for which they offer to forward the reports on the geology of the Colony.

Moving Pictures.

The era of living pictures at the music halls is being replaced by an era of moving pictures. The living pictures, attractive though many of them might have been, were the antithesis of all art; pictures, in a sense, are studies from life; the living pictures were life posing as a study of itself, a truly *fin de siècle* conception. The moving pictures are wonderful reproductions of life on a screen. The spectators sit opposite what seems an ordinary magic lantern screen, and see thrown from the lantern, say, a country railway station. Gradually, before their eyes, a train steams up to the platform, passengers emerge, porters bustle about; the station gradually empties and the train is shunted out. The mechanism consists of an adaptation of series of consecutive, instantaneous photographs of moving objects. An account of the methods by which these may be taken is to be found in the treatises by Dr. Muybridge, and by Professor Marey (a translation of the latter's work having recently been issued by Mr. Heinemann, under the title "Movement"). The consecutive photographs are turned into lantern slides, and the novelty of the process consists in the adaptation of the movements of the lantern slides to the intervals of time that separated the actual events recorded on the different plates.

The Edinburgh Summer Meeting.

Although University Extension in general is on the wane, summer meetings in which instruction is tempered by excursions and amusements flourish exceedingly. We have received the programme of the Edinburgh Summer Meeting, to be held at University Hall, Edinburgh, from August 3 to 29. Professor Patrick Geddes and Mr. Arthur Thomson, who were the founders of the Edinburgh meeting, continue to be its guiding spirits. There are two features about the course which seem to us to distinguish it honourably among similar meetings. First, there is an attempt made to teach the natural and social sciences alongside each other. It is possible to suggest criticism, both of the practicability of this object and of the methods by which it is proposed to attain it; but we have nothing but praise for the synthetic spirit of philosophy that has ruled the drafting of the courses. In less than a month it were foolish to attempt detailed and isolated courses on special subjects; the holiday learners require, and are able to obtain, instruction in the methods of observation and instruction in the value of observation; they are taught why to see as well as how to see. Secondly, the international character of the programme is most noteworthy. There are lecturers from Scotland, England, and Ireland; but, in addition, Professor Wenley is coming from the University of Michigan; Messrs. Paul Desjardins and Elisée Reclus are to represent French and Belgian thought, while Professor W. Rein, of the University of Jena, is to give a course upon the Life and Doctrine of Herbart. This delightful international character of a Scots seminary is a return to the old academic traditions of Scotland, which gradually died after England enjoyed the advantage of the union of the crowns.

Economic Entomology.

Miss E. A. Ormerod's "Report of Observations on Injurious Insects during the Year 1895" well maintains the reputation of that indefatigable worker, who, year by year, sends forth clear and accurate descriptions and life-histories of the insect-ravagers of crops and trees with summaries of the best methods for fighting them. The most important feature of the present report is the account of the two-winged flies injurious to horses, cattle, and sheep. Though the work is intended for the "practical man," the "pure naturalist" will not turn its pages without profit. He will find, for instance, confirmation of the old observation that certain of the carnivorous ground-beetles (Carabidæ) occasionally forsake their predaceous habits to devour greedily roots and fruits.

I.

"Das Tierreich"

THIS proposed great work has been so much spoken about of late that a short account may be acceptable to our readers. The complete title is "Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft." It is to deal with all the species of animals, now living or extinct within historic times, that have received a recognisable description. Besides giving co-ordinated diagnoses of these, it will mention all insufficiently described and doubtful species, as well as sub-species and varieties, and will describe any important developmental stages, alternating generations, and specially remarkable biological relations (presumably this means cases of parasitism, symbiosis, and commensalism). Under each species will be given its geographical distribution, the most important literature relating to it, and a complete list of synonyms, so that no name that has been used in the binomial nomenclature of living species will be omitted. Besides the diagnoses of species, families, and higher divisions, there will be provided systematic synopses and practical keys for the determination of species. The unavoidable length of the work will be reduced, so far as possible, by the use of abbreviations, of which a list will be given with each division. The employment of it will be facilitated by systematic and alphabetical indices for each division and each larger group, as they are published, and for the whole work when it is completed.

The general editor of the work is Geh. Professor Franz Eilhard Schulze, of Berlin, associated with whom is a committee composed of the President for the time being of the German Zoological Society, and Professor Dr. K. Moebius. The general editor is assisted by sub-editors, to each of whom is assigned one main division of the animal kingdom. So far the following sub-editors have been appointed: Professor F. Blochmann, of Rostock, for Brachiopoda; Professor O. Boettger, of Frankfurt a/M., for Reptilia and Amphibia; Professor F. Braun, of Königsberg, for Platyhelminthes; Professor O. Bütschli, of Heidelberg, for Protozoa; Professor C. Chun, of Breslau, for Cnidaria and Ctenophora; Professor F. Dahl, of Kiel, for Arachnoidea; Professor C. W. von Dalle Torre, of Innsbruck, for Hymenoptera; Professor L. Doederlein, of Strassburg, for Mammalia; Professor E. Ehlers, of Göttingen, for Bryozoa; Dr. W. Giesbrecht, of

Naples, for Crustacea; A. Handlirsch, of Vienna, for Rhynchota and Neuroptera; Dr. W. Kobelt, of Schwanheim, for Mollusca; Dr. H. J. Kolbe, of Berlin, for Coleoptera; Dr. H. Krauss, of Tübingen, for Orthoptera; Professor R. Latzel, of Klagenfurt, for Myriopoda; Professor J. Mik, of Vienna, for Diptera; Dr. G. Pfeffer, of Hamburg, for Pisces; Professor A. Reichenow, of Berlin, for Birds; Professor F. E. Schulze, of Berlin, for Porifera; Dr. A. Seitz, of Frankfurt a/M., for Lepidoptera; Professor J. W. Spengel, of Giessen, for Vermes, excluding Platyhelminthes, and for Tunicata. These sub-editors will be assisted by specialists for the minor divisions, and among these there are announced the further names of Graf H. von Berlepsch, Professor R. Blanchard, Professor K. Brandt, G. Budde-Lund, Dr. O. Bürger, Professor G. Canestrini, Dr. E. Canu, Professor C. Emery, H. Friese, Professor A. Giard, Professor L. von Graff, E. Hartert, Pastor F. W. Konow, Professor K. Kraepelin, Professor P. Kramer, Dr. R. Lauterborn, Professor R. von Lendenfeld, Dr. H. Lenz, Dr. H. Lohmann, A. D. Michael, Dr. W. Michaelsen, Professor A. Nalepa, W. R. Ogilvie Grant, Dr. A. E. Ortmann, Dr. G. R. Piersig, Dr. L. Plate, Dr. R. Rhumbler, Dr. J. Richard, L. W. de Rothschild, Dr. F. Schaudinn, Dr. O. Schmeil, Dr. O. Schmiedeknecht, Dr. R. B. Sharpe, Rev. T. R. R. Stebbing, Dr. H. Uzel, Dr. W. Weltner, and Professor C. Zelinka.

To ensure that this array of contributors shall work on the same lines, a number of rules have been drawn up, which will no doubt be rigidly enforced by the editors. We have already commented upon the rules of nomenclature that are to be followed. For the denotation of colours, Saccardo's "Chromotaxia" is to be employed, except in such cases as more special terms may be advisable, *e.g.*, for the birds. The abbreviations of authors' names will follow that cryptographic production known as the Berlin Author-list. German is the language to be used, though English, French, or Latin may exceptionally be employed. German would be as good as any other language if only the Germans would use the Græco-latin technical terms that are used by all the other zoologists of the world; but if the contributors to Das Tierreich are going to continue to use ordinary German words, or, still worse, compound German words such as are given in no dictionary, for the technical terms of the science, then the adoption of this language will render the work far from popular among zoologists of other countries, and will materially detract from its value and its pecuniary success.

The size of the page to be employed is about 26 by 17 centim. (Lexicon 8vo). The paper has a rather smooth surface, is stated to be pure, and weighs eight sheets to the pound. The type is small pica for the diagnoses, and long primer (the type in which this article is set) for subsidiary information; it is set solid throughout. Hair-spacing, *italics*, and **clarendon** are used for distinctive purposes. Seeing that this work will inevitably run to an enormous size, and that its chief use will be as a book of reference, we should urge, if it be not too late, the employment of a rather smaller type (say long primer and brevier), so as to get more into a page, which everyone knows is a great advantage in books of this nature. We should also have thought that a paper of rather less weight, such as that used for the Oxford Bibles or Liddell and Scott's Greek Lexicon, would have had many advantages over the rather stout and heavy paper adopted.

The work will appear in a series of Lieferungen, each dealing with one or more closely connected groups. The sizes of the Lieferungen will necessarily vary, but it is not intended that they shall be less than three sheets. It is estimated that the Platyhelminthes will occupy 4 Lieferungen, the Crustacea 11, the Hymenoptera 13, the Mollusca 15, the Reptilia 3, and the Aves 16. Each Lieferung will be sold separately. Those who promise to subscribe to all that are published during a period of five years will receive them at a price of about 70 pfennige per sheet. The price of separately sold parts will be calculated at one-third higher. Each part will be printed and published as soon as ready, without any relation to systematic order. Notwithstanding this, it is expected that it will take twenty-five years to complete the work. It is intended that the first part shall appear at the beginning of 1897, and in case enough subscribers are obtained, there will be issued an edition on writing paper, as well as one printed on only one side of the page. Orders for the whole work or for separate parts should be sent as soon as possible to the publishers, R. Friedländer & Sohn, 11, Carlstrasse, Berlin, N.W.

As a specimen-part, we have received "Heliozoa bearbeitet von Dr. Fritz Schaudinn," 24 pages, 1896. This begins with a systematic table of contents. Then follows a list of the six abbreviations used in this part for morphological terms; these are: Ectpl. *Ectoplasma*, Entpl. *Entoplasma*, Ncl. *Nucleus*, Pls. Vac. *Pulsierende Vacuole*, Psdp. *Pseudopodium*, Vac. *Vacuole*. The abbreviations for references to literature follow those given in the *Zoological Record*, and a list is given of such works as are here referred to but not included in the *Record*. The description of the division Heliozoa occupies nearly a page and a half, or a page and two-thirds if one includes the drop at the head of the first page, a feature that might well be dispensed with in a book where space is so extraordinarily valuable. In this space are to be found: first, authorities for the name *Heliozoa*; secondly, a diagnosis of six lines, hair-spaced; thirdly, a further explanatory description of twenty-one lines, just such as one might find in any text-book of zoology; fourthly, a description of the various diagnostic characters used in delimiting the minor divisions, accompanied by ten small figures of spicules, and occupying twenty-nine lines; fifthly, a line of small type devoted to geographical distribution; sixthly, the numbers of the orders, genera, and species, a statement that families are impracticable, and the rejection of the Vampyrellidæ from the group, this all forms six lines of small type; lastly, a synopsis of the orders, in four lines of small type. Then follows the systematic treatment of the first order—Aphrothoraca, under which head are the authorities, a diagnosis, numbers of genera, synopsis, and key to genera. The genera of the order are then dealt with in similar manner, and lastly come the species, each with its references, synonyms, diagnosis, and distribution. The part concludes with an alphabetical index to all generic and specific names, synonyms being in italics.

The work appears to be clearly and carefully carried out, but one or two minor criticisms suggest themselves, mainly in the direction of the saving of space. Seeing that the abbreviations of morphological terms are explained under a boldly printed heading on p. 6, it was surely unnecessary to repeat them on p. 7. The word "in" could easily be omitted in such references as "Bory de St.-Vincent in: Encycl. méth., *v.* 2 p. 614"—a colon is quite enough. And surely t is unnecessary to give us the whole mouthful "Bory de St.-Vincent"; "B. de St.-Vincent," or "St.-Vincent" alone, is all that is needed, since the reference to Encycl. méth. prevents any possible ambiguity. Such an expression as "M. confluens Aim. Schneid. 1878 *M. c.*, Aimé Schneider," etc., also appears ridiculously lengthy. It will be noticed that Arabic figures only are used, and this necessitates the introduction of *v.* for volume, p. for page, t. for plate (Tafel), and f. for figure. All the abbreviations used are not explained, thus we find "Durchm.," "ca.," "L.," "Br.,"—of course these are readily intelligible to those accustomed to German systematic writing, but we are thinking of the others. The use of a | instead of a full-stop to separate clauses in the synonymic lists is to be commended. Some space is lost by the insertion of a rule and many leads between the orders; sufficient distinction would have been made by the use of small capitals for the ordinal names. It is a little odd that neither capitals nor small capitals are employed in any connection except as initials. It must, however, be admitted that the pages present a clear and pleasing appearance, and that the printing has been well executed by A. Hopfer.

Altogether the present part contains sixty species, both valid and doubtful. These, with their indices, but excluding the title-pages, occupy twenty pages—that is to say, three species go to a page. Now, since the number of recent species has been calculated at not less than 386,000, we may infer that "Das Tierreich" will occupy at least 128,700 pages. The length of the complete work, exclusive of the binding, will therefore be 12 metres 87 centimetres. The binding will bring it up to 13 metres, and this is no exaggerated estimate. Under these circumstances, we venture to think that every possible suggestion as to the means of reducing this enormous bulk is of value, and for this reason we have printed such suggestions as occur to us.

All success to Professor Schulze and his collaborators in their herculean task!

II.

Change in Zoological Nomenclature.

IN the discussion of this subject at the recent meeting of the Zoological Society a number of eminent and experienced zoologists, including Sir William Flower, who presided, expressed dissatisfaction with the law of priority in the application of generic and specific names. They pointed out that, as a matter of experience, the uniformity in the use of names which the law is intended to produce has not been secured; and they did not believe that in this respect the experience of the future would differ from that of the past. It was urged by the President that, however clear and distinct the adopted rules of nomenclature appeared to be, different interpretations would be given to them by different minds. Several speakers mentioned the inconvenience which is frequently caused, and from which probably all working zoologists have suffered, by the disinterment and resuscitation of an old and forgotten name, used perhaps only once, to replace some well-known name which has been employed in several standard works. One speaker condemned such a proceeding as a scientific crime, but we all know that it is often committed in the sacred name of priority by some of the ablest and most learned naturalists.

Two instances, which have recently made a painful impression on myself, may be mentioned. The most eminent English ichthyologists have given the generic name *Rhombus* to the turbot and brill, and *Pleuronectes* to the plaice, dab, flounder, and other species. Dr. Günther has adopted this nomenclature in his British Museum Catalogue, which is, I believe, the latest survey of the species of fishes of the whole world. But two American ichthyologists lately published a Revision of the Flounders and Soles of America and Europe in which they named the genus of which the turbot is type, *Pleuronectes*. The argument of the American authors is that, although the name *Rhombus* was first used by Cuvier to distinguish the turbot and brill as a sub-division of Linnæus's great genus *Pleuronectes*, it was not declared by him to be a generic name, and that *Pleuronectes* was first applied as a generic name in a restricted sense in Fleming's British Animals, to distinguish turbot and brill from sole and plaice. This shows that the application of the law of priority is not so simple as it seems, and may easily lead to quibbles. Moreover, these changes often involve others.

Another instance is that of the lobster. It was called *Homarus vulgaris* by Milne Edwards; *Astacus* is the genus including the fresh-water crayfish, and *Gammarus* is a common genus of Amphipoda.

But, according to Mr. Stebbing's recent volume on Crustacea, the proper scientific name of the lobster, according to the law of priority, is *Astacus gammarus*, Leach.

The law of priority appears to be a dead failure: it does much harm and probably no good. Are there, then, any principles to guide us in the use of binomial designations, or are we to come to the conclusion that the binomial nomenclature is a failure?

One of the chief objects of scientific nomenclature is to express the mutual relations of living beings. Our classification aims at expressing the natural affinities of species so far as we know them; and nomenclature is the language of classification. It is mainly for this reason that Latin names are wanted at all. The names "horse" and "ass" imply no proposition concerning the degree of resemblance between the two forms, or their degree of difference from other forms; when we call them both *Equus*, we imply that they both exhibit certain characters which we define as generic. Since classification is always changing, nomenclature must change too; and since students do not agree concerning classification, they must also hold different opinions on nomenclature. Therefore, the hope of fixity or uniformity in nomenclature is necessarily fallacious. But the principle that follows from these considerations is that no change of names should be made except as an expression of new propositions in classification. But it will be said, What are we to do with synonyms?—when there are several names for one species, which are we to choose? The answer is, Choose that which is associated with what you consider the most correct description and classification. For example, *Homarus vulgaris* has been used by the latest and best authorities on the systematic affinities of the lobster, and therefore should not be changed. To say that this is an injustice to Leach seems to me a mistake. Leach's fame or historical importance has nothing whatever to do with the retention of the name he used; and no man's fame or importance can be allowed to stand in the way of scientific progress or of the convenience of the investigators and students of the present day. Let the dead bury their dead! The first consideration is the salvation of the living.

It seems to me it must be recognised that the name of a species has no definite and precise meaning unless accompanied by the name of its authority, either expressed or implied. This is another reason why the law of priority is futile and superfluous. If we write *Astacus gammarus*, Leach, or *Astacus gammarus*, Stebbing, we designate the lobster, and anyone who wishes to know what we mean can find out by reading the definition and classification of Leach or Stebbing; but if we write *Homarus vulgaris*, Milne Edwards, we also indicate the lobster, with the great advantage that the reader can find out much more easily and completely the characters and affinities of the species in question. It should be understood, therefore, that by the name of the authority is meant, not necessarily the author who first gave the name, but the author whose diagnosis of the species is adopted by the writer quoting. In thousands of cases the name of a species without the authority for the name means nothing at all, because it may mean either of several species, or because there is no means of ascertaining what characters it implies. This only applies to names when simply quoted. If the name is given in a systematic revision with the diagnosis and description following, the name of the authority is of less importance, the writer is his own authority. There are many cases in which names are used without quoting the authority for them, because it is evident from the context, or it is understood, that the nomenclature of some standard work is followed. There are other cases, probably not very numerous, in which no authority is given, because the name is universally accepted, and any manual will supply the characters and position of the species; but, as a general rule, the name of an authority is necessary, and the most convenient practice is to give, not the name of the writer who first described the species, but of the writer who has made the most recent and accurate revision of its characters and position. In fact, in quoting, it does not matter what name we use, or whether we all use the same, provided that we use one by which the characters and affinities of the species designated can be ascertained with least trouble.

But up to the present only the citation of names has been considered; what are we to do about the giving of new names? It may be said that, if the first name has no more right than subsequent names, then there is nothing to restrain an author from giving his own names to species or genera already described, and so we shall have an endless multiplication of synonyms; but the reply to this is, that it should be a rule that no one should give a new name to a conception already named, and this rule would have as much force as the present rule of priority. The rule of priority does not prevent the describing of the same species under different names, and notoriously has not prevented the appearance of synonyms. If zoologists would be more careful to write diagnoses which were diagnostic, and descriptions which were intelligible, there would be less probability of the re-naming of species already described. There can be little doubt that the law of priority is a direct encouragement to careless and inadequate description, because workers are over-anxious to get their specific names published. If they knew that a name attached to a slipshod, obscure description was likely to be passed over and forgotten, and replaced by another given by a more careful worker, they would make less haste and more speed.

To sum up, the whole duty of systematists with regard to names is never to invent a new one or alter an accepted one, except to express a new conception. To resuscitate a forgotten name for a known form is as bad as to invent a new name for it.

J. T. CUNNINGHAM.

III

A New Method in Soil-Analysis.

IT is proposed in the present paper to give a brief account of an important memoir on soil-analysis, recently contributed by Dr. Bernard Dyer to the Chemical Society, which would otherwise be likely to escape the notice of readers of NATURAL SCIENCE. As everybody knows, there are certain chemical elements, such as nitrogen, phosphorus, potash, calcium, and iron, whose presence in the soil is an essential condition of plant-life; and, naturally, one of the first results of modern chemistry was an analytical examination of the various soils in order to determine in what proportions these constituents of plant-food were present, and, on the other hand, what soils—whether owing to exhaustion by long-continued harvesting, or to natural poorness and infertility—required the addition of manures.

At first, no doubt, the problem appeared delightfully simple and straightforward. With the methods of modern analysis it was easy to make very accurate examinations of the soil; and if phosphoric acid, for instance, were found in minute quantities only, clearly that soil would require dressing with phosphatic manures; while if, say, ·20 per cent. of phosphoric acid were present, it would stand to reason that the soil was in a fertile condition and required no application of manures. Unfortunately, however, like many other things that "stand to reason," this simple inference was often sadly at fault. For instance, as Dr. Dyer points out, it is very usual to find about ·15 per cent. of phosphoric acid in an average English agricultural soil; and this represents about two tons of phosphoric acid an acre distributed in the upper nine inches of soil alone, to say nothing of the supplies in the sub-soil, which, of course, are also utilised by the plants: yet, strange though it may appear, the addition of a few hundredweights of phosphatic manure to this soil, which contains already as much phosphoric acid as ten tons of bone-dust or seventeen tons of superphosphate, will result in a full crop of turneps instead of a bad one.

In the light of such experience it was soon recognised that the determination of the *total* phosphoric acid present in the soil, and soluble in mineral acids, was of almost no value as an index to the fertility; since it was clear that only a small unknown proportion of that present was in a condition available for the use of plants; and that proportion, until recently, we had no means of determining, although various attempts had been made to estimate it by extraction with acetic acid.

Passing over the long list of chemists, quoted by Dr. Dyer, who have worked at this difficult subject, and some of whom have more or less nearly anticipated him, we may point to the work of Stutzer as giving the key to the present inquiry. It had long been admitted that to determine the amount of available phosphates, in manures as in soils, digestion with strong mineral acids was useless; and the practice of extracting from manures with ammonium citrate had come largely into vogue, no doubt because the "precipitated" phosphates, which are known from experience to be largely available as a plant-food, had been found to be soluble in ammonium citrate. Against this practice Stutzer, however, strongly protested, and proposed instead the use of a 1 per cent. solution of citric acid as a solvent; and he showed that there was a considerable correspondence between the solubility of various phosphatic manures in citric acid and their availability for plant-food as tested by field-experiments. Unfortunately, however, Stutzer's solution was open to the objection that it was perfectly empirical; why should a 1 per cent. citric acid solution's dissolving power be an index to the amount of available plant-food? Here it is that Dr. Dyer steps in with a happy and original suggestion.

It had been known for long, in fact ever since Sachs' classical experiment of etching a marble slab by exposing it to growing roots, that the young roots excrete an acid liquid; and it was a fair inference that this acid excretion might be a means of bringing into solution otherwise unavailable constituents of the soil which would not dissolve in mere water. It therefore struck Dr. Dyer that, if one knew what percentage of organic acid was contained in this root-sap, it would be possible to place Stutzer's proposition on an altogether new footing. No data could be found in botanical works as to this acidity; and Dr. Dyer accordingly went to work to determine for himself the acidity of the root-sap in various plants. The work was by no means simple, and involved many difficulties of manipulation; but eventually a large collection of data was obtained. Since these data appear to be unique, and have a very wide scientific interest, it will be well worth while to extract the table entire. It will be unnecessary to trouble our readers with all the statistics collected by Dr. Dyer in his tables, and we will therefore be content with tabulating the acidity found in the roots in the moist (natural) state, (1) in terms of hydrogen, (2) in terms of crystallised citric acid. It will, of course, be understood that the acidity of the roots is not due solely, or necessarily even at all, to citric acid, but no doubt to a mixture of several acids; but for the practical purpose in hand it was convenient to calculate the determined acidity in terms of crystallised citric acid; the percentage in terms of hydrogen is, however, absolute, whatever be the acid. Thus, the formula of citric acid is COOH, CH_2, COH, COOH, CH_2, COOH + H_2O, molecular weight = 210; there are clearly three atoms of acid hydrogen present, therefore three of hydrogen correspond to 210 parts by weight of citric acid. Similarly, one part of acid hydrogen corresponds to sixty of acetic acid CH_3, COOH, or three to 180.

Plant.	Percentage of Acidity in Terms of Hydrogen.	Citric Acid.
RANUNCULACEÆ.		
Caltha sp. (Marsh Marigold)	·0116	·81
,, ,, ,,	·0113	·79
CRUCIFERÆ.		
Brassicæ—White Turnep (half grown)	·0087	·61
,, ,, ,,	·0083	·58
,, ,, (very young)	·0061	·43
,, ,, another year:—		
,, ,, "Bulb" (1 in. diam.)	·0066	·46
,, ,, (fine roots)	·0075	·52
Swede Turnep "Bulb" (3 in. diam.)	·0041	·29
,, ,, (fine roots)	·0054	·38
Field Cabbage (thick roots)	·0047	·33
,, ,, (fine roots)	·0084	·59
Garden Cabbage	·0100	·70
Brussels Sprouts	·0073	·51
,, ,,	·0081	·57
Broccoli	·0103	·72
,,	·0080	·56
Collards	·0064	·45
,,	·0091	·64
Rape	·0053	·37
Cochlearia armoracia (Horse-radish)	·0126	·88
Alyssum sp.	·0140	·98
,,	·0143	1·00
Cheiranthus cheiri (Wall-flower)	·0086	·60
,, ,, ,, ,,	·0111	·78
Matthiola sp. (Stock)	·0084	·59
,, ,,	·0084	·59
Lunaria biennis (Honesty)	·0120	·84
CARYOPHYLLACEÆ.		
Lychnis sp. (Scarlet)	·0096	·67
,, ,,	·0135	·94
Dianthus barbatus (Sweet William)	·0083	·58
,, ,, ,,	·0086	·60
TROPÆOLACEÆ.		
Tropæolum sp.	·0067	·47
LEGUMINOSÆ.		
Trifolium incarnatum (pot grown)	·0119	·83
T. repens (White Clover) (pot grown)	·0050	·35
,, ,, ,, (field grown)	·0143	1·00
T. pratense (Red Clover) (pot grown)	·0065	·45
,, ,, ,, (field grown)	·0157	1·10
Pisum sativum (Garden Pea) (pot grown)	·0043	·30
Vicia faba (Broad Bean) (pot grown)	·0072	·50
,, ,, ,, ,, ,,	·0072	·50
,, ,, ,, (field grown)	·0127	·89
ROSACEÆ.		
Geum sp.	·0527	3·69
,,	·0429	3·00
Fragaria sp. (Strawberry)	·0219	1·53
,,	·0217	1·52
ONAGRACEÆ.		
Œnothera biennis (Evening Primrose	·0220	1·54
,, ,,	·0220	1·54
UMBELLIFERÆ.		
Pastinaca sativa (Parsnep)	·0072	·50
Daucus carota (Carrot)	·0040	·28
Petroselinum sativum (Parsley)	·0077	·54
,, ,,	·0072	·50
Apium graveolens (Celery)	·0133	·93

Plant.	Percentage of Acidity in Hydrogen.	Terms of Citric Acid.
ARALIACEÆ.		
Hedera helix (Ivy)	·0098	·68
,, ,,	·0069	·48
DIPSACEÆ.		
Scabiosa sp. (Scabious)	·0052	·36
,, ,,	·0050	·35
COMPOSITÆ.		
Helianthus tuberosus (J. Artichoke)	·0080	·56
,, ,,	·0085	·59
Cichorium endivia (Endive)	·0062	·43
,, ,,	·0053	·37
CAMPANULACEÆ.		
Campanula sp. (Large Garden)	·0075	·52
,, ,,	·0062	·43
BORAGINACEÆ.		
Myosotis sp. (Forget-me-not)	·0116	·81
SOLANACEÆ.		
Solanum tuberosum (Potato)	·0041	·29
SCROPHULARIACEÆ.		
Veronica sp. (Speedwell)	·0119	·83
Digitalis purpurea Foxglove)	·0053	·37
,, ,,	·0061	·43
PRIMULACEÆ.		
Primula polyanthus	·0077	·54
,,	·0069	·48
PLUMBAGINACEÆ.		
Armeria vulgaris (Thrift)	·0230	1·61
,, ,,	·0196	1·37
CHENOPODIACEÆ.		
Spinacea oleracea (Winter Spinach)	·0089	·62
Beta (Sugar Beet)	·0059	·41
,, Red Chili Beet	·0071	·50
,, Yellow Chili Beet	·0053	·37
,, Red Mangold (pot grown)	·0083	·58
,, Orange Tankard Mangold (pot grown)	·0076	·53
,, ,, ,, ,, (field grown: bulb 2 ins.)	·0031	·22
,, ,, ,, ,, ,, ,, fine roots	·0054	·38
LILIACEÆ.		
Allium porrium (Leek)	·0027	·19
,, ,, ,,	·0023	·16
A. cepa (Onion) ,,	·0059	·41
,, ,, ,,	·0080	·56
GRAMINACEÆ.		
Alopecurus pratensis (Fox-tail)	·0049	·34
Phleum pratense (Timothy) (pot grown)	·0071	·50
,, ,, ,, (field grown)	·0073	·51
Poa pratensis (Smooth Meadow Grass)	·0037	·26
P. trivialis (Rough Meadow Grass)	·0069	·48
Dactylis glomerata (Cock's-foot)	·0069	·48
Cynosurus cristatus (Dog's-tail)	·0049	·34
Festuca heterophylla	·0076	·53
F. ovina (Sheep's Fescue)	·0040	·28
F. pratensis (Meadow Fescue)	·0079	·55
F. elaterii (Tall Fescue) (pot grown)	·0032	·22
Avena sativa (Oats)	·0061	·43
A. flavescens (Yellow Oat Grass)	·0084	·59
Hordeum distichum (Barley)	·0039	·27
Triticum (Wheat), "Rivetts"	·0041	·29
,, ,, Red Square Head	·0049	·34
Lolium perenne (Perennnial Rye Grass (pot grown)	·0043	·30
,, ,, ,, ,, (field grown	·0036	·25
L. Italicum (Italian Rye Grass (pot grown)	·0040	·28
,, ,, ,, ,, (field grown)	·0059	·41

Anyone looking down these tables will be struck by the wonderfully close agreement between the distinct independent determinations of the same species in many cases—an agreement that speaks volumes for the reliability of the data. In certain other cases, however, there is a wide and unfortunate divergence, mainly among the clovers; but since, in these cases, one duplicate was grown in a pot under the unhealthy conditions of a London roof, the small amount of acidity found is readily explained. We will not linger over these interesting tables, only drawing attention to the high acidity found in *Armeria*, *Œnothera*, and pre-eminently in the Rosaceæ —the last observation being one that may possibly be found hereafter to have important bearings upon fruit-culture.

Having obtained this mass of data, Dr. Dyer's next trouble was to decide what would be a fair general average to take as the strength of citric acid solution for his soil-extractions; and finally he decided to adopt Stutzer's original proposal of a 1 per cent. solution as a fair approximation to natural conditions. It was objected, in the discussion which followed the reading of his paper, that this was too strong a solution, since, according to his tables, the average acidity of the chief agricultural plants, viz., Cruciferæ, Leguminosæ, and Graminaceæ, was about ½ per cent.—that of the Graminaceæ being almost without exception below ½ per cent. There was much apparent reason in this objection; but it was almost met by experiments that Dr. Dyer had made on the solvent powers of various strengths of solution on the soils: the following figures, showing the percentage of phosphoric acid dissolved from the soil by citric acid solutions of various strengths, will illustrate our meaning:—

·125	per cent.	citric	acid	solution	dissolved	·0200	P_2O_5
·25	,,	,,	,,	,,	,,	·0250	,,
·5	,,	,,	,,	,,	,,	·0264	,,
1·0	,,	,,	,,	,,	,,	·0312	,,
2·5	,,	,,	,,	,,	,,	·0728	,,
5·0	,,	,,	,,	,,	,,	·0896	,,

It is obvious that the difference between the solvent powers of a ·5 and a 1·0 per cent. solution is small; and this fact much diminishes the weight of the objection. Moreover, any agricultural analyst, with Dr. Dyer's data before him, could adapt his solutions so as to correspond exactly with the acidity of the crop which it was proposed to grow on any particular soil.

We must now proceed very briefly to indicate the happy verification of these conclusions that Dr. Dyer was able to obtain. Everybody has heard of the Rothamstead experiments, and knows that for over fifty years various plots of land there have been treated in every imaginable way as regards manures and crops, and complete histories of every plot preserved. Samples of these soils were placed at Dr. Dyer's disposal by Sir J. Lawes; and their analytical examination by the new method conclusively showed that the amount of phosphoric acid dissolved by a 1 per cent. citric acid solution was a fair index to the amount of available phosphoric acid and potash contained in the soil. It is somewhat difficult to exhibit in its cogency the evidence for this conclusion without going far beyond the limits of our space; but we will endeavour to put the matter clearly before our readers in a few words. Certain plots have been manured completely, and parallel plots in exactly the same way but with no phosphates. The latter contain 2,730 lbs. per acre of $P_2 O_5$, and the former 4,544—a difference of less than 1 : 2; but the amounts of $P_2 O_5$ soluble in citric acid are respectively 237 lbs. and 1,259 lbs.—a difference of nearly 1 : 6. From these facts Dr. Dyer infers that the amount of available plant-food is nearly six times as great in the second case as in the first; and turning to the Rothamstead records we find that the respective yields of barley in 1890 were $38\frac{5}{8}$ and $24\frac{3}{8}$ bushels an acre—a grand difference truly! Yet the determination by the old style of merely the *total* phosphoric acid present would have told us absolutely nothing; for, as Dr. Dyer says, "the difference between 2,500 lbs. of total $P_2 O_5$, and 4,500 lbs., per acre appears to be immaterial as a measure of present fertility for a crop that requires *only* 20 *lbs.* per annum for its actual sustenance"! This single example will suffice to explain to our readers the revolution effected by the citric acid test in soil-analysis—one of the most important factors in that scientific farming by which alone we can expect to get the full benefit of Mother Earth's capabilities. We will not yield to the temptation to multiply technical examples nor to adduce the parallel evidence from the estimations of potash in the soils—contenting ourselves with only quoting Dr. Dyer's guarded opinion that soils containing less than ·01 per cent. of $P_2 O_5$, or, perhaps, ·005 per cent. of $K_2 O$, soluble in a 1 per cent. citric acid solution, stand in immediate need of phosphatic or potash manures.

To sum up the *differentia* of Dr. Dyer's work. He has applied Stutzer's process of analysing manures to the analysis of soils, and has placed this purely empirical method upon a sound botanical basis; he has then verified it by a laborious analysis of numerous Rothamstead soils, the history of the crops from which entirely bears out the inferences drawn from his analytical examinations. We may add that Dr. Dyer has since employed his new method in investigating the available phosphoric acid and potash in the Rothamstead wheat-soils, and expects shortly to publish his results, which are awaited with much interest.

F. H. PERRY COSTE.

IV.

Museum Work in Jamaica.

NOTWITHSTANDING all the criticisms which have appeared, from time to time, in NATURAL SCIENCE upon the aims and objects of museums, there are very few which throw much light upon the claims which a museum in any one of our smaller British Colonies has upon its curator.

In a provincial museum at home he is advised to make local collections and illustrations his main object, leaving for those of the metropolis and a few of the largest cities the additional responsibility of attempting to represent the more complete series of the world's typical animal and vegetable forms. Here, however, one has the duty of the provincial with the responsibility of the national to combine. So far as practical acquaintance with nature is concerned, Jamaica, to the majority of its inhabitants, is the universe, hence to represent in its museum only objects of local importance is to insulate the already inexperienced mind still further. Undoubtedly, in the cause of science, the first object of such a curator should be to obtain the fullest representation possible of the local fauna and flora, and in the next place to endeavour to supply foreign forms for purposes of more complete exemplification and instruction.

Again, in most institutions it is considered sufficient for a curator to confine himself to the acquisition, arrangement, and study of specimens; leaving the teaching of their lessons, the stimulation of the interest of the public and the student in natural history, and the guidance of the original worker, to the professors and staff of some teaching organisation. Here, however, to the duties of one's appointment are added, "the delivery of lectures, the stimulation of original scientific research, and the taking of such steps as may be necessary to best advance the scientific interests of the island." When, added to this, he is the main recognised authority upon the applications of science to economical questions, the qualifications necessary to the training of a curator for a colonial museum evidently require much consideration.

The Museum in Jamaica is one of the components of the Institute of Jamaica, an organisation existing for the advancement of Literature, Science, and Art in the island; and embracing also a well-established Public Library and Reading Room and an embryonic Art Gallery. It is managed by a Board of Governors, and practically the whole support is derived from the Legislature. Members are elected with certain privileges, and Members' Meetings are held. A journal devoted to the special objects of the Institute is published at intervals. Courses of public lectures on science and literature, on the lines of the University Extension courses in England, are arranged from time to time.

Up to the present the literary side of the Institute has flourished, to the disadvantage of the scientific. Now, however, vigorous steps are being taken to secure full recognition of the latter. On November 27, 1895, a new Museum, more adapted to the special requirements of suitably exhibiting objects, was opened under favourable circumstances. In view of some important anthropological discoveries recently made in the island, connected with the aboriginal Indian inhabitants, advantage was taken of the opening of the new Museum to stimulate further interest and researches in the subject. An anthropological exhibition devoted to Arawak remains was organised, and has proved a great success in encouraging investigations of the numerous caves and various deposits which are to be found in the island. Several series of aboriginal crania and other bones have been obtained; numerous examples of pottery, chipped flint and other stone implements, images, perforated shell ornaments, rock carvings, and several series of shell-mounds or kitchen middens have been brought to light; when their investigation, now in progress, is complete, these will form a very important contribution to the previously neglected anthropology of Jamaica. During the special exhibition, public demonstrations are being given upon the collections, especially to the teachers in the training colleges, with a view to direct and encourage research throughout the island.

Placed in the Museum, and arranged according to the parishes into which Jamaica is divided, are the valuable collections made by the officers of the Government Geological Survey under J. G. Sawkins, F.G.S., in 1869, with the corresponding geological maps and sections placed above the cases.

The palæontology of Jamaica was partially worked out by Mr. R. Etheridge, F.R.S., when he was Palæontologist of the British Survey; while the late Dr. Duncan has done much upon the fossil corals, and Mr. Guppy upon the shells. Professor Grenville A. J. Cole, Dublin, is at present engaged upon specimens of Jamaican rocks. With this exception practically no geological work has been done since the time of the survey.

The representatives of the fauna and flora of Jamaica are presented in very variable conditions of completeness. While the birds, reptiles, fishes, molluscs, and insects are well represented, other groups, especially the marine invertebrates, are sadly deficient.

The collection of birds contains many interesting specimens, including the three characteristic species of humming-birds. Jamaican birds have been collected and studied more specially by Mr. P. H. Gosse (1847) and Sir Edward Newton. The collection formed by the latter, while Governor of the island, is in the museum at Cambridge, England.

Jamaica possesses only one indigenous land mammal, *Capromys brachyurus*, Hill, with the exception of the bats, of which there is a rich variety. Four species of snakes, twenty-two species of lizards, and several species of tortoises and turtles occur, while the crocodile is not uncommon. Over three hundred species of fish are known. A few live specimens of the most suitable animals are also exhibited in the grounds of the Institute.

A Herbarium of Jamaican plants, formed by Mr. Fawcett, the Director of the Botanical Gardens, is maintained; as also a duplicate of the Jamaica Court at the Imperial Institute, London, for purposes of reference.

The introduction of the mongoose into the island, about twenty years ago, for the purpose of destroying the sugar-cane rat, has very seriously disturbed the previous balance of nature among the various land animals and plants.

In almost every department of biological enquiry Jamaica and the West Indies generally offer a very rich, but only partially investigated, field for research. A vigorous attempt was made a few years ago to form a marine laboratory upon a large scale, with the special object of affording facilities to foreign biologists in studying tropical life, but unfortunately the scheme fell through, largely because of its too ambitious nature.

A biological laboratory with most modern appliances for carrying on scientific research, and a dark room for photography, have lately been fitted up in connection with the Museum. What with constant and regular intercourse with the outer world by means of various lines of steamers, a library furnished with most of the European and American publications, a laboratory, constant communion with professional men trained in England and America, one feels none of the insulation which might be imagined to exist in such a distant colony; while the varied richness and luxuriance of the tropical land and waters add a completeness to the biologist's conception of life not otherwise attainable.

J. E. DUERDEN.

V.

Reproductive Selection.[1]

(1) In a recent memoir ("Contributions to the Mathematical Theory of Evolution, III. Regression, Heredity, and Panmixia," now in type for the *Philosophical Transactions*) I have found it necessary to note the difference in mean and variation of a population when (*a*) the individuals of a sex are taken into account *once* as mates, (*b*) when the individuals of a sex are treated as parents or weighted with their fertility. The mean and variation of the population are supposed to be taken with regard to any organ whatever. If such a difference is found to exist between the variation curves for mates and for parents, then there is a correlation between fertility and the organ (or characteristic) measured. Under the action of heredity there will accordingly be a progressive evolution in this organ, unless this evolution be checked by some other factor of progressive change, *e.g.*, natural selection. In my memoir I term this factor of progressive evolution *Reproductive Selection*.[2] Without wishing at present to publish my complete work on this subject, I should like to put on record the following conclusions already reached:—

(2) Let any organ in individuals of one sex be selected, and let y be the fertility of an individual, whose organ differs x from the mean organ of all mated individuals. Let M_m be the mean organ for all mates,[3] M_p be the mean organ for all parents, *i.e.*, a mate reckoned

[1] A Contribution to the Mathematical Theory of Evolution, read before the Royal Society on March 5.

[2] The influence of variation in fertility has been considered by Mr. Romanes under the title of 'Physiological Selection,' but the idea he expresses by this term appears to me very different from that of reproductive selection. In mathematical language, Mr. Romanes supposes the fertility curve and the correlation surfaces, owing to some cause or other, to become double-humped; they may accordingly be resolved into two components, each corresponding to a distinct species. Physiological selection thus aims at an explanation of the origin of species. Reproductive selection supposes the fertility curve and correlation surfaces to embrace only homogeneous material, and it can accordingly never give rise to a new species; it is purely a source of progressive change in the same species. The only approach to a double hump which occurs in the curves of human fertility that I have dealt with is a secondary maximum at absolute infertility, due in all probability to artificial restraint on fertility. As those couples who fall into this component leave no offspring, they cannot give rise to a new species.

[3] If there be preferential mating, M will not be the mean organ for all individuals. I have adopted the mate mean in order to free the investigations from the influence of this portion of sexual selection.

once for each offspring. Let M_0 be the mean of the offspring for the same or any other organ, taking one or any other number equally from each mated individual; let M_1 be the mean of all offspring. Let σ_m, σ_p, σ_0, σ_1 be the corresponding standard deviations, reckoned from the formula: σ^2 = (sum of squares of deviations) ÷ (number of individuals), and without regard to any special law of variation, such as Laplace's law of errors.

Let r_0 be the coefficient of correlation between parent and offspring, each parent being given only one or, at any rate, an equal number of offspring, *i.e.*, r_0 is the coefficient of pure heredity for the organs in question, supposing fertility to be uniform, or at any rate to have no correlation with the organ or characteristic under investigation. Let ρ be the correlation between fertility and the given organ in the parent, and let v equal the coefficient of variation of fertility in the parent, *i.e.*, if y_m be the mean fertility: $v = \sigma_f / y_m$, where σ_f is the standard deviation of parental fertilities. Let $y' = y - y_m$ be the deviation from mean fertility of the parent with organ x. The values of r_0 and ρ are to be calculated from the formulæ—

$$r_0 = \frac{\text{Sum of (deviation of offspring} \times \text{deviation of parent)}}{\text{Number of pairs of offspring and parent} \times \sigma_0 \times \sigma_m},$$

$$\rho = \frac{\text{Sum of (deviation of mate} \times \text{deviation of mate's fertility)}}{\text{Number of mated pairs} \times \sigma_m \times \sigma_f},$$

where, in r_0, each parent is to be taken only once, or at any rate the same number of times.

Thus r_0 and ρ are absolutely independent of any special distribution of variation.

Then the following results hold if n be the number of mated pairs:—

$$M_p = M_m + \rho v \sigma_m \qquad \text{(i).}$$

$$\sigma^2_p = \sigma^2_m (1 - \rho^2 v^2) + \frac{S(x^2 y')}{n y_m} \qquad \text{(ii).}$$

$$M_1 = M_0 + r_0 \rho v \sigma_0 \qquad \text{(iii).}$$

$$\sigma_1^2 = \sigma_0^2 \left(1 - r_0^2 + r_0^2 \frac{\sigma_p^2}{\sigma_m^2}\right) \qquad \text{(iv).}$$

The first three equations are true whatever be the distribution of variation in mates, parents, offspring, and fertility; the fourth equation assumes the standard-deviation of a fraternity or an array of offspring to be $\sigma_0^2 (1 - r_0^2)$. This result would flow for normal correlation between organs in parent and offspring, a type of correlation which holds closely for inheritance in the case of man. It would also flow from *any* law of variation which gave a constant coefficient of regression and a constant standard deviation for the array. What, however, is the important point is this, that no assumption has been made with regard to the nature of the fertility correlation. This is essential, as in the case of man this correlation is certainly, like the distribution of variation in fertility, markedly skew and not normal in character. Our equations accordingly amply cover facts, which they could not cover had they been based solely on the usual or normal theory of correlation.

(3) By simply forming the means for any organ (or characteristic) for mates and for parents, we can ascertain from Equation (i) if there is or is not any sensible correlation between that organ (or characteristic) and fertility. Equation (ii) enables us to verify the value found for ρ, since σ_p and σ_m are easily calculated when we know the distribution of fertility. If the correlation were normal $S(x^2y')$ would be zero, and this term, it may reasonably be expected, will never be very large. When ρ has been found from Equation (i), then Equations (iii) and (iv) give us $M_1 - M_0$ and $\sigma_1 - \sigma_0$, or the measures of reproductive selection in its action on the mean and variation of successive generations.

(4) I have applied these results to the only case—that of man—in which statistics are at present available.

I find for upwards of 4,000 families, principally of Anglo-Saxon race, $v = 0{\cdot}692$, and for 1,842 families of Danish race, $v = 0{\cdot}652$. This, considering difference of race, is a very satisfactory agreement. In the next place, there appears to be a significant difference 0·278″ between the mean height of mothers of daughters and the mean height of wives. Thus, we have $\rho v \sigma_m = 0{\cdot}278''$, and since $\sigma_m = 2{\cdot}303''$, it follows that $\rho v = 0{\cdot}121$. Now, the coefficient of variation for fertility in daughters is not quite the same, but still very nearly the same as that for fertility in general. We therefore find that $\rho = 0{\cdot}175$ to $0{\cdot}186$, according as we use the first or second value of v given above. We may accordingly conclude that there is a sensible correlation (*circa* 0·18) between fertility and height in the mothers of daughters.

Turning now to Equations (iii) and (iv), I note that r_0, σ_0, and r_0^2 are multiplied by the small quantities ρ and $1-(\sigma_p/\sigma_m)^2$, and that r_0 and σ_m only differ from r_p and σ_p by quantities of the order ρ. Hence, neglected to a first approximation ρ^2, we can use the value r_p, already known, for r_0 in (iii) and (iv) and the value σ_1, already known for σ_0 in (iii), we thus deduce—

$$M_1 - M_0 = 0{\cdot}081''.$$

$$\sigma_1 - \sigma_0 = -0{\cdot}008''.$$

These are the effects of reproductive selection on the height of women. We thus see that the effect is to render women less variable, and to raise their mean height. The quantities are very small, but it must be remembered that the process is secular. Thus, supposing reproductive selection to have been unchecked by natural selection, say, for forty generations, the mean height of women, neglecting small quantities of the second order, would have been raised about $3\frac{1}{4}$ inches. A factor which would alter stature by about 3 inches in 1,000 years is clearly capable of producing very considerable results in the long periods during which evolution may be supposed to have been at work. In the case of both mean and standard deviation the changes from wives to daughters (0·25″ and 0·044″) are, in the only statistics at present available, far more considerable than the above values; but it must be remembered that other causes than reproductive selection are at work, such as shrinkage with age and the greater physical training of the young women of to-day.

(5) I have only been able to measure, so far, the actual value of the correlation between fertility and any organ in the case of stature in women. It would, doubtless, be more sensible in other cases, *e.g.*, pelvic measurements. But there are certain considerations which may be referred to here, and which will suggest how important—at any rate in the case of man—it is to take into consideration the influence of reproductive selection.

From considering the fertility of man, in England and in Denmark, I conclude that 25 per cent. of the mated population produce one-half the next generation. This is the gross fertility. Allowing for the selective death-rate—which I knew only for Denmark—27 per cent. of the mated population produced half the next generation. In other words, although natural selection tends to counteract reproductive selection by a death-rate which, it may be shown, rises continuously and uniformly with increased fertility, yet, in the case of civilised man, it is totally ineffectual as against reproductive selection. If we allow for the portion of the population which remains unmarried, we are well within the mark if we say that less than 25 per cent. of one generation produce more than half of the next generation. Correlation, therefore, between fertility and any mental or physical characteristic must work a progressive change.

We know that there are very considerable race and class differences in the matter of fertility. It is very difficult to understand how these could have arisen by the action of natural selection combined with heredity, unless either (1) fertility be inherited, or (2) fertility and some inherited mental or physical characteristic be correlated. But either (1) or (2) involves reproductive selection. We have seen that there is evidence of correlation between the stature of women and their fertility. There is also evidence of a correlation between fertility and class. Taking Copenhagen, for which alone we have satisfactory class-fertility statistics, it is possible to show:—

(i) That the gross fertility of the artisan is more than the gross fertility of the professional classes.

(ii) That the net fertility of the artisan is less than the net fertility of the professional classes.

Thus natural selection, at first sight, checks reproductive selection, greater fertility connoting a greater death rate; but we find:—

(iii) That the marriage rate of the artisan is so much higher than the marriage rate of the professional classes that the percentage fertility of the former considerably exceeds that of the latter.

Thus, while a selective death rate checks reproductive selection as between class and class, a selective marriage rate, again, places reproductive selection at an advantage as compared with natural selection; the population would accordingly appear to be ultimately, and in the long run, reproducing itself from the artisan classes.

I hope, later, to publish the analysis, curves, and statistics on which these conclusions are based; at present I only wish to draw attention to the general result: that reproductive selection—at any rate in civilised man—seems a factor of evolution equipotent to natural selection, if, indeed, it be not prepotent.

KARL PEARSON.

VI.

Lyell and Lamarckism.

A Reply to Professor W. K. Brooks.

PROFESSOR BROOKS, in Natural Science for February, p. 89, has informed us that Romanes was mistaken in including him among American Lamarckians, and has at the same time explained why he considers Lamarckism untenable. His reasons do not appear to me adequate, and although I can scarcely hope to induce him to alter his intellectual position, I desire to ask the attention of other biologists to the following criticism of his arguments.

He believes, apparently, that his objections are essentially those expressed by Lyell in his "Principles of Geology," published long before Darwin's theory was made known. It is true that Lyell was unconvinced by Lamarck, but convinced of the truth of evolution by Darwin. Brooks maintains that Lyell's objections to Lamarck's particular views still remain unanswered, and supposes, if I understand him rightly, that his article merely recapitulates and expounds Lyell's arguments. Careful consideration of the article leads me to conclude, first, that Brooks's arguments are not those of Lyell, and, secondly, that they are not sound. I will give my reasons for these conclusions in their order.

According to Professor Brooks, Lyell proved that the effects of the environment were not inherently adaptive, and therefore, whether inherited or not, could not be accepted as the cause of the evolution of adaptations. After perusal of Lyell's reply to Lamarck's views in the "Principles of Geology," I fail to find any indication of this proposition. The general tenor of Lyell's argument, as I understand it, is that the environmental forces may and do produce results some of which are adaptive, and which do become hereditary, but that the departure from the specific type so caused is definitely limited; and that the capacity for change within these limits is merely a fixed property of the species, which, like other specific properties, is immutable in its extent. The importance of the question is sufficient justification for quoting in full Lyell's own summary of his arguments. It is as follows:—

1. "There is a capacity in all species to accommodate themselves, to a certain extent, to a change of external circumstances, this extent varying greatly, according to the species.

2. "When the change of situation which they can endure is great, it is usually attended by some modifications of the form, colour, size, structure, or other particulars; but the mutations thus superinduced are governed by constant laws, and the capability of so varying forms part of the permanent specific character.

3. "Some acquired peculiarities of form, structure, and instinct, are transmissible to the offspring; but these consist of such qualities and attributes only as are intimately related to the natural wants and propensities of the species.

4. "The entire variation from the original type, which any given kind of change can produce, may usually be effected in a brief period of time, after which no further deviation can be obtained by continuing to alter the circumstances, though ever so gradually; indefinite divergence, either in the way of improvement or deterioration, being prevented, and the least possible excess beyond the defined limits being fatal to the existence of the individual.

5. "The intermixture of distinct species is guarded against by the aversion of the individuals composing them to sexual union, or by the sterility of the mule offspring. It does not appear that true hybrid races have ever been perpetuated for several generations, even by the assistance of man; for the cases usually cited relate to the crossing of mules with individuals of pure species, and not to the intermixture of hybrid with hybrid.

6. "From the above considerations it appears that species have a real existence in nature; and that each was endowed, at the time of its creation, with the attributes and organisation by which it is now distinguished."

I think there can be no dispute, with this summary before us, that Lyell's objection to Lamarck's views was, not that the effects of the environment were non-adaptive, but that they were permanently limited in extent. The doctrine of the fixity and essential immutability of species having been abandoned, as it ultimately was by Lyell, it follows that, in the judgment of both Lyell and Darwin, there was no ultimate limit to the extent of adaptive and hereditary modification that could be produced directly by changes in the environment.

Professor Brooks's argument having been shown not to have the authority of Lyell, which he claims for them, we will proceed to consider them on their own merits. He takes the case of the strengthening of muscles by exercise, which he admits to be an adaptive, *i.e.*, a beneficial, change in relation to the conditions calling it forth, "one of the simplest examples of the beneficial effects of the conditions of life." But this, he tells us, is not an example of the direct action of the environment on the organism. On the contrary, the increase and improvement of the muscle are due to the increased supply of nourishment produced by exercise; and the fact that exercise causes an increased circulation of blood in the muscle depends upon structural adjustments, which themselves constitute an adaptation, originally, I suppose, due to congenital variation and selection. Now I think it may well be held that the supply of nourishment is not the same thing as assimilation and growth; and the assimilation and growth of the muscle under stimulus must be ascribed to a fundamental property of protoplasm, which it is not the business of Lamarckians or evolutionists of any other school to explain. But, apart from this, let us consider how far back in the phylogeny of vertebrates we must go to find the origin of a circulatory system; and consider that, from this point onwards, if changes in the locomotor system are due to the use and disuse of various parts of this system, and are inherited, then there is practically no limit to the variety and perfection of the adaptations in the locomotor system which can be explained by the Lamarckian factor. If selection produced in the remote ancestor the circulation and the structural arrangement by which muscle (and, of course, bone and other connective tissues and nerves) received increased supplies of blood when exercised, then it would require to produce nothing else to account for such adaptations as the neck of the giraffe, the various arrangements of the toes and limbs in ungulates, the peculiarities of the legs and skeleton in man which enable him to maintain the erect attitude, the form of the pectoral muscles and sternum in flying birds, the absence of the keel on the sternum in ostriches, the peculiarities of the tongue and hyoid bone in woodpeckers, of the beak in crossbills, and thousands of other mechanisms, all consisting in adjustments of muscle, bone, and nerve.

Professor Brooks next proceeds to argue that organs are only improved by normal or natural use, and that only with this limitation is use beneficial. "The ways to use a muscle are few, while the ways to abuse it are innumerable, and the inheritance of *all* the effects of the conditions of life must lead, not to 'cumulative adaptation,' but to cumulative destruction"; but no Lamarckian supposes that the action of the environment is necessarily beneficial. It would be interesting to know what meaning Professor Brooks attaches to the words "the ways to abuse a muscle are innumerable." To myself they are unintelligible. A muscle can be used, disused, or over-exerted—in fact, there is only one way to use it, and that is to contract it. Excessive strain which does not cause development and increase of the muscle must lead to injury and ultimately to the death of the organism. Disuse leads to degeneration. Degeneration is not necessarily beneficial, but it is included in the conception of adaptation, and it may be beneficial in relation to the adaptation of the whole organism to a new mode of life. The case of a herd of antelopes hunted by carnivores will illustrate the different points of view of the Lamarckian and the selectionist. Certain individuals, we may suppose, are caught and killed, others may escape and die of fatigue or an over-strained heart, while the rest escape and recover their strength. The fact that some are killed is in no way inconsistent with the fact that the survivors are improved with respect to the muscles and bones on which their running powers depend. It may even be that the persecution is so great that the constitutions of the whole herd are injured, their progeny are not sound, or are weaker, and the result is extermination; but the inheritance of *all* the effects of the conditions of life does not always lead to cumulative destruction; if it did, there would be nothing left alive, and the statement that on Lamarckian principles it would, is equivalent to saying that the conditions unfavourable to life are, on the whole, more powerful than those which are favourable, a statement we know to be untrue. What Lamarckians contend is, that the conditions of life kill a large number of individuals and modify those which survive; that the struggle for existence not only involves the survival of the fittest, but the formation of the fittest. Professor Brooks's argument shows that he has quite failed to understand the Lamarckian view, and suggests strongly that he has never tried to do so.

Professor Brooks maintains that the structural changes associated with mental development are also, like the modification of muscles, dependent on structural adjustments for bringing about this development, and that the effects of the environment which are not "already deducible from adaptive structure, must be haphazard." But we are not told what are these other effects of the environment. The effects which are stated by Brooks to be dependent on pre-existing capacities are those which Lamarckians have chiefly in view. The others, it is said, must be haphazard because they are not proved to be beneficial. Now, to take an example, the excessive consumption of alcohol is not beneficial, but are its effects therefore haphazard? It does not follow that, because the effect of a given condition is not beneficial, therefore it must be indeterminate. On the contrary, science is founded on the conclusion, drawn from experience, that the same conditions always produce the same effects, and that is all that Lamarckians contend for.

We see, then, that Brooks's objection to Lamarckism, so far as the effects of use and disuse are concerned, is that such effects are due to structural arrangements already existing for the local increase or decrease in the supply of the nutritive fluids, or blood, and that Lamarckism does not explain these structural arrangements. We have seen that, if this objection were valid, Lamarckian effects would explain all the modifications in animals which have taken place since they had a circulation. But we have seen also that the objection is fallacious, because the supply of nourishment does not necessarily imply assimilation and growth, which are the results of stimulation. The effects of a profusion of nourishment and absence of stimulation are sufficiently notorious in the phenomena of parasitism. Is Professor Brooks unaware that Lamarckism extends to plants, and if not, can he suggest that the modification of flowers by the irritation due to insects depends on structural arrangements for the supply of nutrient fluids?

Professor Brooks has misinterpreted in the most astonishing manner one statement of Romanes, that "no question of value, as selective or otherwise, can obtain" in the case of Lamarckian factors.

He cites this as an admission on the part of Romanes "that it is, to say the least, no better than an even chance whether their influence be good, bad, or indifferent." What Romanes means is that it does not matter how slight the adaptive effects of the conditions may be; if they are inherited at all, they will be present in all the individuals exposed to the conditions, and will be increased in every generation; whereas before a variation can be selected, it must be supposed to have 'selection value'—that is, must be large enough and important enough to give a better chance of life and reproduction to its possessor than other individuals have. This is one great advantage of the Lamarckian theory, that a character which is constant in a whole species may be explained without assuming that it is either of selective value, or correlated with something of selective value. In fact, the idea of advantage or benefit to the organism belongs essentially to the selectionist view. All that the Lamarckian requires is that certain effects which he sees to be produced in the individual by response of living units to stimulation shall be cumulative, and then the modifications which we know to have occurred must necessarily follow. The effects of stimulation in its widest sense may be life-preserving or life-destroying; the hypothesis is that they are definite and cumulative.

Where the question of chance or fortuitous variations comes in I fail to understand. It is notorious that the selection theory assumes the occurrence of fortuitous variations, although with the understanding that fortuitous means unexplained only. But the assertion that the effects of conditions on the individual, or acquired characters, which alone I have considered in this article, are fortuitous is simply a contradiction of universal experience.

We find, therefore, on careful analysis, that Brooks conceives the effects of environment on the individual to be of two kinds; first, the kind of which the enlargement of a muscle by exercise is an instance, and, secondly, the others. Those of the first kind are due to structural adjustments for bringing them about. According to the Lamarckian view, all adaptations, at any rate all adjustments concerning whose action and efficiency there is no dispute, have arisen in the same way as the enlargement of a muscle by exercise; and the assertion that structural adjustments for rendering them possible exist in organisms is just what Lamarckians contend. Therefore, on this point Brooks agrees with Lamarckians; but whereas he supposes that these structural adjustments have to be explained, Lamarckians believe that they are merely the fundamental properties of protoplasm, namely, irritability and the power of assimilation and reproduction. The 'other' effects of conditions are those which confer no particular benefit on the organism. To take a trivial instance, a young man who takes to an open-air colonial life develops muscles and skeleton and senses to such an extent that he can ride, shoot, and work with marvellous skill and endurance. At the same time his skin is tanned brown by the sun. The former changes are adaptive and beneficial; the latter would not usually be called an adaptation, though it may on investigation be found to be beneficial. It is an instance of the 'other effects' of the environment, and is obviously not haphazard, but definite and constant. Brooks asks if there is any evidence that the effects of the environment are inherently beneficial, and the reply is shown by the above considerations to be that, whether beneficial or not, the same conditions acting constantly produce a definite effect. We are here considering, not congenital variations—those which, like a supernumerary digit, arise in a single individual without obvious relation to the conditions of life—but exclusively the effect of external conditions on the individual during life.

Brooks thinks that natural selection, if it act at all, must result in adaptation, and that therefore it is a much more plausible theory than the Lamarckian. But this is begging the question: natural selection means the survival of adaptive variations, and the question is the origin and cause of such variations. Lamarckians do not admit that such variations have been proved to occur without the direct action of the conditions of life; therefore to assert that natural selection must produce adaptation is to assume the very proposition in dispute. Even if it were proved that the variations were independent of the conditions of life, the mere selection of them in itself would not be an explanation; we should still want to know the true causes of them.

J. T. Cunningham.

SOME NEW BOOKS.

Agassiz.

Life, Letters, and Works of Louis Agassiz. By Jules Marcou. 8vo. Two vols. Pp. xxii., 302, and x., 318, with vi. pls. New York and London: Macmillan & Co., Ltd., 1896. Price 17s. nett.

For the writing of this biography Mr. Jules Marcou has many qualifications. As a compatriot of Agassiz in both Old and New Worlds, as an intimate acquaintance and occasional collaborator, he stands throughout on familiar ground. The French writings of Agassiz of course present no difficulty to him, while his mastery of English is remarkably exemplified in the fluent pages of the work itself—one or two mis-spellings, and the use of "editor" in one instance where "publisher" seems to be intended, are the only gallicisms that have caught our eyes. But it is still more important that, to a knowledge of the facts, Mr. Marcou adds a singularly outspoken nature. This, and the lapse of time, enables him to refer to passages in the life of Agassiz that were slurred over by previous biographers. We will not go so far as to say that there are none living who will be offended by Mr. Marcou's remarks, but his attacks are fairly impartial and add piquancy to a book that is far from dull. The relations of Agassiz with Desor, Schimper, H. J. Clark, J. D. Forbes, and others are expounded in a manner that seems very free from personal bias, though there is perhaps a little prejudice against the Englishmen who did not at once appoint Agassiz professor at Oxford or head of a department in the British Museum, and this creeps out in the words, "English geologists are always strongly disinclined to accept any new truth if discovered by foreigners." But on the whole the book bears the stamp of truth, praise and blame of its subject being equally distributed; it affords a fair estimate of the scientific position and capacities of Agassiz, and is probably as near an approach to a final appreciation and biography of the great naturalist as we can expect to receive. To this it may be added that the book is well arranged and adequately illustrated, that it contains a list of all writings connected with the life of Agassiz, an account of all portraits and memorials of him, a bibliography of 425 writings by him, and a careful index. All working geologists and zoologists, for whom and not for the general public the work is intended, may be urged with confidence to its perusal if not to its purchase.

It is not contended that all scientific men of to-day will endorse the judgments of Mr. Marcou, for his scientific opinions are not altogether those now in favour. These, however, place him in more sympathy with his subject, who was himself a protestant against the evolutionary movement, and are easily discounted according to the private tastes of each reader. People in England, for instance, are not likely to concede that "from 1795 to 1873 these two savants [Cuvier and Agassiz] 'de très grand envergure' gave to natural history the most important impulse which it has ever received" (II., p. 233). But perhaps we do not realise the enormous benefit that American science derived from the enthusiasm of Agassiz. He who had created the scientific centre of Neufchatel, embraced and invigorated a continent as easily as a city. One of his many improvements, the manner of publishing scientific writings, is well brought out by Mr. Marcou. Before his arrival most important works on American zoology had been published in Europe, and the scientific reports occasionally issued by the Government were in bad type on worse paper. Agassiz, with his European draughtsmen and lithographers, transferred to Cambridge the example begun in Switzerland, and American scientific publications soon became, as they have remained, the envy of the world. Would that an Agassiz might pay a visit to H.M. Stationery Office!

But, however great the impulse that Agassiz gave to the local investigation of nature, there can be little doubt that, as regards science in general, if we set aside the Glacial theory, the estimate of Mr. Marcou is too high. Those who have studied the works of Agassiz know well enough what a mine they are of accurate facts and brilliant suggestions. But his "Essay on Classification," the book that summed up his philosophy of zoology, a book well worth the careful study of all naturalists, has been simply shelved by the majority in favour of the "Origin of Species." This is a fact that it would be idle to deny, quite apart from any discussion as to the relative value of the two works. The world of zoologists was panting for a revelation, for some guiding principle, and it was not from Agassiz that the revelation came. This, indeed, is fully realised by Marcou, who forcibly contrasts the "classifiers and pioneer naturalists," including Cuvier, Agassiz, Owen, d'Orbigny, Deshayes, Ed. Forbes, Thomas Davidson, Pictet de la Rive, Herman von Meyer, Barrande, Lartet, and Cotteau, with the "philosophical naturalists," most of whom appear, according to our author, to lack some of their senses, being blind, or deaf, or invalids, or hermits. But even Agassiz said, "facts are stupid things until brought into connection with some general law," and after all it is the philosophers who give the most enduring and the widest impetus; and so Mr. Marcou—who, like Balaam, cannot help speaking the truth—admits of Cuvier and Agassiz that, "both saw facts and observed them sharply, but neither thought to link them by theories calculated to lead to the discovery of other facts. They were 'terre-à-terre' naturalists, while Lamarck, Geoffroy Saint-Hilaire, Darwin, Huxley, looked forward to the future, prophesying, and always ready to call to their help suppositions and probabilities."

Mr. Marcou of course does not mean that Agassiz never theorised. On the contrary, he tells us elsewhere that he speculated too much. But the truth seems to be that his speculations, like so many of his enterprises, were rashly entered upon and thrown aside by their author for want of patience to undertake the continuous drudgery necessary for their development.

This, then, is how Agassiz appears to us after the perusal of this book. An insatiate collector, a careful and penetrating observer, a lucid describer, a rapid worker,

> "A mortal, built upon the antique plan,
> Brimful of lusty blood as ever ran,
> And taking life as simply as a tree."

His unbounded energy initiated vast schemes, but lacked the perseverance and organising power to bring them to a successful issue.

He lived for the day on the promises of the morrow, letting the future take heed for itself. The Museum of Comparative Zoology at Harvard, now ably directed by his son, was the one practical object he set his heart upon, and remains an enduring monument to his vigour and to the "persuasion" that "fondled in his look and tone." His own enthusiasm and reverence for natural objects inspired others "to feel the Seeker's noble zest," but did not always direct and restrain them. Confident in himself, yet longing for the applause of his fellows, he owned a charm that overcame men of all classes:

> "His magic was not far to seek,—
> He was so human! . . . Still himself he bare
> At manhood's simple level, and where'er
> He met a stranger, there he left a friend."

Let alone princes and politicians, it is no small thing to say of a man of science that he was the subject of three of the noblest utterances of the poets of his adopted country, Longfellow, Whittier, and Lowell.

> "In all voices known to her
> Nature owns her worshipper."

F. A. B.

Methods in Histology.

Leitfaden für histologische Untersuchungen. By Bernard Rawitz. 2nd Edition. Pp. xiv., 148. Jena: Gustav Fischer, 1895. Price 3 marks.

The second and improved edition of Dr. Rawitz's treatise on histological methods will be welcomed by all histologists, whether students or researchers. The work is avowedly intended to be a guide to students of vertebrate histology, that is to say, of histology as the word is understood and restricted by anatomists, physiologists, and others who are engaged in studies directly or indirectly connected with medicine. It will, therefore, be of more value to the student or researcher in a medical school than to the general zoologist, who will search in vain for any of those methods, now so numerous and detailed, for killing and preserving animals, marine and otherwise, in as natural and lifelike a condition as possible. Such methods form nowadays a most important part of zoological technique, especially for collectors or marine zoologists.

Although Dr. Rawitz devotes chapter i. of part i., and a portion of chapter i. in part ii., of his work to methods of studying living material, it is the constituent cells and tissues, while fresh and still living, of higher animals that are included by him under this term, and not the living animal as a whole. In short, this work, as its title implies, is purely and simply histological, and as we have said, histological in the limited sense of the word. Since, however, the greater part, if not all, of the methods given in this book admit of application, with such modification as circumstances may render necessary, to invertebrates as well as vertebrates, the book may be safely recommended to those histologists and embryologists whose studies are not restricted to the latter portion of the animal kingdom.

The intention of the author has been to make his book, on the one hand, a useful guide to the beginner who, having been through a course of microscopical study, wishes to commence original investigations on his own account, and, on the other hand, a work of reference in which the experienced investigator may find brought together the many important methods of research recommended in scattered memoirs on various subjects. The book is divided into two parts, the first being a classified description of the methods themselves, the latter explaining their application to special instances. Part i. is divided into eleven chapters, with the following headings; Investigation of Living Material, Methods of Cell Isolation, Fixation and Hardening, Decalcification and Bleaching, Imbedding, Section-cutting, Staining, Metallic Impregnation, Putting up of Preparations, Injection Methods, and, finally, Drawing and Plastic Reconstruction. The first, fourth, eighth, and last of the above chapters have been added in the present edition. In part ii. the application of these methods is explained in a series of chapters divided according to the tissues and systems of the vertebrate body, such as The Cell, Muscular Tissue, Nervous System, and so forth.

The author does not aim at giving a complete account of all methods that have been recommended, but at selecting those which seem to him really useful. Several processes which were described in the first edition have been eliminated in the present one. There is certainly, however, no histological method of real value which is not to be found in the book. Each chapter in part i. is preceded by a short introduction, which contains nothing new for the experienced investigator, but is intended especially for the beginner, who will find there, not only many hints and "tips" most helpful in practice, but also valuable explanations as to the why and the wherefore of the processes employed. The application of the methods to particular instances, which is described in the second part of the book, is also a great aid to the student. It may be doubted, for instance, if an inexperienced person could obtain good preparations by the famous method of Golgi, or some of its numerous modifications, after having read only the short account given in chapter viii. of part i., were it not for the further description given under the heading Central Nervous System in part ii. In part ii. will be found also a number of special methods, applicable only to particular instances, such as Blochmann's method for removing the jelly from frogs' eggs, not mentioned in part i.

For imbedding in paraffin the author recommends chloroform as by far the best medium for delicate objects, not only on account of the slowness with which it diffuses, but also because it is possible—and indeed necessary—to drive out every trace of chloroform by evaporation, so that the objects are imbedded in perfectly pure paraffin, the melting-point of which has not been lowered during the process. It may further be pointed out that objects so imbedded can be preserved for any length of time far better, and with much greater safety in packing and travelling, than in alcohol or any other preserving medium. This method is especially useful when large quantities of delicate material are collected during a short time, and cannot be worked out at once, as during visits to marine laboratories.

In the chapter on section-cutting we miss a description of any method for the orientation of minute objects, such as the well known one of sticking them with glycerine and albumen to thin slices of liver, as already described in a former number of this Journal (NAT. SCI., vol. iii., no. 18, p. 122; Aug., 1893). Among various methods of sticking sections to the slide, the glycerine and albumen mixture is especially recommended, while the advantages of the distilled water method are also pointed out. The latter method is certainly dangerous, however, when the sections have to be soaked afterwards for a considerable length of time in staining fluids, especially if the sections are not very thin, but it may be made perfectly safe by adding a very small quantity of glycerine and albumen to the distilled water, *i.e.*, one or two drops of the former to about 10 c.c. of the latter. This method is especially recommended for series of sections—ribbons—which are slightly curved or crumpled, as the water causes them to flatten out, while the amount of albumen present, though sufficient to make the sections stick on, is too infinitesimal to be appreciably coloured by the staining fluids.

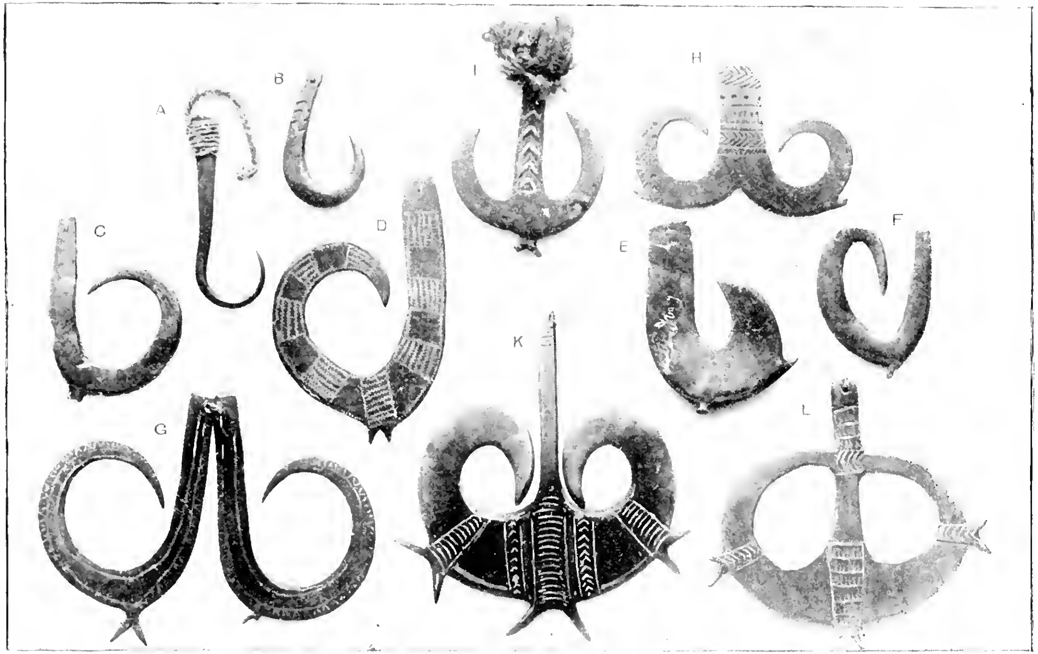
The chapter on staining is certainly one of the most valuable in the book, and the portion dealing with the stains is divided into three parts, headed respectively "Substantive," Adjective," and "Vital Staining Methods." By "substantive staining methods" the author denotes all processes where the staining fluid, as made up, acts directly upon the substance to be stained. By "adjective staining methods" are meant those processes in which the substance is first treated with a mordant, used in a solution separate from the stain, and not combined with it as in the ordinary combinations of alum and other salts with carmine or hæmatoxylin, commonly employed in laboratories. Among adjective staining methods are given the famous hæmatoxylin methods of Heidenhain and Weigert, as well as a remarkable new method of the author's, in which the mordant used is a solution of tannin and tartar emetic, followed by fuchsin, safranin, or other anilines as a stain. This is the first time an adjective method has been employed for an aniline stain, and it is said to give results both curious and valuable. The ordinary staining reaction of the aniline is, as it were, inverted; the fibres of the karyokinetic spindle, for instance, are coloured, and not the chromosomes. The centrosome is also said to be very distinctly shown in the resting cell.

These adjective staining methods, first invented by Heidenhain, and since elaborated by him and by others, are among the most valuable of modern microscopical methods, and Heidenhain's later method with iron, alum, and hæmatoxylin is rapidly establishing itself in zoological and embryological, as well as in histological, technique. It may be especially recommended for showing micro-organisms in cells or tissues, not only in pathological material, but also in cases where such organisms occur normally, as in *Pelomyxa*, for instance, where this method shows the curious bacteria in sections with a clearness not attained by any other stain.

The various methods of staining *intra vitam* with methylene blue form the third section of the chapter on stains. These important processes are perhaps not treated with the fulness they deserve, and the book has appeared just too soon for it to contain an account of Bethe's method for fixing the methylene blue in the tissues, which is of so great importance that it may be worth while to give a brief account of it here, abstracted from Bethe's memoir on the nervous system of *Carcinus mænas* in the *Archiv. für Mikroskopische Anatomie*, vol. xliv., p. 585; 1895.

The stain is applied either by injecting the animals with it, or by placing pieces of tissue in a weak solution. For injecting Crustacea a $1\frac{1}{2}$ per cent. solution in normal saline solution was employed. For fixing the stain in the tissues, the following solutions are used:—(1) For vertebrates: Ammonium molybdate, 1 gr.; distilled water, 10 cc.; H_2O_2, 1 cc.; H Cl, 1 drop. (2) For invertebrates: Ammonium molybdate, 1 gr.; distilled water, 10 cc.; H_2O_2, $\frac{1}{2}$ cc.

The fixative should be used freshly made up, and during the process of fixation should be surrounded by a freezing mixture. Small objects are fixed for two to three hours, larger ones, up to 1 cc. in bulk, for four or five hours. After fixation the objects should be thoroughly washed in distilled water and dehydrated with alcohol,



Evolution of *Sabagorar*.

A. Ordinary Fish-hook of Turtle-shell. B–L. Series of Ornaments of Turtle-shell probably derived from Fish-hooks.

(*Being Fig.* 44 *of Professor A. C. Haddon's "Evolution in Art," the block kindly lent by the publishers, Walter Scott, Ltd.*)

[*To face p.* 337.

the process of dehydration being made as rapid as possible. Clear with oil of cloves, or, better, with xylol, taking great care to work out all trace of alcohol. Mount in Canada Balsam, or imbed in paraffin or celloidin by usual methods. Objects so fixed may be further treated with hardening or staining reagents, but strong mineral acids and alkalies are to be avoided, hence ammonia carmine or borax carmine cannot be used. They may be stained in bulk or sections with alum carmine or cochineal, or with any anilines. Hæmatoxylin does not give good results on account of its blue colour. The objects when fixed can be treated, without further preparation, with chromic or picric acid or potassium bichromate. If it is required to treat with $HgNO_3$ to show epithelia, the HCl in the fixative must be replaced by HNO_3, and after fixation the washing must be very thorough, to avoid formation of silver molybdate. Osmic acid is best applied by adding it to the fixative fluid after the objects have been in it for some time.

Rawitz's chapter on staining ends with a useful appendix giving the synonymy of the various aniline stains employed in histological technique. One and the same stain is often known by as many as four names, or even more, and this frequently causes very great confusion to beginners. We have heard of a student who, being directed to stain a tissue with vesuvin, complained that he could not find this stain in the laboratory, although bismarck brown was staring him in the face on his own shelf. How many people, not specialists in this subject, know that magenta, fuchsin, rubin, and aniline red are but four different names for the same thing?

The chapter on drawing and plastic reconstruction will appeal especially to the morphological student, who often has to reconstruct the structure of a minute object from a series of sections. The usefulness of the book is much increased by the complete index, and it is in every way a work to be recommended, especially to the class of students for whom it is primarily intended. E. A. Minchin.

The Natural History of Ornament.

Evolution in Art: as illustrated by the Life-histories of Designs. By Professor A. C. Haddon. Pp. xviii., 364. London: Walter Scott, Ltd., 1895. Price 6s.

The great interest which in recent years has centred round the study of art from a scientific standpoint, and the investigation of the natural history, so to speak, of designs, amply justifies the numerous books and essays treating of this aspect of the subject, which have lately come into existence. This field of research is indeed a wide and a fascinating one; and as yet, for the most part, the surface alone has been skimmed, the depths still remain to be probed, but the activity of researchers bids fair to secure a rapid development of the subject.

The present volume is the latest addition in this country to the study of the "Life-histories of Designs," and will be welcomed as a concise and suggestive essay, tending to advance our insight into the nature and *raison d'être* of art designs. Professor Haddon lays stress upon the now generally admitted fact that the ordinary biological deductions and lines of inquiry are applicable to the study of the growth, affinities, and migrations of designs, and he brings the eye of a trained zoologist to bear upon the subject.

As regards the material with which he deals in this book, there is but little which can be called new. He has borrowed very freely, and nearly all the instances cited and most of the theories advanced have been published elsewhere, as is also the case with practically all the illustrations. The first section of the book, dealing with the

"Decorative Art of New Guinea: as an Example of the Method of Study," is an abridgment of Professor Haddon's own interesting paper published in the "Cunningham Memoirs" by the Royal Irish Academy, and gives the main points indicated in that monograph. The remainder of the book, in which the classification is a prominent feature, is mainly built up of quotations from various well-known writers on the subject, such as Colley March, Stolpe, Holmes, Cushing, Goodyear, and others, who have with great skill treated of the various branches of the subject of Evolution in Art. The author adds his own views where necessary, and at the end gives suggestions as regards the scientific method of studying Art. His classification of the various modes of origin of designs, and the ways in which they become modified, will be found to be a useful one, as will also his grouping of the various reasons for which objects are decorated.

Some of the instances of "life-histories" of designs are very complete and convincing; as, for instance, the phylogeny of the *sabagorar*, or hook-like ornament of turtle-shell of the Torres Straits (Plate VI.). "Fish-hooks (A) are used in pairs, being fastened at each end of a piece of fine string, which, in its turn, is tied at its middle to the fishing-line proper. When the piece of twine with its hooks was thrown round a girl's neck, the two hooks would often hang down her back shank to shank. Two *sabagorar* similarly arranged occur in the British Museum collections. What more natural than that this should be noticed, and to save the trouble of making two *sabagorar*, a double one should be cut out of one piece of turtle-shell. The more remotely from the fish-hook did the *sabagorar* vary, the larger it became, and in some instances the double form became of considerable size, and the hook portion acquired a slight spiral curvature (K). In one modified specimen the hooks are actually fused with the shank (I). It will be also seen that divergent Λ-like processes often occur on the *sabagorar*, but are never found on the fish-hook" (pp. 76–78).

In some cases resemblances are apt to mislead, and we think that Professor Haddon is in error in suggesting (p. 231) that the Burmese silver "shells" used as currency represent actual shells once current as a medium of exchange. Although it is true that actual shells have been, and are still so used in Burma, surely the silver "shell"-money, so-called, is merely an accident of manufacture, a condition brought about in the crucible, and attainable by the metal only when of a certain degree of purity. The peculiar form, undesigned in the first instance at any rate, is valued as a guarantee of assay, and probably has no connection with the imitation of natural shells.

In dealing with what he calls "heteromorphs," that is, cases in which a design is composed of an amalgamation of two or more designs, Professor Haddon touches upon a cause of variation which is frequently made too little of by writers and students of the histories of art forms. It may safely be predicted that the greater number of decorative designs will prove to be heteromorphs of a more or less definite nature. The influence of one or more designs over another, which tends to produce a new design partaking of the nature of each parent, is very common, and renders the tracing of phylogenies a complex and difficult pursuit. One is indisposed to regard heteromorphism as "a kind of disease which may attack" designs; or to class it under the heading "The Pathology of Decorative Art." It is merely hybridisation, and, like that process in the animal kingdom, is capable of producing noble and improved forms, while in contradistinction to animals and plants, patterns of even widely different "species" may hybridise freely, and with excellent results.

The book is well indexed, and the illustrations are numerous and well chosen. The eight plates at the end of the volume are taken *en masse* from a paper by Dr. Colley March. It is a pity that the publication seems to have been hurried. In the copy before us, at any rate, the illustrations, which cannot have been dry when the sheets were bound up, have left indelible impressions upon the opposite pages which are eminently unsightly: an easily avoidable and therefore inexcusable blemish. This, however, does not impair the scientific value of the work, which should appeal to a wide class of readers.

HENRY BALFOUR.

PERCIFORM FISH.

CATALOGUE OF THE FISHES IN THE BRITISH MUSEUM. By G. A. Boulenger. Second edition. Vol. i. Pp. xix., 394, with 15 plates. Published by order of the Trustees. London, 1895. Price 15s.

IN 1870, Dr. Albert Günther completed his great enumeration of all known fishes, bearing the general title "Catalogue of the Fishes in the British Museum." Just a quarter of a century later the publication of a new enumeration was commenced as a second edition with the same title as Dr. Günther's work. The first volume now published has also the specific title "Catalogue of the Perciform Fishes of the British Museum. Second Edition. Volume First." The author of this new "Catalogue" is Mr. George Albert Boulenger, the work is cast on different lines from the first edition, and the secondary title is entirely different from any that has appeared before, and, therefore, it is only the supposed exigency of Museum administration that justifies the designation of the new work as an edition of the old Catalogue.

During the thirty-five years that have elapsed since the publication of the first volume of Dr. Günther's Catalogue, the nominal additions to the species have been very numerous, but still more noteworthy has been the deviation of many ichthyologists from the system therein proposed. Nevertheless the old system has continued to find favour with most European ichthyologists; consequently there has arisen a division into two "schools" one comprising most all the American ichthyologists, the second most of the others. Naturally curiosity will be excited to learn how both questions—numbers and system—are viewed in the new Catalogue.

Probably by most experienced ichthyologists it has been believed that many of the supposed new species would not stand the test of critical examination; but few, if any, will be prepared for the sweeping reductions which have found expression in the Catalogue of the Perciform Fishes. In the corresponding portion of the old work, mostly published in 1859, 393 nominal species of the groups under consideration were enumerated, but "only 317 were considered as apparently well characterised." In the present volume, only 375 species are recognised. This reduction is the result, not only of identification of many of the "doubtful species" of the old work, but of some considered "well characterised" and of most of the subsequently described species. Some of the identifications rather startle one; such is the degradation of the "*Batrachus gigas*, Günther," in the synonymy of the common *Epinephelus lanceolatus*. The supposed *Batrachus* was based on a dried head and has long been a puzzle; in view of the positive statement by so experienced an ichthyologist as Dr. Günther that "its appearance and structure" are those of a *Batrachus*, and the trenchant characters of that genus, no one has ventured to doubt that the identification was correct for the family at least, although not for the genus, and it could only have been possible for one having access to the type to identify it as Mr. Boulenger has done. This is simply an example of the results of the facilities enjoyed by the author and the good use he has made of them. Undoubtedly, however, there will be dissentients from him in some of his reunions. No one, for instance, who has had the opportunity of examining carefully large numbers of the *Pomoxis annularis* and *P. sparoides* will concur with Mr. Boulenger in combining them in one species (*Pomoxys sparoides*, p. 7); Dr. Jordan did indeed hastily anticipate him in such a conjunction, but he very soon repented.

Notwithstanding the reduction of species, genera not represented by any species in the corresponding portions of the Catalogue of Acanthopterygian Fishes are numerous. The additions are of Centrarchidæ, *Elassoma* (p. 34); of Percidæ, *Ulocentra* (96), *Ammocrypta* (101), *Crystellaria* (103); of Serranidæ, *Percalates* (132), *Siniperca* (136), *Parascorpis* (145), *Dinoperca* (153), *Liopropoma* (154), *Odontanthias* (319), *Plectranthias* (331), *Dactylanthias* (333). These, of course, are independent of new genera based on previously known species.

The system Mr. Boulenger adopts is excellent, so far as his appreciation of the groups is concerned. The fact that the first volume of the new Catalogue is devoted to specialised acanthopterygians is due to the circumstance that he "was desired to begin the work with the Perciformes."

The "division Perciformes" is much more restricted than is Günther's homonymous division, the Squamipennes, Teuthididæ, and Scorpænidæ being the principal types eliminated. The families, also, are very differently limited, and the author has expressed the facts of osteology in his diagnoses of the families, and not simply given perfunctory descriptions of skeletons as addenda of curious but useless information. He has, too, for the first time, utilised the development or want of an ophthalmophorous shelf to the second suborbital as a family character, and has also availed himself of the mode of insertion of the ribs and the development of transverse processes for diagnostic purposes. The results are most satisfactory.

The Percidæ are identical with the family as understood by American naturalists, the Centrarchidæ include the typical Centrarchidæ, Elassomidæ, and *Kuhlia*, and the Serranidæ form a very large family with numerous subfamilies.

The relationship of the peculiar Pacific genus *Kuhlia* to the Centrarchidæ was entirely unsuspected, and Mr. Boulenger is the first to recognise the distinctness of its characters from those of forms with which it was formerly associated. Probably some will be inclined to consider it the representative of a distinct family—Kuhliidæ. Indeed, doubt must for the present be entertained whether the similarity of the vertebral characters of *Kuhlia* and the Centrarchidæ is not the result of independent acquisition from different sources rather than indicative of close genetic relationship.

The Serranidæ are those members of the old Percidæ which have the "second suborbital with an internal lamina supporting the globe of the eye," and include as subfamilies the Serraninæ, Grammistinæ, Priacanthinæ, and Centropominæ, besides others to be hereafter described. The last two subfamilies named are equivalent to the families Priacanthidæ and Centropomidæ of some authors, and are very natural groups, whatever may be their value. (We prefer to consider them of family rank.) The Serraninæ are extended by the addition of the Plesiopinæ, which previously had been widely separated. The alliance of this group with the Serraninæ is at first startling, but there is certainly a superficial resemblance to *Callanthias*, a universally-recognised genus of the Serranids, and we are even prepared to discount the value of the interruption of the lateral line by the characteristics of *Callanthias*. We may, therefore, thank Mr. Boulenger for the approximately true position of the group, for the ascertainment of which he had the skeleton of one species—*Paraplesiops meleagris*. This being conceded, the differences between Mr. Boulenger and American naturalists would be reduced to differences of valuation simply, namely:—

Boulenger.	*Americans.*
Centrarchidæ	Centrarchidæ. Elassomidæ. Kuhliidæ.
Percidæ	Percidæ.
Serranidæ: Serraninæ, Grammistinæ	Serranidæ.
Priacanthinæ	Priacanthidæ.
Centropominæ	Centropomidæ.

This is quite a satisfactory agreement and a great improvement over the previous condition.

The genera admitted by Mr. Boulenger are as great improvements over those generally adopted as are the families. No other ichthyologist, except Bleeker, has been equally fortunate in appreciating the characteristics and relations of the numerous Indo-Pacific and Anthias-like forms. Many, however, will be disposed to delimit and sub-divide some large genera, such as *Epinephelus* and *Serranus*, but even here little more will be required than to elevate his sub-genera to higher rank, although a few of those may be sub-divided. Perhaps there will always be such differences of opinion, and when so much may be said on both sides, dogmatism is out of place; it is even possible that Mr. Boulenger may be more nearly in the right than those who have been more radical. It is not likely, however, that his views will prevail immediately everywhere.

The nomenclature of Mr. Boulenger's work is as good as the system. He is generally obedient to rules, and the differences between him and others likewise amenable to laws depend chiefly on the nature of those laws. Mr. Boulenger adopts the twelfth edition of the Systema Naturæ as the starting point of binomial nomenclature, demands a diagnosis (and not merely a typonym) for every new genus, and requires that the name shall accord with Latin usage and be appropriate.

For one reason or another, seven of the genera of the new volume will be subjects of differences of nomenclature. These are:—

Page	Boulenger.	Diverse.
50	*Lucioperca*, Flem., 1822.	*Stizostedion*, Raf., 1820.
104	*Aspro*, C. V., 1828.	*Zingel*, Cloquet, 1817.
109	*Acerina*, C., 1817.	*Gymnocephalus*, Bl., 1795.
133	*Ctenolates*, Günth., 1871.	*Plectroplites*, Gill, 1872.
144	*Pomodon*, Boul., 1895.	*Hemilutjanus*, Blkr., 1876.
271	*Cromileptes*, Blkr., 1874.	*Serranichthys*, Blkr., 1859.
306	*Gilbertia*, J. & E., 1890.	*Hypoplectrodes*, Gill, 1862.

Which ones of these alternative names shall be adopted time alone can tell. We sympathise with Mr. Boulenger as to several cases, but feel compelled to adopt the other names, although distasteful to us. Probably the difference above noted may even be reduced to not more than five, as the data available to Mr. Boulenger seem to have been insufficient in two cases. *Plectroplites* and *Hypoplectrodes* were rejected because they were supposed to have been justified by "no definition" before the synonyms. It is true they were not defined at the pages noted by Mr. Boulenger, but a little later the differential characters were mentioned, characteristics of *Plectroplites* having been given in 1863 (*Proc. Acad. Nat. Sci. Philadelphia*, p. 83), and some of *Hypoplectrodes* in 1871 (Poey, *Ann. Lyc. Nat. Hist. N.Y.*, x., p. 45). It may be added that *Cromileptes* is rather a synonym of *Epinephelus* than a name available for a distinct genus, and was only used by Bleeker on account of his peculiar view as to type-species.

In fine, we heartily congratulate all ichthyologists and naturalists generally on the publication of a work which so well embodies the scientific spirit of the age in its system, the grasp of the subject as manifest in the treatment of the specimens, literature, and synonymy, and obedience to law as observed in the nomenclature. Naturally, we must look forward with impatience for succeeding volumes.

THEO. GILL.

THE DOG'S SKULL AND OTHER MATTERS.

THE SKULL OF THE DOG. By Walter E. Collinge, F.Z.S. Pp. viii., 124, with 11 woodcuts. London: Dulau & Co., 1896. Price 5s.

THIS little book, with its bright red cover, bears a superficial resemblance to one of Macmillan's excellent "Manuals for Students," but the plagiarism, if such it be, is not carried farther; in fact, the thickness of the paper, the large type, and the width of margin are rather suggestive of book-making. One of the author's reasons, as stated in the preface, for selecting the skull of the dog for description, is that it is "easily procurable in both adult and young stages"; but the enterprising student who provides himself with young stages will derive but little assistance from the book, for there is no chapter on the development of the skull and hardly more than a mention of the milk dentition.

The book is divided into five chapters, the first of which is introductory, while the second relates to the histology of the connective tissues. The third chapter, describing the skull of the dog, occupies only 44 pages out of a total of 124. The matter is reliable in the main, but to describe the vomer with the bones of the olfactory capsules is calculated to confuse the student when he comes to study the skull of the lower Vertebrata, and to give him false ideas concerning the true nature of the mammalian hard palate. Since, also, by "upper jaw" in animals from the bony fishes upwards, is usually understood the tooth-bearing bones, premaxilla and maxilla, the statement that the palatoquadrate cartilage in the embryo dog forms the foundation of the upper jaw of the adult is liable to misconstruction. As regards the illustrations, which are indifferent in quality, the shape of the tympanic bulla in fig. 3 calls for special censure, and it is to be regretted that the dog who furnished his mandible as the model for fig. 4 was not endowed with the full complement of teeth.

In chapter iv., Windle's tables, occupying some sixteen pages, of cranial and dental measurements of the different breeds of dogs might surely have been omitted, especially as the student, in referring to them, has to guess whether the numbers represent millimetres, inches, or yards, and may, moreover, be pardoned if he fails to evolve the "index," when given the total length of a skull and its zygomatic width. To form the subject of the last chapter, a glossary of osteological terms has been thrown in, apparently as an afterthought, for it is not specially related to the subject of the book. The derivation, or rather the author's idea of the derivation, is given for most of the words, and here the classical scholar may gather much information of which he was erstwhile ignorant. He may learn, for instance, that *zugnum* means "I yoke together"; *trochas*, "I roll or run round"; and *phusis*, "I grow"; while, if his predilections lie in the direction of Latin, he may learn the meanings of a great many words which do not occur in the dictionary. The author has evidently been unable to decide whether to render the Greek letter "upsilon" by *u* or *y*, and so gives us an equal quantity of both. This, of course, has the advantage of relieving the monotony of an otherwise unattractive glossary, and further variety is afforded by deriving "pterygoid" from *pteron*, and "basipterygoid" from *pterygion*, although the roots of "entopterygoid" and "mesopterygoid" are recorded as *pteryx* and *pterux* respectively. It is also not encouraging to the inquiring student to be told that the supratemporal is "a bone of the skull in certain Vertebrata," more especially as splenial, prefrontal, and ectopterygoid are described in exactly the same terms.

In spite of these deficiencies which the carping critic sets himself so assiduously to ferret out, there is abundant evidence of the patience and perseverance which the author has exercised in his endeavour to produce a concise and reliable students' manual. We cannot say that this endeavour has been crowned with unqualified success, and it is to be feared that the author will not greatly benefit by the publication of the work. There was no demand for the book, and the thirty closely-printed and well illustrated pages devoted to the skull of the dog in Flower's "Osteology of the Mammalia," to which students have had recourse in the past, still remain far and away the best source of information on the subject.

W. R.

Plankton Gastropods.

Die Gastropoden der Plankton-Expedition. Ergebnisse der in dem Atlantischen Ocean von Mitte Juli bis Anfang November, 1889, ausgeführten Plankton-Expedition der Humboldtstiftung. Von Dr. Heinrich Simroth. Pp. 206, twenty-two plates, seventeen cuts. Kiel und Leipzig, 1895.

The Gastropoda collected during Professor Hensen's Expedition in the "National" were confided for examination to Dr. Heinrich Simroth, who, as might have been expected, found his investigations beset with no ordinary difficulties. owing partly to the small size of the organisms and the distorting effect of reagents upon them. Comparatively few of them could be named, as in the present state of our knowledge it is impossible to refer them with certainty to particular adults.

The first section of this report is devoted to the genus *Ianthina*, and numerous features in its structure and life-history are discussed. The radula is divided quite to the base into two halves, and the sides of the mouth are supported by lamelliform jaws. The teeth appear to serve as a sieve for straining the minute plankton on which the animal feeds. The float consists of different elements; the propodium supplies a homogeneous mucus, of which the air-bubbles are formed; the mesopodium a thread-like byssus; there is, further, a colour gland to which the varying tint of the float is due. The eggs (to the number of 4,000 in *I. umbilicata*, 400,000 in the larger species) are deposited on the under surface of the float by a protrusible ovipositor, and the process takes place all at once. Where a float shows traces of two separate operations, it is because a portion of a last year's float has remained.

Of the larvæ, those of Lamellariidæ were characterised by the possession of a broad, hyaline "scaphoconch." One of the commonest was that known as *Echinospira*, which is probably the young of *Lamellaria perspicua*. The remaining larvæ are classed in seventeen categories, among which only a few can be mentioned here. *Macgillivrayia*, the larva of *Dolium*, is widely distributed; it has long bristles, and the operculum has a vertical median ridge on the inner surface for the attachment of the columellar-muscle, besides which a system of comma-like dots oblique to the ridge indicates incipient torsion. In *Sinusigera*, a collective name for the larvæ of *Murex*, *Purpura*, *Bela*, *Triforis*, *Cypræa*, etc., the notch is correlated with the protrusion of a sail-like lobe of the velum. In this group the metamorphosis of the shell is very distinct: the larval shell (prosopoconch) is often clearly distinguishable at the apex of the definitive shell (teleoconch), and usually bears at its own apex the original embryonic shell (embryonoconch). One specimen suggested the incipient shell of a *Spirula*, but, being smaller than would have been expected, was probably referable to a species of *Cæcum*.

Notwithstanding the difficulties of the enquiry, and the uncertainty of the specific determinations, a few general principles may be enunciated. Slender shells, the length-breadth ratio of which exceeds 5 : 2 occur only on the coasts, not in the plankton. All the larvæ are provided with enormous velar processes, with a complicated double series of cilia, and a strong longitudinal retractor muscle. They have a lacunar structure correlated with respiration. The sole of the foot, though distensible, is extremely small, and the proboscis is wanting, though its sheath occurs as a large pigmented sac. The radula could not be used for systematic purposes, as its lateral and marginal teeth showed different relations from those obtaining in the adult. With respect to the shell, the embryonoconch is of structureless conchiolin. The most primitive complication is the hair, resulting from some active secretion on the mantle-margin; longitudinal and transverse knobs and prominences arise also in consequence of irregular secretion, and in their simplest arrangement are compared with the staves and hoops of a barrel: sometimes their deposition takes place at an angle of 45° to the axis. The colour of the shells is either yellow-orange or blue-violet—that is to say, in the main, of one of two complementary tints. The blue series is the result of exposure to the tropical sun; only forms which dive are colourless, and only swimming forms are phosphorescent.

It will be obvious, even from this brief outline, that the Memoir contains many interesting and valuable facts and much suggestive comment. It is beautifully illustrated, and we congratulate Dr. Simroth on his courage in undertaking such a task and on the success which he has achieved in discharging it. W. E. H.

ECHINODERM EMBRYOLOGY.

TEXT-BOOK OF THE EMBRYOLOGY OF INVERTEBRATES. By E. Korschelt and K. Heider; translated by E. L. Mark and W. McM. Woodworth. Part I. 8vo. Pp. xvi., 484. London: Sonnenschein, 1895. Price 15s.

THE science of animal embryology advances so rapidly that English students have anxiously awaited this long-promised translation of the leading German manual. Delay has not, however, had the result of rendering the book out-of-date. On the contrary, it is a considerable improvement on the German edition, owing to the insertion of numerous notes by the original authors as well as by the two competent translators. For the present volume, which deals with Porifera, Cnidaria, Ctenophora, Platyhelminthes, Orthonectidæ and Dicyemidæ, Nemertini, Nemathelminthes, Acanthocephali, Rotatoria, Annelida, Sipunculidæ, Chætognatha, Enteropneusta, and Echinoderma, 130 additional papers have been consulted. While there are no additions to the literature of Ctenophora, there are no less than thirty to that of Echinoderma, and this without reckoning the numerous papers on experimental embryology, most of which have dealt with the echinoderm ovum. No papers after 1894 are included, so that the latest important works by Bury and MacBride are not discussed. With regard to the general questions of the homologies and relations of the classes of Echinoderma, the authors hold views with which we agree in the main. For instance, "Even the conception of the homology of the plates founded by Lovén and championed by Carpenter, especially those which in the different groups of Echinoderms lie about the apical pole, is not to be considered as assured." They reject Semon's ancestral *Pentactæa*, thinking it "more justifiable to search for the ancestral forms of the Echinodermata among the existing material which is offered to us by palæontology." The search will, we fear, take a long time. It is recognised that the origin of the radial structure must have been due to fixation, hence the common ancestor is sought among stalked forms; this is not absolutely necessary, for the evolution of a true stalk was a slow process, and mere fixation would probably have effected all that the theory requires. The Cystidea are no doubt the most ancestral of the known classes, for we agree with the authors in regarding the Holothurioidea as degenerate in some respects; but there have yet been found no certain transitions between the Cystidea and the other classes, except perhaps some of the Crinoidea. As to the internal structure of the primitive Cystid—that elongate sac, devoid of radial symmetry, with irregular plates developing in its integument, and attached by what was the pre-oral lobe of its young—we know nothing. Here embryology should shed its light, but affords the merest glimmer. The forms of the larvæ have been to a large extent secondarily acquired, and the very one that should be of most help is the most modified, namely, the crinoid larva, that is to say in *Antedon*, where alone we know it. It seems probable that the ancestor was bilaterally symmetrical, and to some extent segmented. The affinities with the *Tornaria* of *Balanoglossus* will doubtless serve as our best clue.

We cannot leave this subject without observing that an account of the development of *Antedon* that takes no note of the anal plate, in either text or figures, is singularly deficient. There is also an inadequacy in the account of the infrabasalia, which do not always have the same arrangement, so that the comparison with the Ichthyocrinoidea falls to the ground. It might have been added that the homology of the first formed stone-canal and water-pore with the stone-canal and madreporite of other echinoderms is confirmed by palæontological evidence, in so far as a similar madreporite is sometimes developed in connection with it. In a future edition the slip at the bottom of p. 453, by which *Rhizocrinus* is printed instead of *Antedon*, should be corrected, as it alters the meaning of half the page.

The remainder of this work is to be translated by Dr. H. J. Campbell, of Guy's Hospital Medical School, who will doubtless be as successful as Drs. Mark and Woodworth, and who will, let us hope, steer clear of their "fundamental" error. F. A. B.

French Beetles.

Faune de France: Coléoptères. Par A. Acloque, with a Preface by E. Perrier. Pp. 466, with 1,052 figures. Paris: Baillière, 1896. Price 8 francs.

This book is to form one of a series of four volumes that shall comprise the whole Fauna of France, with the object of enabling an enquirer to find the name of any animal by a series of dichotomic tables. The larger part of the book is occupied by these tables, but there is an introduction containing a general account of the structure of insects.

As works of this class are much in vogue on the Continent of Europe, we must suppose that they are useful; or perhaps rather that they are considered to be so by a section of the public; we believe, however, that they give rise to much disappointment. In order to find the name of a beetle, a student must commence—supposing him to have ascertained that he has a beetle before him—with the table of families, and trace the dichotomic divisions until he ultimately gets to the species; before arriving at this, however, he must encounter so many doubts and difficulties that he will probably abandon the task as hopeless; should he refuse to allow his doubts to deter him, and continue till he has run down to the species-name, we should say, from our own experience of other books of the kind, that he will as often as not be guided to a name that belongs to something else.

This first instalment of Mr. Acloque's "Faune" is a model of condensation. The author has lightened his difficulties by omitting "litigious" species; but the volume as it stands must include, we should imagine, somewhere about 5,000 species. Detailed criticism of either the introductory matter or the tables would be out of place here; but as other volumes are to appear, we may remark that an alphabetical index—extending as far as genera—is necessary in a work of this kind, though wanting in this volume. The book is well printed, the illustrations are sufficiently good to be useful, and Professor Perrier's preface is a gay fragment of autobiography.

D. S.

Palæontology.

Grundzüge der Palæontologie (Palæozoologie). By Karl A. von Zittel. 8vo. Pp. viii., 971, with 2,048 text-figures. Half morocco. München und Leipzig: R. Oldenbourg, 1895. Price 28s.

Professor von Zittel's Handbook of Palæontology is so well-known, and, if it were not, we have so recently published a critical account of it (vol. iv., pp. 222–225), that a lengthy review of the present work, which is a condensation of the larger one, is quite unnecessary. It will certainly be welcomed by those students who could ill afford to pay for the indispensable but expensive "Zittel." In addition to being compressed, the work has in some respects been brought more up to date: it is true that this process might have been carried out with more rigour, and there are advanced palæontologists who will be horrified at the retention of what they regard as some exploded absurdities; but as most of the important recent literature is referred to, the student who desires to reach this advanced stage is put in the way to do so. In any case the work is a wonderful compendium: the index contains more than 7,000 names, and as for the figures, there are almost too many for the size of the book.

It is not only professed students of geology and palæontology proper that should be grateful for this work; but the zoologists also, now that they have so ready a means of reference put within their reach, may occasionally be glad to pay some attention to the work of their colleagues on extinct animals, which they have hitherto been rather apt to treat as "out of sight and out of mind," to the serious detriment of their own work. There are, however, signs that this state of things is passing away, and one of them is the constant presentation of palæontological papers to societies or periodicals that deal with zoology in preference to those that deal with geology. Another sign is the gradual incorporation of palæontological matter in text-books of zoology, and the preparation of such works as Dr. Bashford Dean's book on fishes, reviewed in our last number. We hope the day will come, we believe it is not far distant, when the text-book of palæontology will be a thing of the past, and when the zoological text-book will treat all animals alike, whether they be living or extinct. The errors into which zoologists have been led through the habit that the circumstances of their training and the facts of nature rendered inevitable, the habit, namely, of treating as typical representatives of the various sub-divisions, forms that the palæontologist sees to be aberrant, degenerate, or extremely modified—these errors, we say, have left their trace in almost every branch of zoology, and it will be long before a truer conception of the relationships of the animal kingdom can gain a hold on the minds of men. Nobody is to be blamed for this: it was the obvious path for science to take, but she has been led by it along an obscure and a devious route.

The wedding-day of palæontology and geology has, however, not yet arrived. The engagement is likely to prove a long one, and in the meanwhile we may profitably employ our time in studying the works of Professor von Zittel. It is, therefore, good news to hear that an English translation of the present book is being prepared by Mr. C. R. Eastman, of Harvard, and that the translation is being revised and added to by numerous specialists, both English and American. It is, we believe, to be issued in two volumes, of which the first may be looked for very shortly.

A Dutch Palæontology.

De Gewervelde Dieren van het Verleden. By Dr. T. C. Winkler. Pp. vii. 291, illustrated. Haarlem, 1893.

We have received from Dr. T. C. Winkler, the well-known curator of the Teyler Museum, Haarlem, a copy of the above popular work, "The Vertebrate Animals of the Past." Though dated 1893, we have not previously had the opportunity of perusing this interesting volume, which is admirably adapted to give the Dutch public a general idea of the results of vertebrate palæontology. Holland is fortunate in possessing perhaps the richest of the smaller palæontological museums of Europe, the institution over which Dr. Winkler has presided for so many years. Here is preserved the original "Homo diluvii testis," and it is accompanied by numerous other unique examples of fossil vertebrata. The present volume naturally makes special reference to these specimens and to the writings of Dr. Winkler himself; it is precisely the handbook to be read by anyone interested in fossils after seeing the Teyler collection. There is a copious index and numerous woodcuts; but the latter are very inferior, and might well be replaced by "process" copies of similar blocks published elsewhere. Were we reviewing the book we should differ from the author on a few points; but on the whole it was remarkably up to date at the time of its issue three years ago.

MR. BRIGGS BECOMES NATURALIST.

BY TANGLED PATHS. By H. Mead Briggs. 8vo. Pp. 203. London: F. Warne and Co., 1896. Price 3s. 6d.

WE liked Mr. Briggs better in the old days, as the plain *paterfamilias*, the friend of Mr. Punch. But now, Mr. Briggs has become degenerate: he has joined the Natural History Club of the South-Eastern College, Ramsgate; he has swilled draughts of Albert Chevalier and the Poet Laureate; he has poured an uncooked mixture of his scraps into the columns of the *Kentish Gazette*; and, worst of all, he has, by a charmingly got-up reprint of his essays (for which all credit is due to the publishers) enticed us into reading them for purposes of review.

His rambles have indeed led poor Mr. Briggs into tangled paths. So long as he sticks to matter of fact we cannot complain: "Nature has many moods," "Death is no respecter of persons," "Colds are at all times undesirable." "Something is wrong somewhere"—true, O Briggs! But we cannot fully subscribe to such statements as these: "Everywhere in winter one finds treachery," "the reaper putteth in his sickle and the blade [*sic*] is severed." The kingfisher's eggs "blush with lovely pink lent by the conscious [!] yolk within." At Folkestone, "along the heights to this very day

'In the whirlwind o'er the spray
They behold the halcyon play.'"

The old naturalists did, it is true, suppose that kingfishers "sat brooding on the charmed wave," but it was reserved for a Briggs to see them above the breakers of the Channel. But then Mr. Briggs does wonderful things: he can hear a bee's heart beating, as we infer from a statement on p. 14; he knows that hedgehogs dream all the while they hibernate, they dream "of golden summer days, when the nightingales sang love melodies"; he knows that "the poet's Lorelei sat on the beetling heights above the sea, luring the sailor and his ship to destruction on the cruel rocks below,

'while softly flowed the Rhine.'"

Ah, yes! the poets! Mr. Briggs is fond of poets. We wonder if they are fond of Mr. Briggs, for he drags them into all impossible connections, not without abundant mis-quotation, even laying impious hands on "Hymns Ancient and Modern," as thus: "The strange wild cry of the wandering owl echoes back amid the deepening gloom,

'O'er moor, o'er [*sic*] fen, o'er crag, or [*sic*] torrent till
the night is gone.'"

or again: "birds of gloom,

'Like the shadows of the evening,
Softly steal across the sky.'"

Mr. Briggs is indeed a veritable Malaprop: he talks about "the shores of Babylon"; he calls an owl "the goose with the golden egg"; he speaks of the chaffinch's "feathered vocalism," as though it sang with its head under the bedclothes; he thinks that "where ignorance is bliss, etc.," is an old proverb; in parody of Shakespeare he tells us that "the blackbird tuned his orange bill"; he adds to the English language the words "discomforture" and "squallid"; and he thinks that "Revolted daughters" have grown so "mannish" that they will "beget" children who "will probably never know their parents."

The readers of the *Kentish Gazette* take their Briggs in instalments; but who shall swallow this warmed-up farrago of a book? Never mind! they that have the courage to attempt it may get many another jest from its pages, not all examples of conscious humour perhaps. Even this solitary witticism may be unintentional: "Socialists are *radically* wrong." The italics are ours. Well, well! "Everybody ought not to be the same—equal. Nature never intended it." True again! but then those who are not equal to it should not publish. Let Mr. Briggs return to the bosom of his family and the illustrated pages of our humorous contemporary.

New Serials.

A new quarterly journal, *Centrallblatt für Anthropologie, Ethnologie, und Urgeschichte*, edited by Dr. G. Buschau, with the co-operation of eminent anthropologists, is issued by J. U. Kern, of Breslau.

Volume i. of the *Reports* of the University Geological Survey of Kansas, to whose energies we have more than once alluded, is announced. It contains about 100 pages of text, with figures and plates, and deals chiefly with stratigraphy of Carboniferous rocks in Kansas.

The *Psychological Review* announces the establishment of a new Russian monthly review of psychiatry, neurology, and experimental psychology, edited by Dr. Bekhteret.

For the study of the districts of Altaï and Nertchinsk there has been formed a Geological Section of the Cabinet of the Czar, under the direction of Professor A. Inostrantzev. This Section publishes its results under the title *Travaux de la Section Géologique*, etc. (Trud'i gheologhīcheskoĭ Kabīneta egho īmperatorskagho Velīchestva). Vol. i., Livr. 1, containing 144 pages, and Livr. 2, containing 94 pages, were published, in 8vo, at St. Petersburg in 1895. They contain papers, written in Russian, by P. N. Venyukov, A. A. Baĭkov, V. I. Pletner, and the editor, as well as a geological and geographical bibliography of the Altaï.

From S. Paulo, in Brazil, comes vol. i. of *Revista do Museu Paulista*, publicada por H. von Ihering, 1895. It is in 8vo, and consists of 254 pp. and 3 plates, containing a description of the museum and other papers by von Ihering, P. Taubert, and A. Lutz.

The *Halifax Naturalist*, a bi-monthly magazine of natural history and archæology of the parish of Halifax, Yorkshire, deserves a welcome, if only for the brightness of its general appearance. The first number contains: a geological map of the parish on the scale of 1 inch to the mile, compiled from the Ordnance Survey; an account of some physiographical features of the parish of Halifax, by W. Simpson; an introduction to the flora of the parish of Halifax, which will form, when finished, an independent work; a record of the meetings of the Halifax Scientific Society; and various smaller notes. The editor is Mr. W. B. Crump, and the price is 6d. This magazine will deal with the natural history of the ancient parish of Halifax, and will no doubt tend to increase the interest in natural history that is already felt by a number of the inhabitants. While we appreciate the merits of this first number, we must again protest against the increase of local publications. There already exists the *Naturalist*, a monthly journal of natural history for the North of England, which, as it so constantly contains articles connected with Yorkshire, should have sufficed the needs of Halifax.

The first number of the *Idaho Mining News* (Boise, Idaho, price $1 per annum) appeared in March. According to the *American Geologist*, it contains papers on the Boise gold belt and the coal-fields of the Payette River.

A monthly *Index* to the medical press of the United States and Canada is announced by Frank Weir & Co., New York.

No. 1 of the *Journal of Experimental Medicine* contains 210 pages, eight plates, and other illustrations. The journal will be devoted to original investigations in Physiology, Pathology, Bacteriology, Pharmacology, Physiological Chemistry, Hygiene, and Medicine. It is published for Johns Hopkins University by D. Appleton & Co., New York. Subscriptions, $5 per volume of over 600 pages, may be sent to Mr. N. Murray, Johns Hopkins University.

OTHER SERIALS.

THE January number of the *Psychological Review* contains a valuable paper on "Psychology and Physiology," by Professor G. S. Fullerton, of Pennsylvania.

The January number of the *Monist* publishes a translation by T. J. McCormack of Professor Weismann's address on "Germinal Selection" delivered before the International Congress of Zoologists last September; also a translation of Professor Ernst Mach's recent inaugural address on the part played by accident in invention and discovery.

A very timely paper by Dr. James Rodway on "the old Boundary of Essequebo" is to be found in the December number of *Timehri*, which also contains "Stray Notes from Pirara" and "Some Guiana Parrots" by C. A. Lloyd, and an investigation into the materials of the urali poison by J. J. Quelch.

Vol. viii., pt. 2, of the *Journal of the College of Science* at Tokyo, which has been sent to us, contains a paper by Asajiro Oka, which describes *Orobdella*, a new genus of land-leech found in Japan. The same author has a note on the so-called excretory organ of fresh-water Polyzoa, in which he comes to the conclusion that the "Ectoproctous Polyzoa have no nephridia. What have been regarded as such in Phylactolæmata is nothing but a portion of the mesodermal epithelium of the body-cavity, made conspicuous by the presence of an epistome-lophophoral partition, wanting in Gymnolæmata." Sakugoro Hirase contributes "Études sur la Fécondation et l'Embryogénie du Ginkgo Biloba." Dr. I. Ijima and S. Ikeda describe a new species of the peculiarly shaped octopod, *Opisthoteuthis*, under the name *O. depressa*. It is remarkable that the only other species of this genus that is known was found in the West Indies; in our January number, p. 10, we recorded a somewhat similar distribution of the Chimæroid *Hariotta*.

The March number of the *American Journal of Science* contains an article on recent and fossil tapirs by J. B. Hatcher, which, besides adding to our knowledge of the Oligocene *Protapirus*, reviews the general question of the phylogeny of the Tapiridæ and Helaletidæ.

In the April number, C. E. Beecher gives a restoration of the dorsal and ventral surfaces of *Triarthrus*; Dr. A. E. Ortmann criticises the arguments advanced by Neumayr for the existence of climatic zones in Jurassic times, and comes to the conclusion that the differences in the faunas of the Jurassic deposits were not caused by climatic differences, but partly by topographical conditions, and partly by differences of depth and of sea-bottom in the seas.

Science for February 21 contains an interesting address by Dr. Theo. Gill on "Huxley and His Work." In this the passage of most original interest is that where the learned author credits to Huxley's sagacity the early appreciation of the affinity of the *Neoceratodus* of Australia to the Mesozoic Ceratodontidæ, with all the far-reaching consequences that appreciation involved.

L'Anthropologie for January and February contains a paper of considerable interest to botanists by Edouard Piette, "Les Plantes cultivées de la Période de Transition au Mas-d'Azil," which place is on the River Arise.

A short sketch of the history, geography, and industries of Venezuela is to be found in the *Scottish Geographical Magazine* for April, which also contains an interesting paper by James Troup, H.B.M. Consul at Yokohama, on the industrial and commercial development of Japan. Very timely also is a long account of Cuba extracted from the articles by Dr. Emil Deckert that have recently been published in the *Geographische Zeitschrift.*

In connection with the acceptance by Dr. J. M. Coulter of the head professorship of Botany at Chicago University, the financial management of the *Botanical Gazette*, of which he is senior editor, passes into the hands of that body. The immediate result is an increase in number of pages, and after July the *Gazette* will be published at the University of Chicago, whither all correspondence should now be addressed. The editorial staff is unchanged. The *Gazette* will be "even more freely open to the botanists of the world than it has been in the past." Its prosperity, as well as its excellence, is now assured.

The April number of *Knowledge* contains a thoroughly practical article by J. W. Gifford, entitled "Electrography or the New Photography," which has some excellent reproductions of electrographs, actinograms, or skiagrams. Other skiagrams are reproduced in the *American Naturalist* for March, in the *Photogram* for April, in *Nature* for January 23, February 6, and March 5, in the *Revue Scientifique* February 1, and in the *Revue Générale des Sciences* January 30; but perhaps some of the best are those that were given in *The Open Court* for February 6 and March 12.

Messrs. Williams & Norgate have kindly sent us their *Foreign Book Circular, Scientific Series*, no. 63. It is stated to be a "list of new scientific publications," and contains 572 titles. Since, however, fully half the publications seem to be older than 1895, and since no reference is made to the fact that many of them are merely extracts from serials, we cannot think that the list will be of much use to either librarians or working naturalists.

From the Free Public Reference Library of Nottingham we receive the third supplement to the list of scientific books and periodicals, compiled, under the direction of J. Potter Briscoe, by S. J. Kirk, senior assistant, price 1d. From this and previous lists it appears that the library contains a very useful selection of scientific works, especially rich in those relating to the neighbourhood. No foreign scientific periodicals are placed on the tables, and we notice in this list scarcely any books published outside Great Britain.

LITERATURE RECEIVED.

Primary Factors of Organic Evolution, E. D. Cope: Open Court, Chicago. British Sea-Birds, C. Dixon: Bliss, Sands & Foster. Ethnology, A. H. Keane: Clay. Natural History of Selborne, G. White: Ginn (Boston). Royal Natural History, nos. xxix., xxx.

Iowa Geological Survey, vol. v.: Administrative Reports. Catalogue de Botanique: Baillière. The Jack Rabbits, T. S. Palmer: *Bull. U.S. Dept. Agric.* Australian Termitidæ, pt. i., W. W. Froggatt: *Proc. Lin. Soc. N.S.W.* Annual Report Geol. Survey Great Britain, 1895. Physiology of the Root Tubers of Isopyrum biternatum, D. T. MacDougall: *Minn. Bot. Studies.*

Actes Soc. Sci. Chili, t. v. Science Progress, April. Micros. Studies in Botany, March. Nature, March 19, April 9, 16. Knowledge, April. Review of Reviews, April. Revue Scientifique, March 21, 28, April 4, 11. Irish Naturalist, April. Revue générale des Sciences, Feb. 29, March 15. Feuille des jeunes Naturalistes, April. Naturen, March. American Journal of Science, April. Journal of Malacology, vol. v., no. 1. Naturæ Novitates, March. Victorian Naturalist, Jan. and Feb. Science, March 13, 20, 27, April 3. Scottish Geographical Magazine, April. Science Gossip, Jan. The Naturalist, April. Westminster Review, April. American Geologist, April. Botanical Gazette, March. Biology Notes, March. Scientific African, March. Psychological Review, Feb. The Photogram, March and April.

OBITUARY.

ROBERT EDWARD EARLL.

Born at Waukegan, Ill., Aug. 24, 1853. Died at Washington, March 18, 1896.

THE Smithsonian Institution loses an old and trusted member of its staff by the death of Mr. Earll, who had been connected with it since 1877. Educated in the Waukegan public schools, and later at Chicago and the North Western University, Mr. Earll, after serving on the Fish Commission as a fish culturist, became in 1885 Chief of the Division of Statistics of that body, and was sent, in 1883, to the International Fisheries Exhibition in London, as a member of the Staff of the U.S. Commission. The aptitude he showed for this work led to his being appointed chief executive officer at subsequent exhibitions at Louisville, New Orleans, Cincinnati, Chicago, and Atlanta, for the exhibits of the Smithsonian Institution and the National Museum. Since 1888 he had been Curator of the National Museum, and editor of its *Proceedings* and *Bulletins*. Himself a skilful fish culturist, and an authority upon the natural history of the shad and herring, he made exhaustive studies of the fishery statistics of the Atlantic and Gulf Coasts, and of the Great Lakes, and took part in the early experimental work on the propagation of the shad, and in the establishment of the cod-hatching station at Gloucester.

Our information is gleaned from a notice in *Science* by Dr. G. Brown Goode.

WILLIAM SHARP, M.D., F.R.S., F.G.S.

Born at Bradford, 1805. Died at Llandudno, April, 1896.

TO this eminent man has been ascribed the introduction of natural science into the curriculum of our public schools. The Sharp family, which included Archbishop Sharp and Abraham Sharp, the astronomer, had been settled for many generations in the Bradford district, and the deceased, after studying in London and in Paris, returned to Bradford in 1828, and succeeded to the lucrative practice of his uncle in that town, becoming also senior surgeon of the infirmary in 1837. In 1843, he resigned his practice and went to Hull, where he gave lectures on chemistry during the winters; but four years later he removed to Rugby for the purpose of placing his sons under Dr. (afterwards Archbishop) Tait, then headmaster of

Rugby. Finding that natural science had no place in the teaching at Rugby, he urged its introduction on Dr. Tait. The latter was quite willing to make the experiment, provided Dr. Sharp would become the first teacher, and, under the style of "Reader in Natural Philosophy," Dr. Sharp conducted the classes during 1849 and 1850. "If," said the late Tom Hughes, "Tait had done nothing else at Rugby than appointing Sharp, not without difficulty, as reader in Natural Philosophy, he would have deserved the gratitude of every Rugby man." Dr. Sharp was also one of the early supporters of the establishment of local museums, and read a paper on the subject before the British Association in 1839. His more important writings were on the various schools of medicine, and appeared at intervals under the title of "Essays in Medicine." He was elected a Fellow of the Royal and of the Geological Society in 1840.

ARTHUR SIDNEY OLLIFF,

BORN AT MILLBROOK, HANTS, OCTOBER 21, 1865.

DIED AT SYDNEY, N.S.W., DECEMBER 29, 1895.

WE deeply regret to learn of the premature death of this energetic worker and charming man. He early displayed a liking for entomology, and, when a boy, assisted Mr. C. O. Waterhouse at the British Museum. From 1883 to 1885 he was private secretary and scientific assistant to Lord Walsingham. In February, 1895, he joined the Australian Museum as assistant zoologist, and remained there until transferred to the Department of Agriculture in 1890. His published writings are chiefly on Coleoptera, and to a less extent on Lepidoptera. Of late years his contributions to economic entomology have had much practical value.

THE death in Havana of JOHN GUNDLACH is announced by *Science*. He was born at Marburg, Hesse-Cassell, in 1810, and went to Cuba in 1839 on the invitation of the wealthy Cuban, Mr. Booth. His collection of the fauna is preserved in the Institute at Havana. He was the author of a work on Cuban ornithology, and of a book on the fauna of both the Antilles.

THE death is announced in Paris of Professor MARIE PHILIBERT CONSTANT SAPPEY, at the advanced age of 86. Though chiefly devoted to medical subjects, he is well-known by several contributions to anatomy and histology. His first paper, published in the *Comptes Rendus* for 1846, is a preliminary account of his volume on the respiratory apparatus of birds issued during the following year in Paris. In 1880 he published a second separate work on the slime-canal and lymphatic systems of fishes.

WE regret to learn from Professor Mitsukuri of the death of Dr. S. HIROTA, who was a worker of great promise. It is not long since we received from him some anatomical notes on the "Comet" of *Linckia multifora*, from the *Zoological Magazine*, of Tokyo, in which he had also published papers on the fauna of the Ogasawara (Bonin) Islands, on the loss of weight in the fowl's egg during incubation, and on a skink with an accessory tail. In the *Journal of the College of Science*, Tokyo, he had published a paper on the sero-amniotic connection and the fœtal membranes in the chick, while the last number of that Journal contains a contribution by him on the dendritic appendage of the urogenital papilla of a siluroid, in which he comes to the conclusion that the organ in question is a highly specialised gland early developed in both sexes.

WE have also to record the deaths of: MARMADUKE LAWSON, Director of the Government Chinchona Plantations in the Neilgherries, who was Sherardian Professor of Botany and Sibthorpian Professor of Rural Economy at Oxford from 1868 to 1883, at Madras on February 14; ABEL HOVELACQUE, Director of the École d'Anthropologie de Paris; on February 10, G. WAGENER, Professor of Anatomy of Marburg University, aged 74; Lieutenant EWIND ASTRUP, a well-known Polar explorer, and participator in both Peary's Greenland expeditions, who disappeared shortly before Christmas and whose body was found in the Dovrefjeld, in Norway, on January 21 by a search party; OTTO EHLERS, the German explorer, who started from Bayern Bay, intending to reach British New Guinea, but was drowned in the Heath River; Dr. L. JACOBY, ichthyologist, of Zürich; Professor K. RATHLEF, botanist; the ornithologist, H. TH. WHARTON, at the age of 50; Lieutenant H. E. BARNES, well-known for his works relating to Asiatic ornithology, aged 48; J. v. BERGENSTAMM, the noted dipterologist, in Vienna; Dr. A. SCHADENBERG, in Manilla, well-known for his researches on the flora and ethnography of the Philippines; JEAN MÜLLER (Argoniensis), the director of the Botanical Gardens at Geneva, Custodian of the Delessert Herbarium, and a leading authority on lichens, at the age of 68, on January 28; Dr. F. SANSONI, Professor of Mineralogy in Pavia, and editor of the Italian Journal of Mineralogy; ROBERT HAY, of the U.S. Department of Agriculture, and author of many papers on Kansas geology, at his home in Junction City, Kansas, on December 14, 1895; ALFRED L. KENNEDY, metallurgist and geologist, who, in 1852, founded the Polytechnic College of Philadelphia, burnt to death in his rooms at Philadelphia, on January 30, being in his 80th year. T. H. BUFFHAM, to whom algologists owe many interesting notes on the reproduction of seaweeds, died on February 9, aged 56.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

The following appointments are announced;—Mr. E. H. Cunningham-Craig, B.A., of Clare College, Cambridge, to be Assistant Geologist on the Geological Survey of Scotland; Professor D. Barfurth, of Dorpat, to be Professor of Anatomy at Rostock; Dr. Smirnow, of Kasan, to be Professor of Histology in Tomsk; H. Ph. von Norbeck, to be Chief Geologist of the Geological Survey in Vienna; Professor G. F. Atkinson, to be full Professor and Head of the Department of Botany (in succession to Professor Prentiss), E. J. Durand, to be Instructor, and K. M. Wiegand, to be Assistant in Botany, at Cornell University; H. C. Warren, to be Assistant Professor of Experimental Psychology in Princeton University.

The Professor of Botany in Amsterdam, G. A. J. A. Oudemans, has resigned his appointment on the ground of old age.

The French Academy of Medicine has awarded the Prix St. Paul, valued at £1,000, to Dr. Roux, of the Pasteur Institute, and Dr. Behring, of Berlin, for their joint discovery of the croup vaccine. The Academy thus gives official recognition to the claims of the German to be co-discoverer.

Professor K. A. von Zittel has received the Hayden Medal of the Philadelphia Academy of Natural Science.

The University of Glasgow has conferred the degree of LL.D. *honoris causa* on Mr. W. T. Thiselton Dyer, whom local papers describe as "of some standing among horticulturists," but otherwise unknown to fame. The University of Edinburgh has conferred the honorary degree of LL.D. upon Professor Edouard van Beneden, of Liège.

The *Psychological Review* states that a laboratory of experimental psychology has been fitted up at the University of Kansas under the charge of Olin Temple, Professor of Philosophy.

Professor E. Hering, the successor of Ludwig at Leipzig, is lecturing on the "Physiology of Sensations and Movements." His addresses on "Heredity as a Form of Memory" and "The Specific Energies of the Nervous System" have recently been published as no. 16 of the Religion of Science Library by the Open Court Publishing Company, of Chicago, price 15c.

A number of scholarships and fellowships for graduates have been established at the University of Pennsylvania by means of a fund of $500,000 left to the University last June by Provost Harrison. "The whole plan," says *Science*, where full details will be found (vol. iii., p. 513), "aims at building up a cultured group of men interested in the advancement of knowledge and who shall be in residence at the University.'

THE Department of Botany of Chicago University has planned a large building, to be known as the Hull Botanical Laboratory "The four stories," says the *Botanical Gazette*, "will contain ample space for lecture-rooms, libraries, laboratories, and private research rooms for morphology, physiology, and taxonomy. A large roof greenhouse will supply an abundance of living material under all conditions."

WE learn from *Science* that Harvard University has, mainly by means of a fund established in 1892 by G. A. Gardner, of Boston, purchased several thousand photographs of geological and geographical subjects.

THE Sunday opening of the National Museums in London was inaugurated on Easter Day by the admission of the public to the various galleries of the South Kensington Museum, and to the Bethnal Green Museum, between the hours of 2 and 6. The total number of visitors to the South Kensington Museum was 7,168, which, however, is probably to be reduced owing to some visitors having passed through the numerous turnstiles more than once. At Bethnal Green the number was 3,026. It was odd to see in the picture galleries at South Kensington several pictures carefully hidden from view by cloths. A young lady visitor was overheard supposing that they were "too improper to be shown on a Sunday"; but we understand the truth to be that the terms of the Ellison bequest, under which they were left to the Museum, forbade their exhibition on the Sabbath. These pictures will therefore continue to be sealed treasures for the majority of Londoners.

THE Horniman Museum at Forest Hill has been open on Sunday afternoons ever since June 1, 1895, and up to Easter Day the visitors numbered 17,330, or an average of 391. The average for week-days, from 2.0 to 9 p.m., is 456. The present building is becoming so crowded with collections, especially of objects from the East, collected by Mr. Horniman during his recent travels, that it is intended to build a new museum. The Report for 1895, which has been sent to us, contains full-page illustrations of some recent acquisitions, of which the most interesting to our readers is, perhaps, the ancient Celtic bell of quadrangular shape, formed of a single plate of iron about 22 inches in length by 10 inches in breadth, which has been bent on itself in the middle, and riveted along the sides with flat-headed nails. The bell appears to have been dipped into melted bronze. It was found at Bosbury, in Herefordshire, and is of a type very rare in England. This museum has recently purchased a fine specimen of *Ichthyosaurus*, from the Lias of Keynsham, about ten feet in length.

A LARGE and beautiful series of original drawings of Fungi, by Mr. Edwin Wheeler, of Bristol, has recently been presented to the Trustees of the British Museum. The evanescent nature of many of the forms renders such faithful representation of the living and growing plants peculiarly valuable. Mr. Wheeler has laid all lovers of nature under special obligation to him for his splendid work, admirable alike for the scientific exactness of form and colour, and for the artistic rendering of these little-known plants. The larger forms, such as *Agaricus*, *Polyporus*, and *Boletus*, are the most fully represented. The Discomycetes, such as *Helvella*, *Pezizæ*, and others, are also included in the subjects of Mr. Wheeler's art. Many of the microscopic rusts, moulds, Mycetozoa, etc., which are so exquisite in detail, have been drawn by the aid of the microscope or the magnifying glass. They show us anew how much is visible to the trained eye that is entirely lost to the casual observer. Mr. Wheeler and his brother, Dr. Henry Wheeler, have handed over, as a free gift to the nation, this magnificent and unique collection of some 2,500 drawings. A selection from them is at present on exhibition in the Botanical Gallery of the Natural History Museum, Cromwell Road.

WE are glad to see that the inhabitants of Bristol take so much interest in their museum that Mr. E. Wilson's excellent little penny guide has gone into its sixth edition. Among recent improvements in this museum is the formation of a students' geological collection, comprising between 600 and 700 specimens of fossils, rocks, and minerals, intended for the use of students studying geology for examinations. A catalogue of the collection, printed on one side the page, has been issued at the price of sixpence. The nomenclature of the catalogue follows that of accepted text-books.

THE Boston *Transcript*, as quoted in *Science*, announces that Mr. Charles B. Cary, Curator of the Ornithological Department of the Field Columbian Museum, has established at Palm Beach, Florida, a museum devoted to the natural history of the State, which is soon to be opened to the public. An excellent collection of birds, reptiles, mammals, fishes, etc., is already in order, and aquaria are to be fitted up for the study of salt- and fresh-water fishes.

FROM the *Botanical Gazette* we learn that the New York Botanic Garden has purchased the collections and part of the mycological library of Mr. J. B. Ellis, of Newfield, N.J. The herbarium contains numbers of type-specimens of fungi. It will be housed in the Museum now building at the Garden.

THE National Museum at Washington is to erect an additional fire-proof building.

AN International Congress of Miners and Geologists will be held at Buda-Pesth during the Hungarian Millennial Exhibition, on September 25 and 26 next.

THE *Irish Naturalist* announces the summer excursion programme of the Dublin Field Club, namely:—April 25, Bray and Killiney (geological half-day); May 30, Lambay Island; June 20, Bective and the Boyne; July 10, 11, and 13, Cavan; August 12, Kelly's Glen (half-day); September 5, Brittas Bay, co. Wicklow; September 20, Woodlands (fungus foray, half-day). The excursion to Cavan, when three days will be spent exploring the many lakes, rivers, and woods of that beautiful county, should prove especially productive, as the district is one almost unworked by the naturalist.

A SOCIETY has been formed at Ipswich for the protection of wild birds and their eggs in Suffolk. Portions of the Suffolk coast are under the protection of a Home Office order prohibiting the taking or destroying of eggs, in accordance with the Protection Acts. The work which the new society has set itself to do is to secure the protection of the whole area, and to appoint watchers to secure the enforcement of the existing order.

THE Technical Instruction Committee of the Essex County Council proposes to give a special course of instruction in marine zoology at the Biological Station of Brightlingsea during the summer months. The course is intended for students, and is the outcome of the lectures and practical instruction given at Brightlingsea during the past winter. The students of the botanical classes held at Chelmsford Laboratory are organising some field meetings for May, June, and July.

MR. A. A. CAMPBELL SWINTON has opened a special laboratory for the medical application of radiography or skiagraphy at his address, 66 Victoria Street, London, S.W.

WHILE regretting the sad loss of life that occurred at the opening of the Snowdon railway, lovers of nature cannot regard the accident to the train in the light of an unmixed evil, especially if it does anything to check the desecration of the few remaining spots of wild nature that still remain to us.

A SYNDICATE has been formed to mine coal near Dover, where, it will be remembered, Coal Measures have been proved to lie at about 12,000 feet below the surface. The syndicate has been buying up land in the neighbourhood for some time, and has acquired mining rights over some 5,000 acres. It is intended to begin work next June in Alkham Valley, three miles west of Dover.

THE State of Maryland has established a Geological and Economic Survey which will prepare and publish reports and maps. An annual appropriation of $10,000 has been made, and Professor W. B. Clark has been appointed State Geologist. Professor Clark's well-known energy and the amount of good work that he has already done in Maryland lead us to hope for great things from this new survey.

ACCORDING to the *Scottish Geographical Magazine*, Mr. Ad. de Gerlache, of the Belgian Navy, intends to start at the end of next summer for the Antarctic Regions in a steamship of 400 tons. He will pass two seasons in the Southern Ocean; in the first he will steer for the lands situated to the south of Cape Horn, and in the second will make for Victoria Land, principally to ascertain more exactly the position of the southern Magnetic Pole. The expedition will include specialists in meteorology, magnetism, oceanography, zoology, and botany, and will be provided with a complete set of instruments. Subscriptions to the sum of £10,000 are invited by the Royal Belgian Society of Geography.

Meanwhile, Mr. Borchgrevink, of whom we have heard so much of late, is, as we hinted in our February number, to join a whaling expedition to Victoria Land, which starts on September 1. For £5,000 he and eleven other naturalists will be taken out and landed at or near Cape Adare. They will work towards the South Magnetic Pole, taking magnetic, meteorological, and pendulum observations, surveying, and making collections. At present Mr. Borchgrevink has transferred his propagandism to the United States, and whether it be as the result of his endeavours or no, the American Society of Naturalists has appointed a committee of three to take measures for the fitting out of an Antarctic expedition in the near future. Its natural object would be the exploration of Graham's Land, which lies due south of Patagonia.

IN connection with Andrée's balloon-expedition to the North Pole, it is hoped to send a zoological expedition, under the direction of G. Grönberg, lecturer at Stockholm University, to the Norsk-öar, near Spitzbergen, from which islands the ascent is to be made. These islands have long been known as one of the richest zoological localities in this region. A Polish contingent to the expedition is being planned by Dr. Roszkowski and Prince O. Hajdukievicz, who are both studying at Stockholm. If thirty volunteers come forward, it is proposed to hire a steamer to accompany the "Virgo," which leaves Gothenburg with Andrée on May 1. After visiting Spitzbergen and the Norsk-öar, this steamer will return to the north of Norway to observe the solar eclipse. The Russian Government has distributed among the northern tribes under its rule several thousand copies of a pamphlet, in many languages, containing a picture of the balloon and the Czar's orders to all and sundry to assist the aëronauts. Mr. Andrée's balloon is being fitted with a complete instantaneous photographic apparatus which improves upon the Kodak, since by pressing the button, not merely is the view taken, but the day, hour, minute, and second are recorded. It is also intended to take several carrier pigeons, which will be dispatched from time to time.

ANOTHER expedition to Spitzbergen is that projected by Sir William Martin Conway, whose intention is to penetrate inland and explore many parts as yet unvisited. The expedition was to have started in May, but we understand that the time of its departure has been postponed till June, in the hope that Dr. J. W. Gregory, of the British Museum, may be able to accompany it. There are fossils of almost all geological periods, from the Devonian to the Pleistocene, to be obtained at Spitzbergen, but they are at present most meagrely represented in the national collections, so that there is plenty of work for a practised geologist. Dr. Gregory's book on his experiences in East Africa is on the point of publication, and he doubtless longs for "fresh fields and pastures new," if such a quotation can be applied to so inhospitable an island.

An exhibition at the Grafton Galleries, London, W, is very timely. This is a series of four pictures by the Arctic explorer, Professor Julius von Payer, representing the loss of the Franklin Expedition. As a representation of Arctic conditions by a skilled painter having practical experience thereof, as well as by virtue of their pathetic subject, the pictures are worth the attention of naturalists.

The "Faraday" has returned from the Amazons, bringing with her Messrs. Austen and Pickard Cambridge, who have amassed a fine collection, chiefly of Arthropoda, and including several spiders' nests. These will go to the British Museum (Natural History). Some interesting bionomic observations have been made.

Professor Alexander Agassiz, accompanied by Dr. W. McM. Woodworth and Dr. A. G. Mayer, has gone to Australia in order to investigate the Great Barrier Reef, for which purpose a special steamer has been chartered in Australia. He expects to return about July 1. Owing to his absence, Wachsmuth and Springer's Monograph of Crinoidea Camerata of N. America will not be published before August.

Science informs us that Mr. J. B. Hatcher, of Princeton College, special agent and collector for the Bureau of Ethnology at Washington, and Mr. O. A. Peterson, collector for the American Museum of Natural History, New York, have embarked for Patagonia on the steamship "Galileo."

Dr. K. Lauterbach, Mr. Tappenbeck, and Dr. Kirsting are leading an expedition to the Hinterland of New Guinea.

Dr. Nils Holst, the Swedish geologist, is to travel for a year in West Australia under the auspices of the Anglo-Scandinavian Exploration Company.

Mr. Roy W. Squires, says *Science*, goes to Venezuela as a representative of the Department of Botany of the University of Minnesota and under the auspices of the Orinoco Company. He will make collections in the unexplored mountain regions south-east of Barancas. The region covered will lie considerably south of that visited by previous botanists, and a valuable collection may be looked for. Mr. Squires will be absent from Minnesota about six months.

After the publication of our last number, Professor D. G. Elliott, who was to have gone to South Africa, altered the destination of his expedition to Somaliland, whither he sailed on March 27, accompanied by Mr. Dodson, who was with Dr. Donaldson Smith's expedition to Lake Rudolph. Landing at Berbera, Mr. Elliott will pass southwards over the plateau to the Shebeyli River, and will return down the valley of the Juba River.

Those of our readers who are in the habit of receiving scientific papers from their American colleagues should note that in future such second-class mail-matter for Europe will have to wait the departure of the American Line steamer on one day in the week, unless the packages are specially marked by the sender to be forwarded by an earlier steamer or another route.

CORRESPONDENCE.

Hydrachna globula (Dugès).

In breaking up a specimen of *Dytiscus marginalis*, which had been in spirit for some months, I found a nymph of *Hydrachna globula* (Dugès) imbedded in the fat-body on the left side, near the first abdominal spiracle. Since then I have learned that Mr. G. E. Mainland, F.R.M.S., had a similar experience some years ago. Dr. Trouessart has kindly identified the specimen for me, but he offers no suggestion as to how the mite—common enough as an external parasite on *Dytiscus*, *Nepa*, and *Notonecta*—got into such strange quarters. I shall be grateful for help on this point. The specimen is now at the British Museum (Nat. Hist.) in the care of Mr. Pocock.

9 Cavendish Road, Harringay, N. Henry Scherren.

A Council of Zoologists.

Your proposal with reference to the Nomenclature question is an interesting one. If it be possible for the German Zoological Society to publish a synopsis of the Animal Kingdom, it certainly should be possible for the names of extinct species to be added to it. Assuming the truth of Dr. Sharp's estimate as to the number of recent species (and almost the same estimate has been made independently and synchronously by an American systematist), we need not suppose that it would be so very greatly increased by the addition of extinct species. It is the Insecta that swell the numbers of recent species, but their fossil representatives are very few. Perhaps a series of Palæontological Appendices to the various parts of "Das Tierreich" might be arranged. But you are right in urging the prior completion of a list, such as Mr. Sherborn's "Index Specierum."

When the Council which you suggest has been appointed, it might draw up an "Index Expurgatorius" of publications. There are writers who, without doubt, should not be treated as serious workers, and who would be blackballed by all true zoologists. Recorder.

Some Corrections.

Mr. Theodore Groom asks us to state that in his letter in our April number on p. 287 the words "long cylindrical glass troughs" should be "long rectangular glass troughs." In the third paragraph of Mr. Pycraft's article on "The Wing of Archæopteryx," p. 261, the implication that Dr. Hurst regarded the bone that he *provisionally* named (not identified as) "ulnare," as belonging to the proximal row of carpals, is contrary to fact. It was also incorrect to state that Owen figured it as the radiale.

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22 St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

The "Challenger" Number.—*In reply to enquiries, we remind our readers that, although the* First *edition of this ran out of print immediately, there are still some copies of the* Second *edition to be obtained at the usual price*—One Shilling. *No more will now be printed, so orders should be sent at once.*

NATURAL SCIENCE:

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NOTES AND COMMENTS.

Progress at the Natural History Museum.

THE most obvious change that has lately been made at the British Museum (Natural History) is the removal of the huge skeleton of the sperm-whale from the middle of the entrance-hall to a more appropriate place in the large temporary room recently erected at the back of the Museum for the Cetacea. This will make room for more of the beautiful cases that illustrate such subjects as Mimicry, Protective Coloration, Seasonal Variation, and Albinism.

The Introductory Series, or "Index Collection," arranged under the supervision of Sir William Flower in the bays round the central hall, continues to advance. The work begun many years ago by the late R. S. Wray, then assistant to the Director, is being continued in the same careful manner by his successor, W. G. Ridewood, with all the advantages of modern museum technique. The latest portion of the series to be finished is in the bay devoted to the anatomy of fishes, including the lancelet and the lampreys, and illustrates the structure and development of fishes' teeth. A paper which may serve the student as a companion to, and memento of, this exhibit has kindly been contributed by Mr. Ridewood to the present number; the illustrations to it are not mere reproductions of text-book *clichés*, but have been accurately drawn from the exhibited specimens by Mr. J. Green.

We may remind our readers that we have already published articles on portions of this Introductory Series, namely, "The Teeth of the Horse" (vol. vi., p. 249, April, 1895) and "Morphology at the National Museum" (vol. vii., p. 258, October, 1895). We hope that, as the work progresses, we may be able to furnish students with more of these valuable summaries.

Birds and Mammals at the British Museum.

Passing into the Zoological Department, we find changes taking place on all sides, and some of them form the subject of Sir Henry Howorth's "Casual Thoughts" on a following page. The nests of

British song-birds have been brought down from the corridor, and now stretch from the Bird-gallery, across the Coral-gallery, down the middle of the Reptiles; this disposition is far from elegant, but the birds are at all events near their fellows, and we are not sorry to see some of the gaping crocodiles placed in a less conspicuous position. We welcome, however, *en passant* a really fine and well-mounted specimen of *Tomistoma*, a crocodile from the Malaccas. The corridor from which these birds have been removed is now being filled by the stuffed specimens of African antelopes, among which the magnificent Kudu has a prominent position. Thus room is made in the adjoining Mammal-gallery for an extensive series of admirable alterations, being carried out by Sir William Flower with the assistance of R. Lydekker. The first principle of the change has been to bring the various specimens of the respective groups into proximity. Thus, the Monotremata occupy two glass cases near the entrance; the first bay on the right is devoted to Marsupialia; the second, to Edentata and Sirenia (Cetacea cannot be represented here on account of their size, so the visitor is informed where they are to be found); the next bay is occupied by Suina; the fifth by Camelidæ; then follow the rest of the artiodactyle ungulates up to the end pavilion, which is filled with specimens of *Bos* and *Ovis*, of which the Museum has a fine collection. The perissodactyle ungulates and the rest of the Mammalia will be arranged in the bays along the other side of the gallery. The arrangement is purely systematic, but an attempt is made to bring out the meaning of the system by calling attention to the diagnostic characters of Orders, Families, and Genera, with the help of explanatory labels and specially prepared osteological specimens. Each genus is exemplified, but only such species are exhibited as show range of variation in structure or of distribution. The distribution of the divisions, from Orders to Species, is shown by maps of the world of gradually decreasing size; thus the greatest detail has to be shown on the smallest map, a difficulty which might be got over by having maps of the zoö-geographical provinces for the species, since a species is rarely found in more than one province. Where not required for exhibition purposes, the upper portions of the lofty wall-cases are blocked in, the fronts being used for maps and explanatory labels, and the backs for the storage of duplicate stuffed specimens. The gaps in the modern systematic series, caused by the extinction of many families and genera, are filled by specimens, photographs, and labels, while the visitor is also directed to the corresponding exhibits in the Geological Department. The latter department has followed this plan for some time, so far as recent animals are concerned, and we are glad to see it at last adopted by the Zoological Department. Nevertheless, it brings out more clearly than ever the not only unphilosophical, but unpractical, character of our separation of animals into recent and fossil; for as each department advances towards its ideal, we see evolved two independent series of zoological exhibits, each complete in itself, but the one rather richer in skins, and the other better supplied with fossils.

Uintacrinus at the British Museum.

We have already drawn attention to recent important acquisitions of fossil Vertebrata, to which might be added the bones of *Æpyornis*, collected in Madagascar by Dr. Forsyth Major, and exhibited at the *soirée* of the Royal Society. Among Invertebrata new to the Geological Department, the place of honour goes to a fine slab of Niobrara Chalk from West Kansas, containing twenty-two crowns of the free-swimming crinoid *Uintacrinus*. Since remains of this genus were first found, twenty-six years ago, in N. America and Westphalia, and described almost contemporaneously by Grinnell and Schlueter, our knowledge of its structure has not greatly advanced. It has presented zoologists with a puzzle for which they have attempted

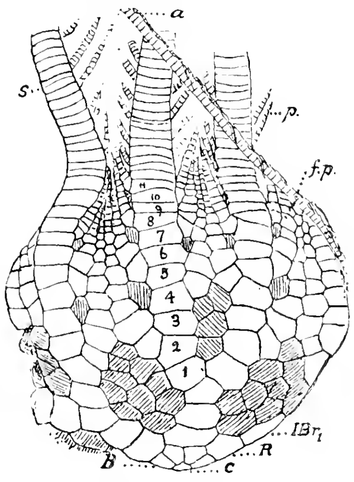


Fig. 1.

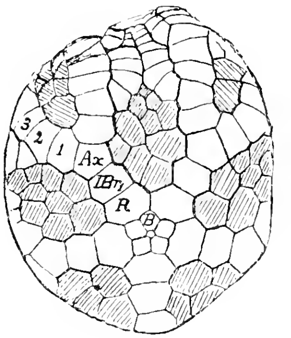


Fig. 2.

Uintacrinus socialis, Upper Cretaceous of America, $\frac{5}{6}$ nat. size.

Fig. 1, from the side. Fig. 2, from below. *c*, centrale; *B*, basals; *R*, radials; IBr_1, first primary brachial; *Ax*, axillary brachial; 1, 2, 3, etc., secondary brachials, bearing *p*, pinnules, some of which are included in the walls of the cup, viz., *f.p.* The intercalated plates, which bind these elements together, are shaded.

many solutions. The large cup, with numerous plates intercalated between the radii, suggested to them that *Uintacrinus* was a straggler from the host of what used to be known as the tessellate crinoids of the Palæozoic era, and while a few connected it with the Rhodocrinidæ, the majority, among whom is Von Zittel in the "Palæontologie" reviewed in our last number, referred it to the Ichthyocrinoidea. Its want of a stalk, and perhaps its occurrence in precisely the same zone as *Marsupites*, have caused many to ally it with that similarly puzzling crinoid.

The British Museum specimens were carefully investigated by

F. A. Bather, whose results are published in the last number of the *Proceedings of the Zoological Society* (vol. for 1895, pp. 974–1,004, pls. liv.–lvi.). A restoration there depicted shows *Uintacrinus* swimming about in swarms, with ten arms, each over 3 feet in length. These arms contain numerous syzygies, or brittle immovable unions, between their ossicles, indicating points at which the arms could readily be broken off if they became entangled in those of other individuals. But the most interesting part of the paper is that which discusses the affinities of *Uintacrinus*. It is pointed out that the absence of a stem is a feature common to genera drawn from diverse groups. *Marsupites*, *Saccocoma*, and *Uintacrinus* are three genera that have no trace of a stem or of any anchoring organs, but in other respects are of dissimilar structure. The points in which they resemble one another, viz., the large size of the calyx, and the presence of a centrale, are therefore held to be secondary features. The essentials of structure in *Uintacrinus* being determined, it is shown that they are quite different from those of all crinoids with which previous writers had connected the genus. On the other hand, the resemblances to the Pentacrinidæ lie in essentials, and the main difference—the intercalation of interbrachial plates—is of a secondary nature. The author maintains that the Triassic pentacrinid, *Dadocrinus*, possesses just those features which must have been possessed by the ancestor of *Uintacrinus*, and also shows a tendency to the intercalation of tegminal plates between the arms. *Uintacrinus*, he concludes, is descended from the palæozoic Crinoidea Inadunata, and branched off from the ascending line that contains *Encrinus*, *Dadocrinus*, *Pentacrinus*, and *Apiocrinus*.

The moral of the paper seems to be that more detailed knowledge is needed about forms that we are supposed to know fairly well, and that speculation is useless until such knowledge is gained. We hope that Mr. Bather may be able before long to complete the studies which, he hints, he has long been making on *Marsupites*.

A New South American Mammal.

It is notoriously difficult to understand the relationships among living and extinct marsupial animals. No doubt marsupials represent the highly modified and divergent descendants of a decaying group, and it might be expected that the gradual discovery of the remains of extinct forms would lead to a better understanding of the modern relics of the group. Up to the present time, however, the palæontological discoveries have not made the questions simpler, and Mr. Oldfield Thomas' account (*Proc. Zool. Soc. London*, 1895, p. 870) of a newly discovered American marsupial, has added, in a very unusual fashion, to the interest and to the difficulties of the question. If we accept Mr. Oldfield Thomas' view that syndactylism is a character that may have been acquired secondarily by different sets of marsupials, the most important anatomical distinction in the group relates to the character of the incisor teeth of the lower jaw. One great division is termed *Diprotodont*, because the median lower incisors are enormously long, are horizontal in position, and dominate the aspect of the front of the mouth. The other great group is described as *Polyprotodont*. In these, as in existing carnivorous animals, the large canines are the chief feature of the front of the lower jaw, while the incisors between them are small and inconspicuous. A few years ago it would have been asserted confidently that Diprotodont creatures, living or extinct, were peculiar to Australia and the adjacent islands. Recently, however, Señor Florentino Ameghino has described a number of fossil Diprotodont creatures from the rocks of Patagonia. The age of the geological strata in which these interesting fossils were found is doubtful. Ameghino thinks that the beds are Middle Eocene. Mr. Lydekker, who has examined the remains more recently, regards them as much later, probably as Oligocene or Early Miocene.

Here, however, is a link binding together Australia and South America, and pointing vaguely towards a former land-connection between the extremities of land in the Southern Hemisphere. Much weight could not have been laid upon the existence of Polyprotodont marsupials in Australia and in South America, because, not only do these extend into North America, but fossils referred with considerable certainty to the Polyprotodonts occur throughout the Northern Hemisphere. The Diprotodonts, however, living and fossil, are known only in South America and the Australian region. It was possible to argue, while only Ameghino's fossils were known, especially if there were accepted his ascription to the Eocene Period of the beds in which they were found, that Diprotodont fossils might yet be found in the Northern Hemisphere, and that their occurrence in Patagonia was no strong argument for the existence of a recent land-connection between Australia and South America. Mr. Thomas' new mammal, *Cœnolestes obscurus*, recently obtained by a native hunter in Bogotà, and now in the British Museum, strengthens the case for the land-connection enormously. For Mr. Thomas, in his careful account of the characters presented by the skull, proves that it belongs to the Epanorthidæ, one of Ameghino's fossil Diprotodont families. The Diprotodonts, living and fossil, therefore, so far as is known, are confined to Australia and South America, and occur in both these regions.

Lime in Plant Chemistry.

In the most recent issue of the *Annals of Botany* (vol. x., no. 37) P. Groom gives an account of some experiments on the function of calcium in plant chemistry. It is well-known that plants will not thrive unless supplied with a small amount of calcium in their food; one of the symptoms of mal-nutrition when this element is absent being the accumulation of starch in the tissues.

More than twenty years ago Boehm came to the conclusion that one of the functions of calcium was to assist the carrying of carbohydrates. Working subsequently on the same subject, A. F. W. Schimper showed that, in plants which normally contain crystals of calcic oxalate, oxalic acid is a bye-product in the building up of proteids, and that, in the absence of calcium, acid potassic oxalate accumulates in the leaves and buds and acts as a poison. He concluded that the calcium served to neutralise this salt, but played no fundamental part in the conduction of carbohydrates, since these were proved to travel without a corresponding movement of calcium.

Groom suggests that the choking of the tissues with starch may be due to the fact that potassic oxalate arrests the change of starch into sugar, and shows by experiment that the diastatic action of extract of malt upon arrowroot-starch is hindered by even very dilute solutions of the acid salt; also that the same substance retards the process of the change of starch into sugar in the living leaf of the Canadian water-weed (*Elodea canadensis*); and further, as the soluble oxalate accumulates, that the manufacture of starch is retarded, and, finally, the protoplasm is killed. The possibility of the diastatic action in plants, which, like *Oxalis*, normally contain a considerable amount of acid potassic oxalate in solution in their leaves, is explained by the fact already elucidated by Giessler, that the salt is stored in the epidermis, not in the assimilating tissue. Giessler suggested that the object was protection from snails and the like, but Groom thinks, from his own experiments, that the protective significance is at most secondary, and that the primary reason of the superficial storage of the oxalate is because its presence in the underlying tissues would derange the metabolic processes.

THE FLORA OF THE SOONDREEBUN.

THE issue of the *Proceedings of the Linnean Society* (from November, 1894, to June, 1895), which has recently appeared, includes an interesting presidential address by Mr. C. B. Clarke on the Soondreebun of Bengal. This contains not only an account of the flora of the district, but also notes on its geography and natural phenomena. The derivation of the name is a much disputed point; Mr. Clarke adopts the one which gives the word as Soondree-bun, meaning the forest of "Soondree," or *Heritiera Fomes*, a prevalent tree in the salt-water swamp-forests of the mouths of the Ganges, and important from an economic point of view. The area included is about 8,000 square miles, and by no means uniform in character. There are large tracts of mud flooded at high water, but becoming hardened in the sun at low tide, when it is possible to walk for several hours among the scattered and open mangrove vegetation. There are also large open areas of grass, and, thirdly, the Soondreebun proper, with dense jungles of Soondree on tolerably firm mud, broken in all directions by creeks. The grass jungles are full of beasts; the tiger, here very dangerous to man, the buffalo, the axis-deer, and a rhinoceros are characteristic larger animals. All are quite at home in the water. The tiger swims long distances, and there is a wonderful story of an elephant which, carried one night out of sight of land by a north-wester, swam all next day, and the following morning brought his mahout, nearly dead with thirst, safe to land. Mr. Clarke does not think the presence of the larger animals in England an *à priori* proof of a former land-connection with the Continent.

The greater part of the paper is, however, devoted to a consideration of the geographic distribution of the *characteristic* vegetation of the district, and gives a most instructive lesson to workers in systematic botany. There are sixty-nine species, about one-sixth of the whole flora, which grow in the Soondreebun, but not in the Bengal plain for 100 miles outside the Soondreebun. These characteristic plants are here tabulated so as to show their distribution in longitudinal areas east and west of the district. The tables show that the range of all the sixty-nine is continuous, each plant being found in every intermediate area between its extreme eastern and western limits. Thirty-two species extend to China, the same number to the Pacific Islands, but only eight to America, among which are the only six found in the Sandwich Islands. Eighteen plants extend westwards to Mascarenia, and fourteen to the east coast of Africa. The number of species in common is found to diminish regularly as we get further from the centre. Of the 69 plants selected, 53 occur in Burma, 45 in the Malay Peninsula, 43 in Malaya, 32 in Tropical Asia, and so on; and a similar relation would, it is suggested, result if the characteristic plants of Hampshire were selected and their distribution similarly represented in the maritime counties from Kent to Cornwall. Not the least value of Mr. Clarke's address is in the emphasis he lays on the results to be obtained by working with a few well-defined easily recognised species rather than from a comparative tabulation of whole floras. "An investigator should look round well (before commencing an inquiry) to discover the simplest case, that in which he may observe and record the action of the smallest number of causes acting at the same time. This is a commonplace remark: chemists understand the principle very well; but I think biologists require reminding that human industry is limited, and that their zeal, great as it is, ought only to be expended in the most economic manner."

Ehret.

As an appendix to the same issue of the Linnean Society's *Proceedings*, is a memoir of the famous flower painter, George Ehret, translated by Miss E. S. Barton from his own MS., now kept in the Botanical Department of the British Museum, where are also a number of his drawings. Ehret was born at Heidelberg in 1708, and spent a large portion of his life as a working gardener. His story is one of assiduous perseverance. He seized every opportunity to perfect himself in the art of accurately and scientifically depicting plants, and at the date of writing the memoir (1758) he was living in London, a Fellow of the Royal Society, and so famous as an instructor in the "painting of plants and flowers" that, to quote his own words, "If I could have divided myself into twenty parts I could have had my hands full."

AUSTRALIAN TERMITIDÆ.

IN the *Proceedings of the Linnean Society of New South Wales*, July, 1895, Mr. W. W. Froggatt has published the introduction to a study of the Termites of Australia. It is chiefly devoted to particulars as to the importance of these insects in other parts of the world, and is no doubt to some extent prompted by a desire to obtain sympathy or assistance in carrying out an extensive and much-needed work. We hope that he will be successful and enabled to prosecute his work thoroughly. We anticipate that it will prove more laborious and difficult than he supposes, for the northern parts of Australia are now among the headquarters of termite operations, and the species and varieties of white ants are much more numerous than is commonly believed, while their habits and economy present profound differences, which it is of the first importance to unravel. There are only about one hundred species of termites known from all the world, but Mr. G. D. Haviland, who has a greater acquaintance with the exotic forms than anyone else, has obtained evidence which satisfies him that there exist some hundreds of species in the island of Borneo alone. It is probable that the Australian species are numerous, though only six have yet been ascertained to exist there. We fear, from Mr. Froggatt's remarks, that he has not yet obtained sufficient material for his purpose. If an effort to elucidate the termite fauna of Australia is to be really successful it must be based on extensive and well-collected material, obtained in larger part from the Termitaria themselves. It is of less advantage to collect the winged forms away from their nests, because they cannot then be associated with their wingless fellows, which, from the naturalist's point of view, are of the greatest interest. The nests should be examined at the period of swarming, and winged specimens should be taken from the nest as well as soldiers, workers, and young; the queen and king should also be looked for, and should, if found, be preserved, together with the other forms from the same nest. It is of little use to attempt to work out the habits and life-histories until the distinct species have been elucidated; there exists very great confusion in termite literature, and much of it is due to observations made on one species being mixed up with those derived from others that have been supposed to be the same, though really different. When the species have been satisfactorily discriminated, the resident naturalists will no doubt be able to make out the life-histories and habits in a useful manner. In speaking of the remarkable termite that always places its nest with the same orientation, Mr. Froggatt terms it the magnetic termite. This is an unfortunate name, and was not used by Mr. Le Sœuf (quoted by Mr. Froggatt), who called this species the meridian termite, the appellation that has also been used by Mr. J. J. Walker and others. We hope Mr. Froggatt will not be discouraged by the difficulties he will have to overcome, and that he will receive assistance from every one able to give it.

The Search for Water in Queensland.

A year ago (vol. vi., p. 364, and p. 82 *antea*) we gave some account of the investigations being made by the Geological Survey of Queensland in search of artesian water. A paper recently read by Mr. Jack, the Government Geologist, before the Royal Society of Queensland gives further details regarding the progress of this work. Under ordinary circumstances it would be cheering to read of "a number of unsuccessful bores having been put down in the north-western portion of the colony," but in the present connection the information is rather disappointing. The experience, however, indicates that artesian water must not be sought for north of a line that extends from the boundary of the colony, by the Tropic of Capricorn, to the Georgina River, and thence north-eastward (perhaps not in a straight line) to the head of the Warburton River. North of this line are none of the water-bearing Cretaceous rocks, but their place is taken by metamorphic rocks whose age may be either Archæan, Cambrian, or Silurian, or one or other or all of these. Some hopes had been raised by the references of the earlier explorers to "rolling downs" and "Mitchell grass" up the Georgina River, but, as Mr. Jack points out, limestone of any age is likely enough to furnish open, rolling, and well-grassed "downs" country.

Science "Written Up."

We are well aware that our contributors are devoid of the lurid craft of the reporter, and that we cannot trick out our cold facts in the meretricious charms of the popular Press. We are indebted to Dr. Herbert Hurst for sending us a delightful specimen of how science should be written. It is apparently a perversion of Mr. Pycraft's account of *Opisthocomus* which appeared some short time ago in our columns (Natural Science, vol. v., p. 358). We did not induce the Manchester *City News* to copy directly from us, but *Science Siftings* fetched it with the following paragraph. Our compliments to the Editor of *Science Siftings*:—

"A Four-Legged Bird.

"*Science Siftings* says: Nothing in the realm of natural history in late years excels in interest the announcement we are able to make of the discovery in British Guiana of a bird with four legs. The Crested Hoatzin (*Opisthocomus cristatus*), the only survivor of a race of birds, several of which are known as fossils, inhabits the most secluded parts of the forests of South America, and it is probable that it is owing to its retiring habits it has outlived its congeners, as well as to the fact that, feeding as it does upon wild arum leaves, its flesh acquires so offensive a flavour as to have gained it the name of the 'stink' bird, and to render it entirely unfit for food. It is a large bird, almost as large as a peacock, in fact, but is very seldom seen. Oftener its loud wailing cry is heard.

"The chief peculiarity of the Hoatzin consists in the fact that when it is hatched it possesses four well-developed legs, the front pair being of a reptilian character. The young birds leave the nest and climb about like monkeys over the adjoining limbs and twigs, and act and look more like tree toads than birds. After hatching, the modification of the fore-limbs begins, the claws of the digits falling off, and the whole of the claw-like hands becoming flattened, change into wings. After this modification has taken place, feathers begin to grow, and in a short time not a vestige remains of its original character. The adult birds not only have no claws upon their wings, but their thumbs, even, are so poorly developed that one would hardly suspect that in the nestlings we have the nearest approach to a quadruped found among existing birds."

In Post Octavo.

In view of recent attempts to resuscitate the quarto *Transactions of the Geological Society of London*, an editorial by Professor J. C. Branner in the February–March number of the *Journal of Geology* may be read with profit. On behalf of the field-geologist it pleads for books with a small page. Big books cannot be carried in the field, and are inconvenient even in the library. "Small books will serve equally well the man in the office or in the field, in camp or on horseback. The taking of books into the field should be encouraged; our laboratory is there, and there is no other place in which a book can render such lively service." So far as descriptions of topographic geology are concerned, there is much force in these remarks, and there is no doubt that experience of books in general confirms the arguments of Mr. Branner. A study of the evolution of scientific periodicals and the publications of learned societies has already been made by some ingenious Americans, and it has been shown that the octavo form has in nearly all cases survived as the fittest. "There is no advantage in very large type," says the *Journal of Geology*. "There is no advantage whatever to a working geologist or to a student for his books to have large pages, wide margins, or to be printed on unnecessarily thick paper." True though these statements are, their occurrence in the *Journal of Geology* is curious. Its current number of 128 pages, and weighing 12¾ ounces, contains about 51,600 words, whereas our last number of 72 pages, and weighing 4½ ounces, contains about 43,000 works. In these estimates, illustrations and blank space are reckoned as words. To put it another way, an average page of Natural Science, which is of the same height but six-sevenths of the width, contains just half as many words again as a page of the *Journal of Geology*; while an equivalent weight of NATURAL SCIENCE would contain far more than twice as much matter. We use our own Journal for comparison merely because it is the nearest to our hands, and doubtless our valued contemporary makes up for this discrepancy by the greater weight of its words.

THE LIVER FLUKE.

SINCE the classical researches of A. P. Thomas on this parasite of the sheep, all naturalists have known that its larval stages, under the peculiar shapes known as *redia* and *cercaria*, are developed in the snail *Limnæa truncatula*, and that the *cercaria*, eventually escaping from the snail, encysts itself either on a water-plant or on blades of grass, where it is readily eaten by sheep. Some members of the Field Naturalists' Club of Victoria have recently obtained from the fresh-water snail, *Isidora tenuistriata*, large numbers of *redia* and *cercaria* similar in form to those found in *Limnæa truncatula*. They have also been found in *Isidora texturata*, *Ancylus tasmanicus*, and a species of *Planorbis*. Other forms of *cercaria* have been detected in *Segmentina victoriæ*, *Planorbis gilberti*, *Isidora gibbosa*, var. *fusiformis*, and *Limnæa lessoni*. These may of course belong to some other species than *Fasciola* (or *Distomum*) *hepatica*.

"What causes surprise," says the *Victorian Naturalist*, "is the wonderful amount of ingenuity which the ciliated embryo fluke employs in obtaining admission to the pulmonary chamber of such snails as *Planorbis* and *Ancylus*. The former takes the shape of a disc only $\frac{1}{16}$ in. thick and $\frac{1}{8}$ in. across, whilst the latter can scarcely measure half that size. Our special climatic conditions evidently arouse desire in the embryo to widen its choice in the matter of suitable hosts. This fact unfortunately multiplies the chances of the increase of fluke, for whilst only one species of one genus favours the transmission of the pest in Europe, at least three or four different genera must be credited to Australia."

As stated above, it is supposed that sheep eat the fluke in its encysted form upon grass or water-weed. The Rev. W. Fielder has, however, observed that cysts are formed actually within the snails *Planorbis* and *Ancylus*, molluscs which, from their small size, may easily be swallowed by the sheep when drinking. Mr. W. McCaw has also noted cysts within *Isidora tenuistriata*. Possibly, as the *Victorian Naturalist* suggests, this last stage of larval life has also been influenced by the special climatic conditions. Anyway, the danger to sheep is still further increased.

"REMEMBER MITCHELSTOWN!"

THIS continues to be the watchword of the green-coated *Irish Naturalist* (we refer, of course, to our estimable contemporary, so ably conducted by G. H. Carpenter and R. Lloyd Praeger, not to any individual), and an excellent watchword it is. In a note headed

"Irish Cave Dwellers" (vol. vi., p. 148) we gave an account of the interesting researches by Mr. Carpenter into the fauna of the celebrated cavern; these are continued in the April number of the *Irish Naturalist* by Mr. H. Lyster Jameson, who was assisted in his exploration by a grant from the Royal Irish Academy. The chief addition made by him is the spider, *Leptyphantes pallidus*, which is new to the Irish fauna. This is a rare species that has been found by Mr. Pickard-Cambridge in Dorsetshire, at roots of heather, also in caves of France and Bavaria. Mr. Jameson also found the mollusc, *Hyalina contracta*, which, though it occurs in Sweden, Germany, France, and Switzerland, had hitherto been found in the British Isles only at Killarney, by Dr. Scharff. Mr. Jameson has also examined the caves at Enniskillen, which are of less age than that at Mitchelstown, and contain a fauna less purely troglodytic in character. By further investigations among the many unexplored caves of Ireland, he hopes to fill up the gaps in the history of the evolution of cave-faunas.

This paper is followed by one from Mr. E. A. Martel, President of the Société Spéléologique of Paris. He gives a survey of the cave, and a plan on the scale 1:2000. Three things, he says, are remarkable in Mitchelstown Cave:—

"1st. Its ramification in every direction, and the infinite subdivisions of its central parts.

"2nd. Its extent, which attains and even exceeds, including all the passages, one mile and a quarter. This must be the longest cave, yet known, in the British Isles.

"3rd. Its blind fauna. It is the only grotto in England, Scotland, or Ireland where, up to the present time, there have been found animals peculiar only to caverns."

"The cave of Mitchelstown," he concludes, "may still be considered as a worthy object for interesting future work and research."

The May number of the *Irish Naturalist* contains a further list of Irish caves, by R. Lloyd Praeger.

Blind Animals.

An interesting discovery of blind animals has recently been made at San Marcos, Texas, U.S.A., where, in sinking an artesian well to supply water for the station of the U.S. Fish Commission, a subterranean stream was struck at a depth of 181 feet. The water flowing from this well contains numerous shrimps and a lesser number of Isopoda and Amphipoda, as well as a few batrachians, all new.

The batrachians are characterised by their extremely long and slender legs, which may serve as tactile organs, and by their broad, flattened, squarish snout. The species is related to the North American *Necturus* and the European *Proteus*, and has been named *Typhlomolge rathbuni* by Dr. Stejneger (*Proc. U.S. Nat. Mus.*, vol. xviii., No. 1,088).

The crustaceans have been named by J. E. Benedict *Palæmonetes antrorum*, *Cirolanides texensis* and *Craugonyx flagellatus*. It is an interesting fact that the nearest relative of the new genus *Cirolanides* is a salt-water genus, *Cirolana*, and this raises the question of a possible former connection of the subterranean stream with the ocean.

The interest of these communications is great, but is it sufficiently great to necessitate the publication of these new names without figures and with descriptions professedly incomplete? Mr. Benedict's word may be taken for the fact that the mouth-organs of *Cirolanides* are those of the family; but in view of the varying meanings attached by systematists to the name *Craugonyx*, we must deplore that this preliminary notice contains nothing by which Mr. Benedict's accuracy in calling the new species a *Craugonyx* can be tested, while there is, moreover, nothing to show what definition of that genus he accepts.

THE NEW PHOTOGRAPHY AND NATURAL SCIENCE.

HITHERTO we have not said much about the X-rays, chiefly because in their physical aspects they lie outside our scope. It is partly for this reason, and partly because we prefer in such cases to wait for the publication of the complete work, that we refrain from discussing a *vorläufige Mittheilung* "Ueber einige Eigenschaften der Röntgen'schen X-Strahlen," by Drs. A. Winkelmann and R. Straubel, extracted from the *Jena Zeitschrift* and kindly sent us by Mr. Gustav Fischer. The time is, however, come when something should be said about the application of skiagraphy to anatomical purposes. At the recent *soirée* of the Royal Society, the walls of the Council Room were almost entirely papered by a series of skiagrams exhibited by Mr. Sydney Rowland. These illustrated the considerable use that surgeons have already made of this new method of research. About 20 per cent. of them included the discovery and location of foreign bodies, needles, bullets, etc., lodged in soft tissues, and in one case of a coin lodged in the intestine, which had caused troublesome symptoms. In one of these cases two fruitless operations had already been performed. Fifteen per cent. of the cases were instances of pathological conditions of the elbow joint of more or less obscurity, on which new and unexpected light was thrown by the diagnosis thus obtained. In 10 per cent. of the cases the object was the determination of the extent and distribution of tuberculous lesions in bone. The same enterprising gentleman is the editor of a new serial entitled "Archives of Clinical Skiagraphy," of which the first number has lately been issued by the Rebman Publishing Co., London, price 4s. The plates include one of the skeleton of a living child, and five showing injuries to the knee. The *Photogram*, however, points out that, although many of the skiagrams undertaken for surgical purposes have been successful, in others, with conditions apparently the same, the results have been very disappointing. Photographers and physicists will have to do much more work on the subject before the process can be relied upon by surgeons. We learn also from this journal that Dr. Macintyre, of Glasgow, who was the first to complete the skiagraphic survey of the body of an adult, has proved that it is quite possible to skiagraph the bones of the skull, and to show very complete details of its structure. "This is rendered possible by the fact that the thickness of the head allows considerable dispersion of rays, so that the varying structure of the side of the skull furthest from the dry plate causes no definite shadow at all, while the one that is nearest to the plate gives a perfectly sharp image, full of detail of the bone-structure." At the Royal Society's *soirée* many of the visitors amused themselves by studying their own skeletons with the aid of the apparatus exhibited by Mr. A. A. C. Swinton and Mr. Herbert Jackson.

It is, however, the applications of this process to zoology that are of more interest to our readers. At the meeting of the Zoological Society on May 5, Mr. W. E. Hoyle exhibited a remarkably fine skiagram of a snake in the act of swallowing a mouse; but, unfortunately, the most remarkable point about it was that the snake was a grass snake, which never touches mammals, but only such cold-blooded prey as frogs and lizards. Mr. G. A. Boulenger, who followed with a paper on some Batrachians from the Caucasus, has been one of the first to use the X-rays for purposes of systematic zoology. In studying the new toad, *Pelodytes caucasicus*, which is only the second species of the genus known (the other, *Pelodytes punctatus*, being confined to Western Europe), skiagrams had enabled him to determine all the more important points in the structure of its skeleton. The value of the application of this method lies in the fact that only a single specimen of the species is known, and this, being in the British Museum, cannot be cut up to determine its osteological characters. In this particular case, moreover, these characters are of much significance, one of them, the junction of the calcaneum with the astragalus, occurring in *Pelodytes* alone among the Anoura; this peculiarity is clearly shown in the photograph, as also are the form and extent of the fronto-parietal fontanelle, the shape of the enormously-expanded sacral transverse processes, and the direction of those in the lumbar region. Here, too, we may refer to a skiagram of *Astropecten irregularis* sent to *Nature* by Mr. Alexander Meek. The more interesting features shown by it are the various food-bodies and their position in the stomachic cæca.

Experiments made by W. G. Miller, of Kingston, Ont., and published in the *American Geologist* for May, p. 324, seem to show that the X-rays may prove an aid also to the petrologist and mineralogist, though they will hardly supplant polarised light. Botanists and palæontologists have not as yet shown any eagerness to adopt this method: we suggest it to the disputants over *Archæopteryx*, as no less efficacious than controversial personalities.

The most striking of all the exhibits at the Royal Society's conversazione, namely, Professor Lippmann's colour-photographs, produced in a collodion or gelatin film by interference, are not, in their present state, of much use to zoologists; but the remarkable instrument which Mr. F. E. Ives showed under the name of Stereoscopic Photo-chromoscope, suggests a possible application. The photo-chromoscope camera makes, at a single exposure on a commercial photographic sensitive plate, three pairs of images which, by differences in their light and shade, constitute a record of everything that excites vision in the two eyes. The stereoscopic photo-chromoscope translates this record to the eyes, so that the object appears to be seen through it in its natural shape and colours. It is clear that this apparatus gives us an easy means of recording fleeting changes of colour, and it would be of much value in the study of living animals and plants. It may also be possible to use its principle for the future development of those methods of colour-printing which depend on the use of a series of half-tone blocks. There are, however, technical difficulties in the way of superimposing many colours by means of such process-blocks, and these have yet to be overcome by engravers and printers.

Some Faunal Notes on Birds.

It is pleasant to be able to call attention to the unpretentious, but none the less valuable, services of the Perthshire Society of Natural Science, although we are forced to mourn the loss which its members have sustained in the death of their veteran leader, the late Colonel H. M. Drummond Hay, C.M.Z.S. Vol. ii., part iii., of its *Transactions* opens with an interesting paper by J. A. Harvie Brown upon the Scottish distribution of the Marsh Tit. In this connection, attention should be called to the extensive and important article on the same species, which has lately appeared in the same author's "Fauna of Moray." Lieut.-Colonel Campbell, the Governor of H.M. Prison, Perth, follows Mr. Harvie Brown's discursus on *Parus* with a happily-conceived essay on the "Ornis" of Perthshire. This paper suffers somewhat from the fact of its having been written for a popular audience. It succeeds, nevertheless, in conveying a good impression of the species which constitute the local avifauna. There are a few mistakes. Colonel Campbell tells us, for example, that he met with the Great Grey Shrike (*Lanius excubitor*) in Southern Spain, where no doubt he really came across the Southern Grey Shrike (*Lanius meridionalis*). But slips of this kind will not mislead an experienced eye, and the tyro cares for none of these distinctions of science. Taken as a whole, the essay reflects credit on an excellent naturalist, and we thank him for the research which he has brought to bear upon a congenial topic.

The same number of these *Transactions* includes a dainty, if brief, essay upon the habits and idiosyncrasies of the dipper (*Cinclus aquaticus*), from the pen of Lieut.-Colonel W. H. M. Duthie. We never read a prettier account of the doings of this sprite of our highland burns. It is brimful of realism.

An interesting paper on *Diomedea melanophrys* in the Faeroë Islands, has been communicated by W. Eagle Clarke to a recent issue of the *Proceedings of the Royal Physical Society* (vol. xiii., part i., pp. 91–114). Ornithologists will recall the surprise which was felt when the news arrived that an adult example of *Diomedea melanophrys* had been shot in the Faeroë Islands in May, 1894. This bird, which met with its fate at the hands of a native gunner on Myggenaes Holm, was well known to the fishermen, who had seen it consorting with gannets (*Sula bassana*) for no less a period than thirty-four years. It is a pity that it met its unauthorised doom just before Mr. Harvie Brown and Mr. Hugh Popham visited the locality in their yachts. Otherwise we might have had the pleasure of reading some remarks upon its habits by skilled naturalists. The bird was skinned and forwarded to Mr. Knud Andersen, of Copenhagen. This gentleman has drawn up, for the Physical Society, a careful statement of all the circumstances connected with the occurrence of this unusual straggler to the North Atlantic. The value of the present essay is enhanced by the trouble which the writer has taken to make an abstract of our present knowledge of the distribution and breeding stations of this albatross. It is embellished by a beautiful photograph of the Stacks of Myggennaes, on which the bird was killed, reproduced from a negative secured by that talented photographer, Mr. W. Norrie.

THE CHINCH BUG.

THE "Chinch Bug," *Blissus leucopterus*, Say, is an insect which has long been notorious in the United States on account of its injuries to corn-crops. As it was first found in the Atlantic States, it has generally been believed to have travelled westwards, as fresh land came under cultivation by the farmer. In a recent discussion of its distibution (*Journ. Cincinnati Nat. Hist. Soc.*, xviii., p. 141) Mr. F. M. Webster brings forward evidence in support of the view that it has travelled northwards from the shores of the Gulf of Mexico, showing that its near allies inhabit Tropical America, and that it may well have subsisted on native grasses in the central States before the land was cultivated. An original maritime home for the insect is inferred from its habit of congregating in colonies at the roots of grasses in all stages, and choosing slight elevations for its breeding-places. The latter habit, presumably adopted for safety from floods or high tides, is still practised in the centre of the continent.

I.

Casual Thoughts on Museums.

Part IV.[1]—The Zoological Department of the British Museum.

EVERYBODY knows that all well-regulated houses contain a cupboard in which there is a skeleton, but it does not seem to strike people, especially those who live in museums, that cupboards are the most suitable and proper places for the majority of skeletons to be housed in. A room full of skeletons is not the place for the student in search of sweetness and light, and what it is supposed to teach no one quite knows. If we are to compare bones and thus to discriminate between different forms, it is no use having them articulated. The student who is advanced enough to appreciate these distinctions will learn little or nothing from bones linked together by iron wire, while the casual visitor, who ought to be taught that a skeleton is the necessary scaffolding upon which every animal is moulded, ought, if he is to learn anything, to see the skeleton in juxtaposition with the stuffed skin and with some of the soft parts.

Under any circumstances, if skeletons are to be exhibited, it seems monstrous to separate entirely the recent and the fossil ones. The replacement of gelatine by carbonate of lime is not a process confined to buried bones, as my own gouty fingers tell me.

For these several reasons, everyone will welcome the change contemplated by Sir William Flower, by which the Dead-House in the upper storey of the Natural History Museum is no longer to furnish subjects for nightmares to nurses and children, and this very fine exhibition gallery is to be devoted to a much more sensible show. It is to be hoped that a large proportion of the skeletons will be duly placed in cupboards and the rest distributed between the galleries containing the stuffed animals and those containing the fossil ones.

I will venture a few words about each of these departments and the function exhibited skeletons ought to fulfil in them. *In limine*, let me give one more groan over the almost criminal folly and obstinacy by which the Museum was so planned that, while the fossil beasts are on the ground floor, the stuffed ones are upstairs, the whole logical sequence of the arrangement being inverted. The expense and trouble of changing the plan are so great as to make it almost

[1] For Parts I., II., and III. *see* Natural Science, vol. vii., pp. 97 and 319, and vol. viii., p. 114.

impossible to contemplate, so that it promises to remain a remarkable monument to someone. It is said the excuse for this absurdity was that the cases which could alone be accommodated downstairs were not sufficiently high, it being thought that, like the giraffe, the British youth and maiden could easily study objects placed at eight and ten feet from the ground. I see that Mr. Lydekker is sensibly closing the upper cases in the Mammalia Room, and filling the fronts in with maps and diagrams.

The revolution that is going on in this room is most welcome, and proves what a special genius for museum arrangement Sir William Flower possesses. Instead of a gallery filled with ill-shaped horrors three or four deep in the cases, and arranged without any order, and with inadequate and childish labels, the collection will soon be an unrivalled school for teaching this branch of natural history, not merely to children, but to Members of Parliament and other half-educated people. The portion already arranged by Mr. Lydekker is simply first-rate; the peculiarities which mark off each genus or family are plainly shown either by whole skeletons or portions of critical importance; the stuffed specimens really look as if they had once belonged to living animals, only specimens that teach something are exhibited, and they are arranged in sequence, beginning with the monotremes and ending with monkeys, while the labels are an epitome of what ought to be known by educated people on the subject. One thing only I would complain of in these labels. Every Latin or Greek technical term other than a specific name ought to be accompanied by a translation in a museum meant for everybody.

It will not, I hope, be thought impertinent if some suggestions are offered while the work is progressing. If it were possible, it would certainly be a gain to a large number of ignorant people to show what food the animals live upon, whether they frequent deserts or otherwise, whether the young are in a helpless condition or matured when born; in the case of the kangaroos, the antelopes, chamois, etc., to show their mode of progression by leaps, etc. Let an effort, too, be made to secure, if possible, at least one adult specimen of the African and of the Indian elephant—surely no museum of first-rate importance in the world except this is so poor as not to be able to show at least one adult elephant.[1] A new specimen of the giraffe less damaged by time would be very welcome, and lastly, to meet the demands of those who love beautiful objects, as well as bloodthirsty boys and sportsmen, let us have some well-mounted groups of the Carnivora. Daniel would have preserved his self-possession unscathed among lions like some of these.

All these things will no doubt come—in fact, they are coming quickly—for we have great faith in the "Panjandrum" of museum

[1] Since this paragraph was written, the great Asiatic Elephant at the Zoo has died, and we are glad to say its skin is presently to be set up in the Mammal Gallery.

arrangement, and we sincerely hope he may have a long lease of power, and plenty of strength in his elbow, as he certainly has a loyal staff determined to help him.

As is well known, what has been done for the mammals is also being done for the birds, and I doubt whether anything so instructive to the ornithologist has ever been shown in any museum as the case illustrating the arrangement and the economy of the woodpeckers, a scheme which is now being applied to the humming-birds. Here, again, occasional skeletons are judiciously employed, and also preparations of the soft parts, which mark off and distinguish classes, etc., and the tyro in systematic zoology is taught the principle underlying scientific arrangement.

One thing I would plead for very hard. There are rumours that possibly the special collection of British animals will be done away with, or distributed in the general series—this would be a serious disaster for the great bulk of visitors who go to the museum for some other purpose than flirtation or catching flies. The natural history of these realms is a subject of prime importance to the school-boy, the collector, the curator of the local museum, the sportsman, the field naturalist who cannot afford to travel—these crowd to the museum to see what they know best, namely, our English fauna and flora. If these English specimens are distributed in the general collection, they will be entirely lost to the special class of students just named, and besides it is a great gain, apart from the general systematic arrangement, to show a sample of a zoological province on a small scale, and it would be well to bring together in one gallery the beautiful and dramatic series of stuffed British birds, and thus to make room for similar groups of foreign, and especially of tropical, birds, showing them with their proper surroundings in the general Ornithological Gallery.

When this is done, or, still better, as soon as possible, let us be rid at all hazards of that ridiculous collection of cottage-window cases in which Gould put his humming-birds when he wanted to make a special show at the great Exhibition. They are literally absurd, and remind one of the way in which the Hindoo ornaments his curtains with green and golden beetles. A case of humming-birds, well stuffed and arranged, with models of the flowers among which they live, would be very welcome; but the great national museum ought not to house mere specimens of the bonnet-maker's style of taxidermy. By the way, taxidermy is a fine art, and it would become a finer art still if the true artist who sometimes produces an artistic effect were to have his name commemorated on the cases as well as the ingenuous and lucky gentleman who happened to give one out of twenty names to some wild animal not at all anxious for notoriety.

I have perpetrated enough impertinence for one number of your Journal. If I put in any more, people may think I belong to the staff.

HENRY H. HOWORTH.

II.

The Teeth of Fishes.

THE calcified teeth of vertebrated animals bear no morphological relation to any of the heterogeneous structures called teeth that occur in invertebrates, but have been evolved within the confines of the vertebrate group. The low position which fishes occupy in the vertebrate series renders the study of their dentition of the greatest interest, because it is among them that the first evolution of such teeth originated. Vertebrate teeth are not new structures, *sui generis*, and independently developed, but have arisen by a modification of tegumentary or dermal organs; and nowhere is this fact more clearly demonstrable than in fishes. A comparison, under the microscope, of vertical sections of the teeth of the jaw with the placoid spines of the skin of the skate or dogfish, shows that the teeth are formed on the same fundamental plan as the spines, and are made up of the same essential tissues. In the young dogfish, shortly before hatching, there is no lip, and the spines which clothe the skin form a continuous series with those embedded in the mucous membrane covering the jaw. It is only when the lips develop that the continuity is interrupted, and the differences between the teeth and spines become more marked. The teeth then increase in size and solidity, and acquire their specific characters, whereas the spines on the exterior of the body remain practically unchanged.

Structure.—The three tooth-tissues, dentine, enamel, and cement, are represented in the teeth of fishes, the first, as usual, occurring in greatest bulk. The dentine is usually deposited uniformly around a conical pulp by the activity of a superficial layer of "odontoblast" cells; and the dentinal tubules, occupied by delicate fibrils proceeding from these cells, are arranged at right angles to the surface of the cone. Blood-vessels do not penetrate into the dentine, and its texture is consequently dense. In a few cases, *e.g.*, *Lepidosteus*, the surface of the pulp cone is fluted at the base, and the form of the dentinal covering is modified accordingly, so that a transverse section shows the dentine thrown into radiating plications or folds.[1]

[1] The complex pattern of the section of the tooth of some of the extinct Labyrinthodont Amphibia is hardly more than a further elaboration of this form of plication.

In the teeth of the eagle-ray (*Myliobatis*) and in the rostral teeth of the saw-fish (*Pristis*), the pulp is broken up into a great number of delicate parallel columns, around which the dentine is regularly deposited. A transverse section through the middle of such a tooth exhibits numerous radiating dentinal systems, each about what appears to be a separate pulp; but a section taken nearer the base shows how these pulp-columns unite below into a common pulp-mass.[1]

Besides this hard dentine, traversed by fine protoplasmic fibrils, there is another kind, termed *vasodentine*, in which dentinal tubules cannot be distinguished, but through which numerous irregular blood-capillaries ramify (Fig. 1, *vd.*). The minute structure of this dentine is much coarser than that of the former (Fig. 2, *d.*), and when, as frequently happens in fishes, the two kinds occur in the same tooth, it is the vasodentine which is internal and in closer relation with the pulp. A third kind, called *osteodentine*, bears a closer resemblance to bone than the two foregoing varieties of dentine. It is not developed entirely on the surface of the pulp, and is not related to an odontoblast layer, but is deposited irregularly *within* the pulp. The channels and spaces of this form of tooth-tissue, therefore, differ from those of vasodentine, not only in their superior size, but in being occupied by pulp and not by capillary blood-vessels only (Fig. 2, *od.*).

The prismatic structure of the enamel is not well marked in the teeth of fishes, and this accounts for the relatively small number of cases in which its presence has been recognised. It is undoubtedly absent in some cases, *e.g.*, *Labrus*. Cement is of rare occurrence in fishes. A coarse form of cement, called by Tomes (9) 'bone of attachment,' serves in many cases to fix the tooth to the jaw; but since this substance is said to be developed from the bone of the jaw, and not from the tooth, it can hardly be regarded as the exact equivalent of the cement or 'crusta petrosa' which attains so great a development in the teeth of some mammals.

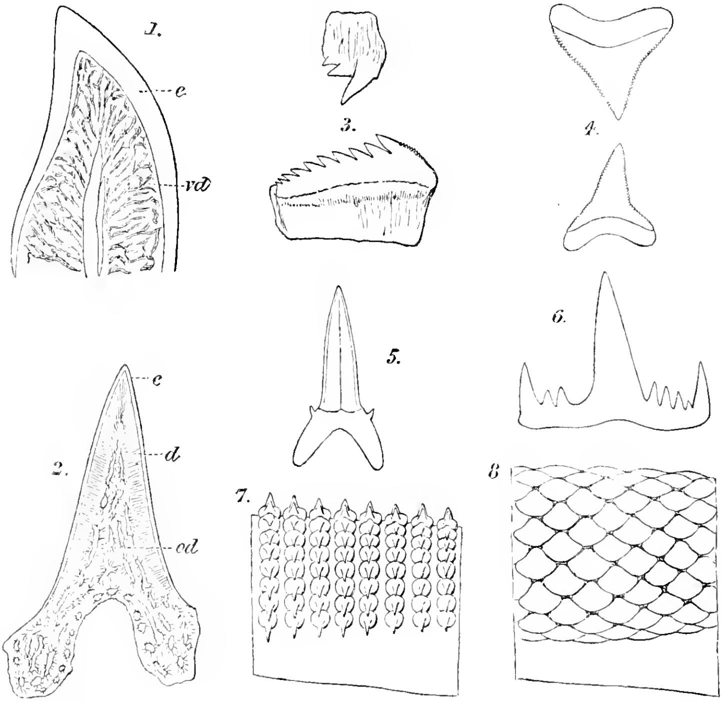
The teeth of Cyclostomata are epidermal in origin, and consist of hollow cones of a horny material belonging to the *stratum corneum* of the skin. In the hag-fish (*Myxine*), and in *Bdellostoma*, Beard (1) has shown that the dermal papilla develops an imperfect calcified tooth beneath the horny epidermal tooth.

Attachment.—Although teeth are structures developed entirely and solely from the mucous membrane covering the jaws, it is very commonly found that, in order to obtain that support which is necessary for the due performance of their function, the teeth acquire an intimate connection with the underlying skeletal parts. So accustomed are we, in fact, to this intimate relationship between tooth and bone, that we have come to regard the teeth as an essential of the jaw; and a skull from which the teeth have been lost we discard as imperfect. In the sharks and rays the teeth retain their

[1] A similar structure is presented, among Mammalia, in the teeth of the Cape ant-bear, *Orycteropus*.

primitive independence and are not directly connected with the jaws[1]; they are simply embedded in the tough fibrous gum (Fig. 9, *m.*).

Some teleostean fishes are provided with teeth which yield to pressure in a certain direction, and subsequently resume the upright position, by the elasticity of the ligament which attaches them to the jaw. In the angler (*Lophius*), in which these teeth acquire considerable size, the front of the base of each tooth is free, while, on the posterior side, dense fibrous ligaments radiate from the tooth to the bone of the jaw. The teeth, therefore, bend readily inwards towards the back of the mouth, but cannot be made to point outwards without



FIGS. 1 and 2.—Vertical sections, greatly enlarged, of teeth of *Cestracion* (1) and *Lamna* (2) (after Tomes), *d*, hard, unvascular dentine; *vd*, vasodentine; *od*, osteodentine; *e*, enamel. Fig. 3.—Upper and lower teeth of *Notidanus griseus*. Fig. 4.—Upper and lower teeth of *Carcharias lamia*. Fig. 5.—Tooth of *Odontaspis elegans*, Mid. Eocene. Fig. 6.—Tooth of *Cladodus striatus*, Lr. Carboniferous. Fig. 7.—Portion of lower jaw of skate, *Raia batis*, male, seen from behind. Fig. 8.—Portion of lower jaw of thornback, *Raia clavata*, female, from behind.

breaking the ligament. In the hinged teeth of the pike (*Esox*) the elasticity resides, not in the hinge proper, but in elastic fibres running from the osteodentine, that occupies the interior of the tooth, to the bone of the jaw.

[1] No true ossification takes place in the jaws of Elasmobranch fishes. A layer of calcified tesseræ is frequently found on the surface of the cartilage in the form of a crust, and in some extinct forms, *e.g.*, *Pleuracanthus* and *Cladodus*, as also in the recent *Aëtobatis*, *Myliobatis*, and *Rhinoptera*, the cartilage is permeated throughout by granular calcifications.

The commonest method of attachment of teeth to the jaw in bony fishes is by anchylosis. The calcified tooth-substance and the bone are in actual continuity, so that it is often difficult to distinguish the line of junction. The connection is effected by a cement-like substance, which is called by Tomes 'bone of attachment,' because it develops from the periosteum of the jaw rather than from the dental capsule. It is very coarse in texture, and full of irregular lacunæ: it is absorbed when the tooth falls, and is developed afresh for the next tooth that occupies the same position. Instances of anchylosed teeth are found in the pike, eel, haddock, and mackerel.

Implantation of teeth in sockets is somewhat rare among fishes, but examples occur of lodgment of teeth in complete alveoli, and of numerous approximations towards this condition. The tooth and bone are in organic continuity by means of a periosteal layer common to the tooth and the jaw; and this layer may remain uncalcified, so that the teeth can be pulled out of their sockets, as in some Characinoid fishes; or 'bone of attachment' may, except in young teeth, anchylose the tooth to the wall of its socket, *e.g.*, *Sphyræna*.

Form.—The greatest diversity of form is observable in the teeth of fishes; in fact, as Owen points out (3, p. 1), "the teeth of fishes offer more various and striking modifications than do those of any other class of animals." In the aberrant ocean shark, *Rhinodon*, the teeth have the form of small, closely set, slender pillars, standing out at right angles to the surface of the jaw; but in most sharks the teeth are far larger in proportion, and are more important as organs of prehension. They may have the form of pointed spines, circular in section as in *Scyllium*, or compressed parallel to the axis of the jaw, as in *Carcharias*. The edges of such trenchant compressed teeth may be smooth and keen, as in *Lamna*, or finely serrated as in *Carcharias* (Fig. 4), *Galeocerdo*, and *Hemipristis*. An accessory cusp or denticle may be present on either side of the base of the main spine, as in *Odontaspis* (Fig. 5); in the three-pronged teeth of *Chlamydoselache* these lateral cusps are nearly as long as the median spine, and in the extinct *Diplodus* considerably longer. Among extinct sharks, teeth with multiple denticles are not uncommon, as, for instance, in *Cladodus* (Fig. 6) and *Hybodus*. The lower teeth of *Notidanus* (Fig. 3), two species of which still survive, have several such denticles on the posterior side of the main cusp. No hard and fast line, however, can be drawn between serrations and accessory cusps, the difference being one of size only.

While, in the compressed teeth of recent sharks, the portion embedded in the gum lies nearly in the same plane as the part exposed, in mesozoic fishes, *e.g.*, *Hybodus*, the base is bent inwards, and forms an obtuse angle with the crown, and in sharks of palæozoic times, *e.g.*, *Cladodus*, the teeth are characterised by a broad horizontally-expanded base, set nearly at right angles to the crown (Woodward, 10). In the archaic shark, *Chlamydoselache*, of the Japan seas, the base is as broadly expanded as in the palæozoic *Cladodus* (Röse, 8, p. 200, Fig. 7). Crushing teeth are not common in selachians, but are found in the Port Jackson shark (*Cestracion*) (Fig. 10). In batoids, flattened grinding teeth are of more frequent occurrence, and the examination of the dentition of such a series of forms as *Raia*, *Rhynchobatus*, *Rhinoptera polyodon*, *Rhinoptera javanica*, *Myliobatis*, and *Aëtobatis* will explain the relation that exists between the single row of bent dental bars in the latter genus and the more normal dentition of *Raia*, which, in all essential respects, is the same as that of the selachoid *Scyllium*. The crushing surface of the teeth of the Cretaceous *Ptychodus* is marked by a series of parallel ridges, while the margins are delicately granulate. A somewhat similar surface-ornamentation is to be seen in the living *Rhynchobatus*, although here the teeth are much smaller in size.

Considerable variety of form is also found in the teeth of the bony fishes. The commonest and most typical form of tooth is the conical. Blunted, button-shaped teeth, frequently approaching the hemispherical form, are found both in teleosteans, *e.g.*, *Pagrus*, and the extinct lepidosteoid fishes, *Lepidotus*, *Cœlodus*, *Gyrodus*, etc. Blade-shaped teeth occur in *Sphyræna*, and the teeth of the eel have the form of compressed cones set transversely to the axis of the jaw. In the chætodont fishes the teeth are very long and slender, and in some cases even flexible.

The forms of teeth occurring in the Cyclostomata, Holocephali, and Dipnoi are characteristic of these groups; but, since they are dealt with in other parts of this article, a special description of them here is unnecessary.

There are probably very few fishes in which all the teeth in the mouth are exactly similar in character. In sharks, the teeth near the symphysis of the jaws usually differ from those situated towards the articular region in being larger and more powerful; and those between these extremes form a graduating series, in which the differences between adjacent teeth are hardly perceptible. Not infrequently the upper and lower teeth differ in shape, as in *Notidanus* (Fig. 3), *Carcharias* (Fig. 4), and *Læmargus*. Only in a few instances can the term "heterodont" be applied to the dentition of fishes. In the Port Jackson shark, *Cestracion* (Fig. 10), among Elasmobranchii, and in the wolf-fish, *Anarrhichas*, among Teleostei, the front teeth are pointed and adapted for the seizure of food, while the hinder are flattened into powerful crushing organs. In such teleosteans as *Chrysophrys* and *Pagrus*, the hind teeth are more rounded than those in front, but the difference is less marked than in *Anarrhichas*. Sexual differences in the dentition are extremely rare, but striking instances occur in many species of *Raia*, where the teeth are sharply pointed in the male, but flattened in the female.

Succession.—In sharks and rays the teeth are embedded in the dense fibrous gum, and are arranged in rows parallel to the axis of each jaw. The teeth which are situated upon the edge of the jaw are usually erect, while the rows which lie behind them, farther within the mouth, point backwards, and are more or less recumbent, not having yet come into full use. New teeth are continually being formed on the buccal surface of the jaw, beneath a protecting fold of the mucous membrane (Fig. 9, *m'*), which acts as a composite enamel organ, locally differentiated into the enamel organs of the individual teeth. The developing teeth increase in size and thickness as, by a continual, but gradual, sliding of the gum over the inner surface of the cartilage, and outwards over its border, they are brought to the edge of the jaw, where they become functional (Fig. 9). They are finally shed, and their place is taken by the rising teeth behind. Owen (4, p. 383), with that happy choice of metaphor which always

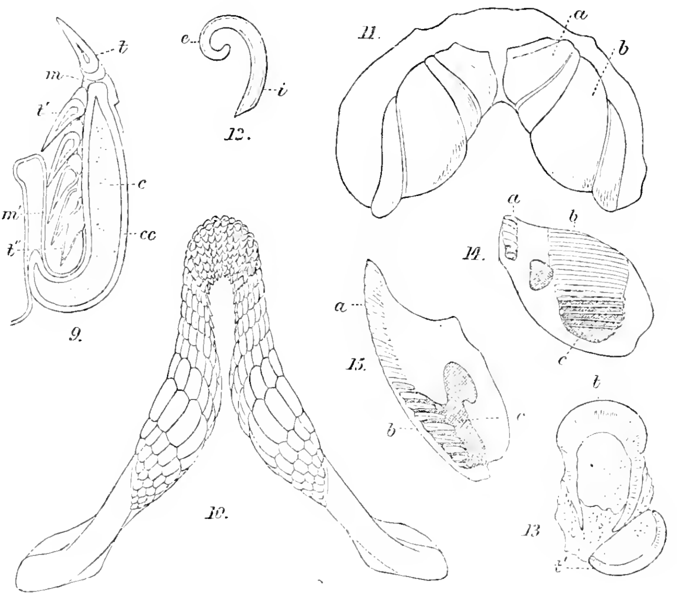


FIG. 9.—Transverse section through the jaw of *Carcharias*: *c*, cartilage of jaw; *cc*, its calcified crust; *m*, mucous membrane covering the jaw; *m'*, the fold of mucous membrane beneath which the young teeth develop; *t*, the tooth in use; *t'*, its successor; *t''*, the youngest tooth of the series. Fig. 10.—Upper jaw of *Cestracion philippi*. Fig. 11.—Lower jaw of *Cochliodus contortus*, Lr. Carb.: *a*, anterior dental plate; *b*, posterior do. Fig. 12.—Section of posterior dental plate of *Cochliodus*: *c*, external surface; *i*, internal or buccal surface. Fig. 13.—Vertical section through a tooth (*t*) of *Lepidotus maximus*, Kim. Clay, showing its successor (*t'*) in process of reversal (after Etheridge, *Q.J.G.S.*, xlv.). Fig. 14.—Section through the lower jaw of *Diodon*: *a*, marginal dental mass; *b*, second do.; *c*, alveolar cavity. Fig. 15.—Section through the lower jaw of *Scarus*: *a*, amalgamated teeth; *b*, younger teeth, still free; *c*, alveolar cavity.

characterised his teaching, describes the whole phalanx of teeth as ever marching slowly forwards over the border of the jaw, the front ranks, after having engaged in active service, being successively lost, while the rear ranks are continually being recruited by newly developed teeth. In the skates (*e.g.*, *Raia*), and some dogfish (*e.g.*, *Scyllium*), and sharks (*e.g.*, *Odontaspis*), several rows of teeth are in use at a time; but in many sharks (*e.g.*, *Carcharias*, *Galeocerdo*), where the edge of the jaw is thinner, there is but a single row of functional teeth in each jaw. In the latter forms it is unusual to find adjacent teeth shed simultaneously. The replacement takes place alternately, so that there is never a large vacuity left in functional dentition. This provision against leaving any large extent of jaw unarmed is identical with that which is to be observed, with even more regular alternation, in the python, crocodile, and many other reptiles. In the jaw of the Greenland shark (*Læmargus*) the teeth overlap one another and interlock so closely that alternate succession is impossible. The successional teeth, therefore, rise together *en bloc*, and stand slightly higher than the older teeth. Seeing that the latter are not shed until some time after replacement, the dentition never for a moment loses its effectiveness.

The teeth of Holocephali and Dipnoi persist for life and grow continuously. These teeth are considered by Röse (7) to have originated by a fusion of separate tubular denticles, a view which is borne out by palæontology; but he unfortunately compares the teeth of Dipnoi with those of *Myliobatis*, the tubular structure of which is due to a sub-division of the pulp of the individual teeth (*see* p. 381). The horny teeth of Cyclostomata are vertically replaced. In the common lamprey, *Petromyzon*, as many as three hollow cones may be found superimposed, separated from one another by a soft white tissue, which, like the cones themselves, is epidermal in origin, and which is in marked contrast with the dark yellow or brown colour of the horny material of the teeth. Of these three cones, the external one (Fig. 17, *t*) is the tooth in use, and the other two (*t′* and *t″*) are replacing teeth. A reserve tooth is thus ready for use immediately its predecessor is shed.

In most bony fishes, where the teeth are numerous and closely packed, the succession is irregular (*e.g.*, cod). In those, however, where the teeth are less numerous, an alternate replacement, calculated to gain the same advantages as in *Carcharias*, may frequently be found (*e.g.*, *Thyrsites*). The succession of socketed teeth is usually vertical. The young tooth is formed at the side of the older one, but, by absorption of the base of the latter, comes to lie vertically below it, and ultimately occupies the same socket (*e.g.*, *Sphyræna*, *Chrysophrys*). A most perfect instance of vertical succession is seen in the pharyngeal teeth of the wrasse (Fig. 20). In the extinct lepidosteoid *Lepidotus*, the replacing tooth undergoes a complete inversion before it finally comes into position (5 and 6). When first formed it has its pulp-cavity directed towards that of the tooth which it will replace, while its crown points in the opposite direction. The tooth then gradually turns over (Fig. 13, *t′*), and by the time it supplants the old tooth it has turned through an angle of 180 degrees.

In teleostean fishes there are found a number of anomalous, composite tooth-structures, which have resulted from a modification of continuous succession. In the porcupine-, or globe-fish (*Diodon*), the upper and lower jaws are each provided with two complex structures of a dental nature. The one of these (Fig. 14, *a*) situated along the anterior border of the jaw, constitutes a blunt cutting edge, while the other (*b*), which is larger in size and situated farther back, presents an oval crushing surface. A section through the jaw shows that the dental organs consist of a great number of superposed plates of dentine, free when young and widely separated, but firmly and closely amalgamated by a bony cement when they approach the surface of the jaw to replace their predecessors which have been worn away. The obliquity of the grinding surface to the plane of the plates causes portions of several of these to be exposed at a time. In the parrot-fish (*Scarus*) the teeth are developed in great profusion in the interior of a large, common alveolar cavity in the bone of the jaw. The younger teeth (Fig. 15, *b*) are free, that is tò say, they are held together only by the organic materials occupying the alveolar cavity; but the six or eight oldest teeth (*a*) of each vertical series are firmly bound together by a bony deposit. The teeth lie on their sides, and are piled up one above the other with their apices directed outwards, so that the biting surface is made up of the *sides* of the amalgamated teeth (Boas, 2).

Arrangement of Teeth in the Different Groups of Fishes.—In the lamprey (*Petromyzon*) the teeth are uniformly and symmetrically disposed over the surface of the suctorial disc. The teeth are mostly conical in form, but those in the centre of the mouth are larger and of a more complex shape (Fig. 16). In the hag-fish (*Myxine*) there are several sharp teeth arranged in four rows on the extremity of the lingual cartilage, but only a single tooth in the roof of the mouth.

Although in most sharks the largest teeth are to be found at the front of the jaw, in the Port Jackson shark (*Cestracion*) (Fig. 10) the front teeth are small and pointed; whereas the hinder teeth have the form of broad crushing plates, adapted for breaking the shells of the molluscs that constitute the food of this shark. Numerous examples of such a dentition are found in extinct sharks, *e.g.*, *Acrodus*, *Orodus*, etc. In *Pleuroplax* and *Pœcilodus* the crushing teeth tend to fuse into continuous plates, a form of coalescence which finds its culmination in *Cochliodus*. The individual crushing teeth are indistinguishable in *Cochliodus*, but each ramus of the jaw is provided with two spirally-coiled dental plates (Fig. 11, *a* and *b*). There is nothing equivalent to the shedding of teeth, but the disused external portion of the dental plate (Fig. 12, *e*) becomes buried in the edge of the jaw as the spiral revolves slowly outwards. In the skates and rays the dentigerous surface of the jaw is much more rounded than in the sharks, more rows of teeth are in use at a time, and the teeth are more closely set, with smaller intervals. In some forms the teeth are so blunt and so closely packed as to form a dental mosaic or pavement, *e.g.*, *Rhinoptera*, and the eagle-ray, *Myliobatis*. The central tooth-plates are, in such cases, usually larger than the marginal plates, although this inequality is not apparent in the young. In *Aëtobatis* the central plates alone are present. Small denticles frequently occur embedded in the general mucous membrane of the mouth, and over the pharyngeal borders of the branchial arches, *e.g.*, *Galeus* and *Cestracion*. These denticles, being less specialised than the teeth of the jaw, bear a much closer resemblance to the placoid spines of the integument than do the teeth. In the basking-shark (*Selache*) long comb-like gill-rakers, said to be composed of dentine, project inwards from the branchial arches and act as strainers, preventing the escape, through the gill-clefts, of the small animals taken into the mouth as food. Very similar gill-rakers are found in the ganoid fish, *Polyodon*, and in some teleosteans, *e.g.*, the shad (*Clupea alosa*). In the saw-fish (*Pristis*), the prenasal rostrum is greatly elongated and armed with a series of strong teeth along each margin, in the form of a two-edged saw. The teeth are arranged at regular intervals, and are implanted in distinct sockets. They are not shed, but continue to grow from persistent pulps, and, if lost accidentally, they are not replaced.

No great development of teeth is to be found in the cartilaginous ganoids. The mouth of the sturgeon has the form of a protrusible suctorial tube, devoid of teeth; but true teeth are present in the larva (Fig. 18). In *Polyodon* the jaws are armed with numerous minute teeth, embedded in the mucous membrane, but not connected with the underlying bone. In the Dipnoi there are two pairs of large grinding teeth, one pair in the mandible (Fig. 19, *s*) anchylosed to the splenial bones, and the other pair (*p*) borne by the palato-pterygoid bones in the roof of the mouth. There is also a small pair, known as the vomerine teeth (*v*), situated in front of the palatine pair. These are not in relation with any of the bones of the skull, but are loosely fixed to the under surface of the ethmoidal cartilage. In *Ceratodus* the inner border of the large teeth, both upper and lower, is convex, and the outer edge is, in the living species (*C. forsteri*), marked by five deep notches. The two vomerine teeth have the form of plates in contact anteriorly, but diverging behind. The large teeth of *Ceratodus* were known in the fossil state long before the discovery of the existing species. In the ancient forms, *Ctenodus*, *Dipterus*, etc., the general build of the teeth is the same as in *Ceratodus*, but the complexity is greater. In *Protopterus* there are only two notches in each of the large teeth, and the vomerine teeth are slender and conical in shape. The palato-pterygoid teeth of the right and left sides are in contact in the median line, as are also the mandibular teeth; but this is not so in *Ceratodus*. The mandibular teeth are situated more anteriorly than in *Ceratodus*. The dentition of *Chimæra* bears a striking resemblance to that of the Dipnoi. The external borders of the teeth are not notched, but the mandibular teeth show a pair of broad shallow grooves on their upper or buccal surface. The vomerine teeth in *Chimæra* are relatively larger and more important than in Dipnoi, and they touch and overlap the palato-pterygoid teeth.

In the osseous fishes (Teleostei and Ganoidei Holostei) the dental system is well developed, although exceptionally, as in the pipe-fish (*Sygnathus*) and sea-horse (*Hippocampus*), teeth may be altogether wanting. Teeth are usually present on the premaxilla and dentary, and frequently also on the vomer and palatine, and on the branchial arches. The maxilla, pterygoid, parasphenoid and splenial bones bear teeth in the Ganoidei; but in the Teleostei maxillary teeth are confined to the Physostomi, the pterygoid and parasphenoid bones

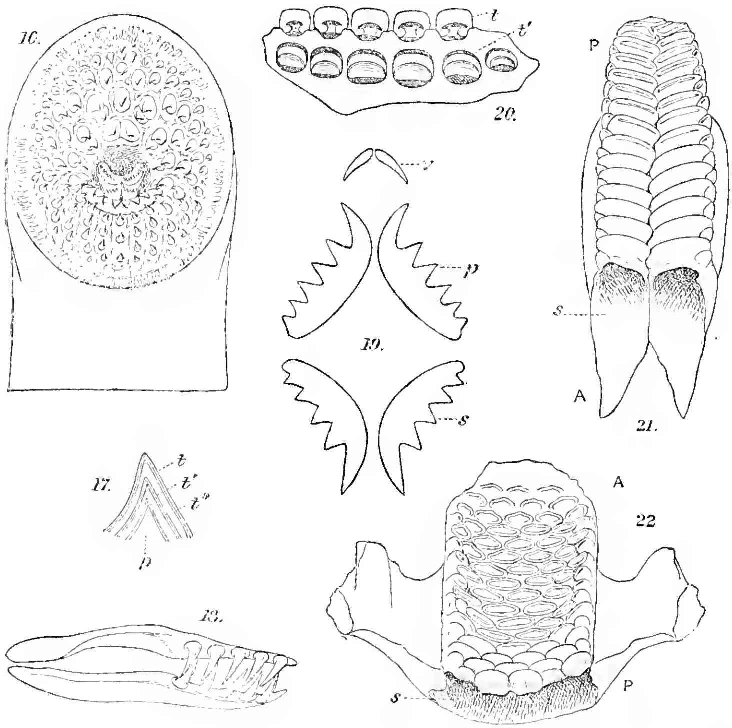


FIG. 16.—View of suctorial disc of the mouth of the lamprey, *Petromyzon marinus*. Fig. 17.—Section, greatly enlarged, of a tooth, *t*, of the lamprey, with its two successors, *t'* and *t''*; *p*, the dental papilla. Fig. 18.—Upper and lower jaws, greatly enlarged, of the larva of the sterlet, *Acipenser ruthenus* (after Parker, *Phil. Trans.*, 1882). Fig. 19.—Teeth of *Ceratodus forsteri*: *v*, vomerine; *p*, palatopterygoid; *s*, splenial teeth. Fig. 20.—Section of a portion of the pharyngeal bone of *Labrus* (after Owen): *t*, tooth in use; *t'*, its successor. Figs. 21 and 22.—The upper (21) and lower (22) pharyngeal bones of *Scarus muricatus*: A, anterior end; P, posterior end; *s*, space occupied by developing teeth which have not yet coalesced or become adherent to the bone.

are only exceptionally dentigerous, *e.g.*, *Elops* and *Albula*, and splenial teeth do not occur at all. In the living bony Ganoidei all the bones related to the mucous membrane of the mouth are richly beset with teeth, but in the Teleostei, where these bones are more deeply placed, the teeth are more restricted in their distribution. It is only in the most lowly organised forms, *e.g.*, *Albula*, that a more uniform distribution of teeth, at all approaching that which occurs in the Ganoidei, is to be observed. Teeth are very extensively developed on the palatine bones in the pike (*Esox*), but in a great number of Teleostei, *e.g.*, the cod (*Gadus*), the palatines are edentulous. The exceptional dentitions of *Diodon* and *Scarus* have already been alluded to (p. 387). The dentition of *Tetrodon* is essentially similar to that of *Diodon*, except that only the marginal set of tooth-plates is present. *Triodon*, on the other hand, appears to be more related to the Scaroids, judging by the nature of its dental armature. In the file-fish (*Balistes*) the teeth are relatively large and are disposed in a double row in the premaxilla, and a single row in the dentary. In *Thyrsites* and *Sphyræna* the teeth at the front of the premaxilla are very large in size and are backwardly directed, in a manner recalling the disposition of the poison fangs in a venomous snake.

Gill-teeth, developed on the pharyngeal margins of the branchial arches, are usually small in size and thickly set (*e.g.*, pike). They may be united by their bases into small plates, but the plates are merely embedded in the mucous membrane, and are not united to the bone. In the sun-fish (*Orthagoriscus*) the gill-teeth are enormously developed. They are elongated and sharply pointed and are anchylosed to the branchial skeleton. The carp (*Cyprinus*) is edentulous so far as the mouth proper is concerned, but the two lower pharyngeal bones carry well-developed teeth, opposed to a callous tubercle projecting from the basioccipital bone. It may be taken as a general rule that the pharyngeal dentition is inversely proportional to the extent of tooth development on the jaws. In the wrasse (*Labrus*) the upper pharyngeal bones bear teeth as well as the lower. The teeth are of hemispherical shape and have a vertical succession (Fig. 20). The pharyngeal teeth of the extinct *Phyllodus* have the form of flattened, slightly convex plates. Underlying each of these is a series of five or six similar plates of the nature of reserve teeth. The older plates are not shed as a whole, but wear away in places, leaving the younger replacing teeth partially exposed. The pharyngeal teeth of the parrot-fish (*Scarus*) are compressed antero-posteriorly and are developed in common alveolar cavities (Figs. 21 and 22, *s*) situated at the posterior end of the lower and at the anterior end of the upper pharyngeal bones. The upper teeth therefore succeed one another in a backward, and the lower in a forward direction. The teeth are developed independently, but are firmly anchylosed to the bone and to one another before they come into active use. There is a close analogy, as Owen points out (4, p. 381), between the dental mass carried by the pharyngeal bones of *Scarus* and the complicated molar teeth of the elephant, both in form, structure, and in the reproduction of the component denticles in horizontal succession.

The substance of this article agrees, in the main, with the information supplied by the explanatory labels attached to a series of preparations, illustrating the dental system of fishes, recently added to Sir William Flower's educational collection, or "Index Museum," in the entrance hall of the Natural History Museum. My grateful acknowledgments are due to Sir William Flower for kindly permitting the reproduction of several of the specimens to illustrate this paper.

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W. G. RIDEWOOD.

III.

The Midwife Toad.

[Twenty specimens of the curious batrachian, *Alytes obstetricans*, having recently been purchased for the Zoological Gardens, London, we have induced Mr. Hartmann, who supplied the animals, and who has made an exhaustive study of their habits, to furnish us with the following account of his observations. Mr. Hartmann is ready, not only to supply further specimens, but to act as guide to any zoologist who would like to observe the animals in their native haunts.

The genus *Alytes*, we may remind readers of this article, belongs to the ancient family Pelobatidæ, which is in some respects intermediate between the Ranidæ (Frogs) and the Bufonidæ (Toads). In the presence of teeth on the upper jaw, they resemble frogs. In the more important character of overlapping ends of the coracoids, the thick body, the coarse, glandular skin, the short limbs, and in their habit of laying the eggs in strings, they resemble toads.—Ed. Nat. Sci.]

THE German name for the animal, of which I am about to tell English-speaking friends of terraria and their inhabitants, is not beautiful—"Geburtshelferkröte." In English natural history it has an equivalent name "Midwife Toad." In sundry works on natural history, the names "Fessler" (lit. "chainer") or "Höhlenkröte" ("toad-in-the-hole") are also found. These names, however, do not express the curious characteristics of the creatures, as does the first-mentioned. The midwife toad occurs only in hilly ground, where clear, perpetual springs are found, as in the Black Forest, the Vosges, Taunus, Ahrthal, Siegthal, Wupperthal, and in the Harz and Sauerland. In France, whence the animal appears to have come into Germany, it is to be met with in the neighbourhood of Paris.

From the middle of March, so soon as the snow no longer covers the fields, till August, in the evening as dusk comes on, the call of the male, which is like a soft bell, can be heard in the places where they live. Each individual has a different note, so that there is no monotony; on the contrary, the calls are like a distant melodious chime. If you approach, the creature is silent, and retires creeping into its hole, where it sits till all is quiet; then it emerges again, and lets its bell-like note float into the air. Professor Landois writes, in his work "Animal Life of Westphalia," that this batrachian has indeed been named "Glockenunke (Bell-frog) *Rana campanisona*" on account of its note. A person who does not know the creatures will not believe that it is they that can give forth such lovely tones.

At the call of the male the little female comes out. When a pair are met, the male clasps the female with his forelegs in such a way that, with the aid of the hindlegs, the egg-cord is drawn out of the cloaca of the female; thereupon the male fertilises the eggs and winds the cord, containing about 200 eggs, in the shape of an 8 round its hindlegs, putting a leg in each loop of the 8. Now the pair let go; the female has done its duty and is free, while the male alone undertakes the care for the future. With this "sweet" burden it hops and creeps about, seeks food, and pipes its note to its comrade. The burden does not seem to inconvenience the little creature in the least. About three weeks later it jumps all at once into the water, struggles out of the egg-cord, and begins again its terrestrial existence. So soon as the eggs reach the water, their tense covering softens, and, through the movements of the buried but visible creature within, it splits, and the young larva disports itself gaily in the new element, its second home, till, grown into a toad, it also seeks the land, to live by day in a hole, and to creep out at night in search of a fat slug, or some other dainty morsel. To my personal knowledge, all tadpoles winter in the water, so that the creatures are never fully developed in one summer. They may also be completely frozen without any injurious effects. This I have seen, not only during the severe winter on my daily walks to the spots where they are found, but also among the twenty larvæ which I have harboured since last July in my aquarium. During the severe cold of last February I moved from Barmen to Münster. My aquarium was for seventy-two hours in a furniture van, with the result that the water in it was frozen through and through, and arrived here a solid piece of ice, in which the beetles, gold-fish, and *Alytes* larvæ could be seen lying. When brought into a warm room the ice took seventy-two hours to melt; one larva after another got free and hurried merrily about. They are still all living and are beginning to develop into adults. I may mention that the imprisonment in the ice was also not detrimental to the water-beetles and goldfish, but all my toads, which made the same journey in a terrarium, were frozen to death.

The larvæ subsist on carrion and the corpses of any animals in the water: thus they gnaw a frog or a triton to the bone. They lick the plants and slide their mouth against the stones and glass walls, whence one may conclude that they also like the delicate slime as food. In colour the larvæ are like the adults—olive-green, mixed with brown—but there are some which shade into a yellow. The belly is yellowish-white towards the head, verging towards the anus into rose, with which the throat also is speckled. The back is covered with warts, which are especially prominent at the junction of the belly and the back. The backs of the larvæ are quite smooth.

The little creatures do not lose their tail till they come on land. In great numbers they leave the water from May till September, and hide themselves under neighbouring stones, where they sit huddled together till dusk, when they begin the march to the fields in which they desire to spend their lives. To attain sexual maturity they need three years. Though I have handled more than 1,000 *Alytes*, I could discover no outward sexual differences.

The toads sit the whole day in hollows which they have dug out, and which look like mouse-holes slightly flattened, or under stones in old quarries. The drier and hotter the weather, the deeper they bury themselves. They seem to need damp earth, though they only use the water to throw off their eggs. They do not jump very often, but sit in front of their holes, and lie in wait for a slug, a fly, a worm, or similar insect, so that in case of danger they can retire into their holes. If they spring unsuccessfully after an insect they turn their backs on it, just as though they would not show their anger to a mere food-creature. If they swallow it only half, or if it is too large for a single bite, they aid themselves with the right or left leg, blink their eyes, lick their jaws again, and resume their look-out. Three years ago I had so tamed a toad that it ate a wriggling worm which I held out in my hand. It is interesting to watch how the toes of the fore-feet tremble when the toad discovers an insect, how it slowly advances in order to make a sure spring, and what exertions it makes with the whole body to get a stalk or a stone out of its mouth again, which, in the eagerness of the skirmish, it has also snapped up. Young animals, which have chosen too large a worm as food, are overthrown by its twisting and wriggling, and have to let it go again.

One often finds egg-cords lying about loose. Presumably the male, in squeezing into too small a hole, has rubbed them off, or even lost them in a fight. In the holes I have found twelve toads lying next to, over and under, each other. If exposed suddenly, so that daylight strikes them, they appear to want to creep into themselves without hopping away. In the day, however, one can only catch them by digging them out with a spade. In the evening one must slowly creep to the place whence the song issues, taking a dark lantern. Its colour shields the toad well from danger, for a damp stone covered with very fine moss has just the same appearance. The eyes, with perpendicularly-cut black pupil and golden iris, stand out of the head. The forefeet, on which are four toes, bend quite inward, so that they can be used for the excavation of holes.

Münster, Westphalia. CARL HARTMANN.

IV.

The Meaning of Metamorphosis.

AN article in *Nature* for December 19, 1895, on "The Transformations of Insects," by Professor L. C. Miall, is so obviously the result of a prolonged consideration of this subject by a gentleman who is well-known for his labours in the field of entomology, and is so important, that it does not seem to us advisable to allow the views brought forward to pass without some marks of dissent from those that hold opinions either partly or wholly distinct from his.

It is certainly very much to Professor Miall's credit, and of essential service to the advancement of science, that he has taken up this department of research, which, as he correctly states, has been much neglected by entomologists. It is, nevertheless, to be regretted that he has confined his reading before publication to the few works that he mentions, and has consequently not given a complete view of this field of research from a historic standpoint.

Professor Miall would doubtless have given more consideration to the opinions of other investigators than those who received their inspiration from Darwin's "Origin of Species," and his own researches would have been made more complete, so far as their explanatory hypotheses were concerned, if the possibilities of theories having another origin had been admitted and discussed.

This author's assertion "that the metamorphoses of insects are fundamentally unlike the transformations of polyps, echinoderms, molluscs, and crustaceans" is founded upon the idea that insect larvæ of the so-called higher orders often have resemblances to the adults of more generalised types, such as Thysanura, and on the fact that they pass through their transformations more slowly, these lasting to the sudden and late production of the winged imago or adult.

There are among insects, as in other branches of the animal kingdom, notable differences in the metamorphoses passed through by individuals belonging to different grades of forms. That these are more remarkable among the more specialised insects, and much more noticeable there than among the primitive forms, goes without saying. This matter has been treated of in the little book "Insecta," written by the authors of this paper, and there the distinction between direct (incomplete metamorphosis) development of the first nine orders of

Insecta, viz., Thysanura, Ephemeroptera, Odonata, Plecoptera, Platyptera, Dermaptera, Orthoptera, Thysanoptera, Hemiptera, is contrasted with the indirect (complete metamorphosis) development of the remaining seven orders, viz., Coleoptera, Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Hymenoptera, and Diptera. The development of the individual in the first nine orders does not differ materially from that of animals in other branches of the animal kingdom which also have direct development. The fact that the larvæ resemble the adults of the more primitive Thysanura is parallelled by many similar cases in the animal kingdom. It is the usual rule that the younger stages of more specialised forms resemble the adults of the more primitive forms of the same stock, and this principle, discovered by Von Baer and Louis Agassiz, is the foundation of all systematic researches in phylogeny. Such resemblances have been traced between batrachians and fishes, especially by Huxley, among the fishes themselves by Agassiz, by Beecher among corals, trilobites, and Brachiopoda, by Jackson in Pelecypoda and Echinodermata, and by several authors, including one of the signers of this article, among Cephalopoda. Mr. Miall compares the batrachians with insects as a more nearly parallel type, but in this is there not some confusion? The comparison can only be made with those forms of insects having direct development. The batrachian has no quiescent stage, occurring subsequently to an active voracious larval stage, which last has provided by overfeeding for the existence and development of a pupa-like resting stage. In the insects and batrachians he introduces the term "adult transformations" for the later changes in which the pupa changes into the imago and the tadpole into the frog. Mr. Miall thinks, because the frog and the winged form are new and comparatively late additions to the primitive forms represented by the tadpole or the pupa, that the incoming of these stages should be called "adult transformation" or adult metamorphosis.

The trouble that one has in adopting this term arises from the general conception of the adult. This latter term is usually applied to the sexually matured individual, and in "Bioplastology and the Related Branches of Scientific Research"[1] one of the authors of this paper has endeavoured to define this stage more or less, and also other stages of the life of the individual. According to the nomenclature there devised, and supposed to be natural, adult changes of structure or characteristics, designated as sub-stages, are not confined to insects, but occur in all animals, and are found equally in their old age. The term "metamorphosis," however, in a technical sense, can hardly be applied to these sub-stages. The life of the individual can be divided and classified as follows, either in man or any of the invertebrates, although in some animals whose existence is dependent upon seasonal changes, *e.g.*, Lepidoptera, it is questionable whether

[1] HYATT: *Proc. Boston Soc. Nat. Hist.*, xxvi., pp. 59–125; 1893.

there is any distinct old age, and in very primitive forms also the marks of decline in the ontogeny may not exist, or may be difficult of observation, *e.g.*, Orthoceratidæ and the like.

TABLE OF ONTOGENIC TERMS.

Structural Conditions.	Stages.	Stages.	Sub-stages.	Sub-stages.
Anaplasis (Haeckel)	Embryonic	Embryonic	Several	No popular names.
	Larval or young	Nepionic	ananepionic metanepionic paranepionic	
	Immature or adolescent	Neanic	ananeanic metaneanic paraneanic	
Metaplasis (Haeckel)	Mature or adult	Ephebic	anephebic metephebic parephebic	
Paraplasis	Senile or old	Gerontic	anagerontic metagerontic paragerontic	

It will, of course, be understood that the artificial sub-division of each stage into three sub-stages is merely a matter of convenience. In our own experience, we sometimes find only two, and sometimes more than three, sub-stages, but in a large number of cases all the changes within any one stage may be described under three headings.

It does not appear that the epembryonic (postembryonic) changes taking place in the earlier life-histories of the first nine orders of Insecta, and classifiable under the term of direct development, can in any way be separated from those of other animals. The wings are not introduced suddenly in the Orthoptera, for example, nor, for that matter, in any other orders. Their development is strictly a phenomenon accompanying the nepionic or neanic stages of insect development, and the last stage in the orders from x. to xvi. is the pupal stage. The unfolding of the wings, of course, takes place in the ephebic stage, but this is not a change in which new structures appear. Their expansion and hardening is a mechanical result of unfolding and use taking place in structures elaborated in the pupal stage and probably inherited from animals in which such structures arose more gradually and became hardened and shaped by usage in more prolonged substages of growth.[1]

[1] Mr. Alfred G. Mayer, who has been working up this and connected subjects among Lepidoptera, and whose researches are original and thorough, and accompanied by drawings that will, when published, demonstrate his discoveries, has, at our request, furnished us with the following note in support of the conclusion stated above, that the changes taking place in the development of the wings are not so sudden and startling as they appear to be :—

"In the Lepidoptera the rudiments of the wings have been found in very young larvæ, Landois having demonstrated them in larvæ only 4 mm. long. My own researches have shown that they occur in the second and third thoracic segments, and consist merely of thickened infolded portions of the hypodermis itself. The cells of the larval wings are very much crowded together, and are elongate spindle-shaped. When the larva changes into a pupa the wings expand to about sixty times

Professor Miall states that, "In the Amphibia which undergo transformation, the stage added to the life-history of the more primitive forms is not the tadpole, but the frog or toad." This, it seems to us, depends upon what part of the animal's life is taken as a point from which to view the preceding stages. We must remember that the tadpole represents a highly-modified stage of development, and that in this are concentrated many chapters of the evolution of the ancestry of this type among the fishes and gill-breathing batrachians. This abbreviation or concentration of adult characters has been termed acceleration by Cope and one of the authors of this paper, and has been made the subject of special researches conducted among Vertebrata and Invertebrata. The results have been formulated into a law lately designated, by one of the authors of this paper, as the law of Tachygenesis. In following out genetic series it has been ascertained that the successive species or genera do not repeat the characters of their ancestors in detail, but abbreviate or shorten them in accordance with definite laws of procedure. The characters first acquired during adult stages of ancestors are not inherited at the same age in descendants. The supposed tendency to inherit at the same age in closely approximated living descendants is misleading, because, when one examines series in time, one finds that inheritance at the same age is only true of nearly contemporaneous individuals, and not even generally true of any large number of these. In other words, even in members of the same species, if a series of these in time be followed, there is constantly expressed a tendency to inherit characteristics earlier than the age at which they first appeared in ancestors. The terminal or highly specialised members of series have also been found to skip ancestral stages altogether, and these cases are cited, often by high authority, as unaccountable examples of abbreviations, or falsifications of the embryological records, and also under other imaginative, subjective appellations, showing that these authors are using their fancy to eke out their knowledge of the facts. The abbreviations are really the direct inevitable result of the continued action of the law of tachygenesis.

One of the very best examples is the *Salamandra atra* of the Alps, which brings forth living young. The embryo really passes through its aquatic gill-bearing stage in the ovary, and may, as has been

their former area, and, as a consequence, the cells of their tissues flatten out, forming a pavement epithelium. The pupal wing, therefore, is derived directly from the hypodermis of the larva. Some of the hypodermic cells become modified in the pupa, and form the scales; others become elongated and bind the upper and lower layers of the bag-like wing together, so that when the insect emerges from the chrysalis, and the blood pressure within the wings causes them to expand, they are prevented from bulging out into balloon-shaped bags, and become the large, thin, flat organs of locomotion with which we are familiar. The area of the wing of the mature insect is more than five hundred times greater than that of the larva. The pigments of the scales are derived from the 'blood' or hæmolymph of the pupa.

"Alfred G. Mayer, Cambridge, Mass., *February* 26, 1896."

demonstrated by Mademoiselle de Chauvin, be arrested in its development and made to re-adopt the aquatic existence and reproduce the aquatic breathing-organs of its ancestors. It is obvious, in this case, that the *Salamandra atra* is highly tachygenic in its development, and has greatly shortened up the gill-bearing larval stage necessarily passed in the water by the other species of salamanders that are neither so highly specialised nor so completely fitted for terrestrial existence. The same is true of the tree-frog of Martinique, *Hylodes martinicensis*, which passes its tadpole stage in the ovum, and is born as a true frog. Such examples as these show that the ephebic (adult) highly specialised, acquired characters which fitted these forms for living upon the land have become more important, and encroached upon the field occupied in the ontogeny by ancestral adaptive aquatic organs and tendencies, until finally these animals have ceased laying their ova in the water and become able to carry them within themselves until their inherited aquatic metamorphoses have been passed through.

This law has been lately explained by one of the authors of this paper as due to the prepotency of acquired characters in phylogeny. Acquired characters introduced late in life, and adaptive or suitable, are seized upon by heredity, acting according to the law of tachygenesis, and are necessarily repeated, if they appear at all, in a certain succession with relation to other characters of the ontogeny, and this succession is parallel with the modifications that have taken place in the evolution of the group to which the animal belongs. Thus, in each succeeding member of a series, the last or later acquired modifications necessarily take up space and time previously occupied in ontogenic development by ancestral characters inherited from more remote ancestors. Two things cannot occupy the same space, and, consequently, the latest acquired and most suitable characteristics press back upon and tend to obliterate those which have been acquired from more remote ancestors, and which usually lie between the embryo and the middle of the neanic stage—that is, in the larval and earlier adolescent sub-stages.

This is obviously a rational corollary of evolution by descent with modifications, but it was not founded upon mental processes by either of its authors. On the contrary, it was laboriously worked out in detail in different series of animals, and carefully grounded by minute observations. It does not seem to us that the earlier appearance of the ephebic characters of the true frog or salamander can be spoken of as "adult metamorphosis," although in these the latest acquired adaptive ephebic characters have undoubtedly encroached upon the period usually considered as the larval or tadpole stage, leaving merely a transient recapitulation of this condition. This term, however, seems more appropriate for tachygenic types of this kind than for any of the Insecta. The metamorphoses of the last are exactly the reverse of the process common in Amphibia, and the comparatively prepotent, newly acquired, adaptive characters are first manifested in the nepionic and neanic stages instead of in adults, as in Amphibia.

The Insecta of the more specialised orders, x.–xvi., afford, next to some parasites, the most notable examples of this mode of evolution. Their larval or nepionic, and pupal or neanic, stages are prolonged at the expense of the ephebic, winged, stage, and the reasons for this prolongation are found in the great number of new features introduced into these stages of development in these orders as contrasted with those of the more primitive and, in large part, more ancient orders, i.–ix. The law of tachygenesis has been at work here, as in the former cases alluded to above, and it is shown in the encroachments of the adaptive characteristics of the caterpillar, grub, and maggot upon the inherited characters of the Thysanuran stage, which loses its ancestral characteristics, until in most cases they are either obsolete or recognisable with difficulty.

The habits and structures which have been evolved in different types for continuing the life of the individual through the winter occur only in animals likely to be injured or to perish if exposed without some defence, and vary from the horny coverings of the winter buds of fresh-water sponges, Bryozoa, and Crustacea, to the storage of provisions in sheltered places by land-animals, and even hibernation may perhaps be included under this head, since this is equally the result of inability to lead an active life under the rigorous conditions of extremes of temperature.

The old view that the larval stage arose as an adaptation acquired by the insect according to its surroundings, providing either a caterpillar, grub, or maggot, and that these lead necessarily to a more or less protracted quiescent pupa stage, in which the animal can pass through the dangerous time without feeding, is more easily supported than any other view. It is certainly more in accord with obvious facts than the view that this stage arose because it was essential to the good or success of the species in the struggle for existence, or some other equally obscure teleological cause; as, for example, that each individual ought to have a prolonged period of rest in which to elaborate its complex internal and external anatomy.

As a matter of fact, we do not see how the same argument can be applied to the Odonata or Orthoptera, whose structure is certainly very complex, and which, in their insectal peculiarities, are not so far behind the higher orders as to justify the assumption that their differences of structure must necessarily be provided for by modes of development that are so disproportionately complex. If this be met by the assertion that their wings are transparent and their ephebic organs materially simpler than those of the orders x.–xvi., how is it that Ephemeroptera and Platyptera, which are very highly specialised in the ephebic stage, have no quiescent stage which can be compared with the pupa, and yet the Coccidæ, among Hemiptera, have such a stage, although the full-grown forms of this family are not usually considered as pre-eminently the most complex of the first series of orders?

Mr. Miall uses a purely Darwinian phraseology, in part of his paper, in speaking of the generally earlier transformations of the inhabitants of shallow seas as contrasted with the later occurring and supposed "adult transformations" of Amphibia and Insecta. "It is," he says, "often of advantage that there should be division of labour between the several stages of the life-history, and the functions of migration and growth may be allotted to special times of life instead of being carried on throughout." "Marine animals commonly produce far more eggs than insects. The risks of the shallow seas are so great that a small proportion only of the young animals come to maturity." That is to say, if we correctly understand the argument, the inference is that these differences between marine animals and the inhabitants of the fresh waters and land have arisen through natural selection. So also in the following:—"The more sluggish and sedentary the adult, the greater the activity we may expect to find in the larvæ. It is they that have to travel and find suitable quarters."

This appears to us as assuming as proved the question just now at issue in the world of science. Is a habit or a structure of any special advantage, and, if so, what effect has it upon the life of the species and the possible origin of varieties and other species? Can these structures have arisen from other causes than natural selection? Everything that is suitable must in one sense be advantageous, but the fact, that any structure is of advantage, does not prove that this is, or even may have been, the cause either of its suitability or of its origin or anterior existence. It is of advantage, and it is also extremely suitable to its surroundings, that a drop of rain is spherical, but both of these adjustments to the surroundings are the results of laws that govern the relations of fluids to the earth and its atmosphere.

Natural selection resting on the often unproved assumption of the advantage of this or that structure is, in most of its supposed applications, to our minds untrue, and when it is true it is a result and not a cause. For example, with reference to the last quotations from Professor Miall, a vast number of Protozoa are very active, and we are not aware that they have very sluggish young, nor yet that their methods of reproduction differ essentially, or that they produce young which are any less volatile than those borne of sedentary forms. It is true that Porifera, Hydrozoa, Actinozoa, Vermes, and most of the Invertebrata that are aquatic have numerous eggs and very active larvæ as compared with the parents; but it is also worth while to consider whether this may not be due to the fact that these all belong to groups having a certain structure which may have been acted upon in a certain way by their surroundings.

There are also exceptions to this rule even in these aquatic groups. Thus the fresh-water *Hydra* has very few ova; the Bryozoa do not appear to us to have an over-supply; the Mollusca, as a rule, although marine and rather sluggish, do not have very numerous ova or remarkably active larvæ, yet their highest specialised voracious, quick-moving forms, the squids and cuttle-fishes, have very active larvæ; the highly specialised Spatangoids, such as *Hemiaster cavernosus*, Ag., and *Aceste bellidifera*, Thomp., protect their young, and must have comparatively few of them; while most fishes have numerous ova, this is not the case with those that are viviparous or rear their young in pouches that can only take in a limited number, or in their gills. Professor Miall refers to this as tending to promote helplessness in the young, and seems to consider this has a relation of cause and effect, the helplessness being due to the fact that the parents are able to find them food and protection. Does not this statement again assume to answer a question awaiting strict investigation? Do not parental care and helplessness of the young appear simultaneously? Can the helplessness of the young of the kangaroo, for example, when transferred from the vagina of the female to the pouch, be due to such a cause? Obviously, it is a case of premature birth, or at any rate of birth at a time when the young could not possibly take care of itself, and it is difficult to imagine how this could be advantageous in the early history of this group or arise out of parental care. Professor Miall imagines that the sluggishness of the parent "promotes activity" in the young, and that activity in the parent has the opposite effect, and also, that the power of flight "favours a sedentary life in the larvæ, which is spared all effort in connection with the dispersal of the species, and can give its undivided attention to feeding."

Professor Miall sees that this explanation does not accord with the active larvæ of the winged forms of the orders i.–ix., and he endeavours to overcome this by the further assumption that the larvæ do not necessarily become degenerated until their self-helpfulness, "care and responsibility," are taken away from them by parental care. These statements are eminently true, but conflicting in spite of this explanation, and it still remains obvious that the power of flight in orders i.–ix. does not favour "a sedentary life in the larvæ" any more than it does among some birds and the bats, and the Mammalia generally. There is connection between parental care and the degeneration of larvæ, and there is still more between parental care and tachygenesis; nevertheless, it is extremely difficult, if not impracticable, to place either of these phenomena in the relation of cause and effect, or even to take the first steps towards proving that parental care antedated and might have caused tachygenesis. Tachygenesis occurs equally in animals that as a rule take no care of their young, as among echinoderms and fishes, and yet the highly tachygenic young of the more specialised forms are found nestling in specialised trough-like ambulacral furrows among the former, or in special pouches, or in the gills of the latter.

Professor Miall's view as to the causes of degeneration of insect larvæ approaches very close to that taken by the authors of this paper some years since, but differs in that he assumes natural selection to have been one of the active factors. It seems to us that the correlations between the kind of food and the structures of the larvæ, whether degenerate or not, are obvious; and the fact that the food was directly supplied by the parent, or merely indirectly furnished by the location of the ova, is not in our opinion anything more than the expression of a habit which was not in any sense dependent upon the possession of wings nor yet upon the necessity of distributing the species in search of favourable fields. Some Coleoptera have active larvæ, as in Gyrinidæ, although the parents are themselves among the most restless of insects, and there are many examples of wingless females, incapable of any extended travel, which lay their eggs upon food-plants from which the larvæ never stir until the plant is destroyed. The example of the active larvæ of *Epicauta* and *Melöe* which forage for themselves, as do many parasitic larvæ, and hunt food and provide for their own development through several variable stages and metamorphoses, as well as the great activity and migratory capacity of the army-worm, among the larvæ of Lepidoptera, are not favourable to the view that there is any causative connection between the activity of the parent and the capacity for active life of the larvæ. They are, however, favourable to the hypothesis that traces obvious connection between the structures and habits of the larvæ and their surroundings.

The structural modifications of the larvæ are, so far as we can see, the direct products of their habits and surroundings, and that the former should be suitable, and therefore advantageous, is a necessary and inevitable result. This result, in our way of looking at the facts, seems to differ from the results of other physical causes acting upon inorganic bodies, only in being obscured by the complexity of organic structures and false mental habits of regarding them.

In other words, it is putting the cart before the horse to place advantage as a cause when it is, together with the struggle for existence (as first clearly stated by an eminent entomologist, Dr. A. S. Packard), the result of the evolution of organisms which has been directed and governed by other and more fundamental laws.

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V.

Verworn's "General Physiology."[1]

WHEREVER there be two or three physiologists and zoologists gathered together, the question of the scope and method of physiology is discussed. From modern habit, and from the special relation of physiology to medicine, the physiologist is accustomed to defend the position that physiology is best advanced by the study of higher animals. The zoologist, on the other hand, maintains that the simple functions and properties of protoplasm are less clearly revealed in higher animals on account of the specialisation of their tissues. To this the physiologist makes the ingenious retort that in simple creatures all the capacities of protoplasm are so united and confused that it is impossible to distinguish them: in *Amœba*, for instance, you cannot study nervous, or muscular, or excretory functions, because the three occur simultaneously in the same mass; while in man or the guinea-pig you have cells and tissues in which the nervous, excretory, and muscular qualities are isolated, or at least preponderate. In this treatise, Max Verworn is more inclined to the zoological view: taking the phenomena of life and the qualities of living material as his subject, he elucidates them by reference chiefly to simple organisms, distributing his attention almost equally between plants and animals. His treatise is not a text-book of physiology in the current sense of the term: in it you shall find no direct prolegomena to the study of medicine, but rather an examination of the fundamental phenomena of all living things. "A Treatise on General Biology" would be a title more consonant with the existing terminology of the sciences, and in this respect the dedication to the memory of Johannes Müller is noteworthy.

Since we regard this treatise as a biological production of the highest importance, and since we think that no biologist should neglect it, a general account of its scope is the best method of commending it to our readers. The first chapter, of 58 pages, gives an account of the development of physiology from the earliest times to the middle of this century—that is to say, practically, to the end of Johannes Müller's time of activity. The author then discusses the method of physiological inquiry, and after full treatment of

[1] "Allgemeine Physiologie." Ein Grundriss der Lehre vom Leben. Von Max Verworn. Pp. 584, with 268 illustrations. Jena: Gustav Fischer, 1895. Price 15 marks.

various physiological and psychological theories, including an excursus into metaphysics, he comes to the sane conclusion of Johannes Müller, that there is no special physiological method, but that all methods are right if they lead towards the goal. The goal is investigation of life; and chemistry and physics, anatomy and embryology, zoology and botany, mathematics and metaphysics, all must be pressed into the service.

The second chapter, 84 pages in length, treats of the living material. Noting first that living material occurs discretely in individual masses, Dr. Verworn discusses the conception of individuality. He dismisses, of course, the old view that indivisibility was the criterion of an individual, and comes to the definition that an organic individual is a single mass of living material, in a formation that is capable of maintaining independent existence. He discusses the various categories of individuality from cells to states, pointing out that the higher individuals are composed of colonies of the next lower grade, and distinguishing, although not with the felicity of Professor Patrick Geddes (in the Encyclopædia Britannica), between morphological and physiological individuality. He discusses Altmann's granular theory, but accepts the criticism that Altmann included among "bioblasts" structures of quite different morphological and physiological value. He regards the cell as the vital elementary organism, and proceeds to discuss its various forms and its organs, such as the nucleus and the centrosome, which he takes to be a specialised part of the nucleus, sometimes with an independent existence. Then follows an account of the morphology of the cell, and of the plastids, such as starch granules, that may be found in it, and of the physical structure of protoplasm. In the latter connection he follows Bütschli (*see* NATURAL SCIENCE, vol. ii., p. 31) in the main. Then comes a most careful account of the chemistry of protoplasm, and an ingenious summary of the differences between organic and inorganic matter, a comparison in which, however, we think he is inclined to insist more upon the differences than upon the identities between the two. His final summary, however, is sufficiently mechanical to disturb the most ardent vitalist. "The process of life," he says, "consists in the metabolism of albumens."

The third chapter, extending to 130 pages, treats of elementary vital phenomena. The first section of this deals with metabolism, and the author gives a good account of the different food-materials and methods of absorption found among plants and animals. He makes the curious slip of stating that plants absorb their gaseous food through the stomata; it has been shown clearly by many experiments that the main function of stomata is regulation of the transpiration of aqueous vapour; carbonic acid and oxygen are absorbed through the general surface of the leaf. He then treats of anabolism, dealing perhaps rather superficially with the stages between food-material and proteid; and of katabolism, where his account of excretion and of the relations between secretion, excretion, and the formation of inter- and extra-cellular matrices is excellent. The second section of this chapter describes the phenomena of change of form, which Verworn, following Haeckel, regards as divisible into two separate, but mutually dependent, groups, the phylogenetic and ontogenetic series of changes. In these, heredity is the conservative force; adaptation, the changing factor. In a short discussion of heredity, he points out that Weismann has practically disproved the inheritance of acquired injuries, but that in our ignorance of the correlations between organs it would be almost impossible to prove the definite inheritance of acquired characters. Moreover, he would not expect that experiments, unless conducted through a very large series of generations, could be expected to give any definite results. In a similar short discussion of adaptation he points out the direct effect of environment in shaping an individual organism, and the effect of natural selection in changing the form in a phylogeny. Obviously, there was no space for a full treatment of problems so vast as heredity and adaptation, but the mere raising of them in appropriate places in the development of the subject is an enormous gain to the philosophical treatment.

Then follows a general discussion of ontogenetic change, of growth and reproduction, of cell-division, fertilisation, of ontogenetic changes in single-celled creatures, and of the general phenomena of ontogeny in Metazoa. Verworn does not attempt a condensed account of embryology, but merely specifies the general nature of the changes that take place, summing them up in the sentence: "Cell-division, equal and unequal, and coherence of the results of division, are the factors that determine the embryonic development of a specialised cell-community." It is perhaps to be regretted that no room was found for a discussion of modern criticisms of the cell-theory: there are, at least, suggestive parallels to be drawn between the uni-cellular development of, say, a *Vorticella* from a spore, and the shaping and moulding of a metazoon.

The last section of this chapter refers to what may be called the vital transformations of energy in living organisms. The author discusses in detail the activities of living creatures, their movements of all kinds, and their productions of light, heat, and electricity. To the physiologist, accustomed only to consideration of ciliary motion, protoplasmic motion, and muscular motion, the comprehensiveness of this section will come very pleasantly.

The fourth chapter, 60 pages, on the general conditions of life, seems to us the most attractive section of the whole volume. After a brief review of the positive and negative conditions of life, the author passes to a historical and critical treatment of theories of life and death, and of the definite facts upon which theories must be based. His discussion of ancient and modern theories of the origin of life and of known facts leads him to the plain conclusion that what we call life is an ordinary and not a supernatural result of the development of our planet. We know life only by its qualities, and these qualities, one and all of them, are necessary results of the interaction between the chemical, physical, and morphological properties of the mixture we call protoplasm and the surrounding forces. Similarly his discussion of death leads to a plain conclusion: no definite material system, like a piece of protoplasm, no definite complex of activities like life, is immortal; in the whole world all that is immortal and eternal is elementary matter with its forces.

The fifth chapter, of 120 pages, is upon stimuli and stimulation, and perhaps is the most directly interesting to physiologists. After treating of the nature of stimulation, the author deals with the mechanism of the different kinds of stimulation, in this following rather more closely than is his wont the familiar course of a physiological treatise. Thereafter he describes the less familiar phenomena known as tropism, and includes figures and descriptions of chemotropism and galvanotropism, which will be new to most readers.

The last chapter, entitled the mechanism of life, contains a large amount of material that, so far as we know, has not yet found its way into text-books. It is inspired more definitely than the other sections of the book by the individual conceptions of the author. He discusses Roux's view of the mosaic nature of living bodies, and details his conception of *biogenes*, the ultimate vital particles or units which, to a certain extent, correspond to the biophores of Weismann, the physiological units of Herbert Spencer, the gemmules of Darwin, the pangenes of De Vries, and the idioblasts of Hertwig. The correspondence, of course, is of the vaguest kind, as these theoretical units are in every case merely a concrete expression of their authors' conception of the nature of vital activities. In this chapter, too, occur Verworn's special views as to the function of the nucleus, views which, as is well-known, differ from those held by most biologists. We have no desire to object to the inclusion of individual views; indeed, after so careful and impersonal a discussion of the main parts of his subject, as is to be found in five-sixths of the volume, the reader is glad to become on more intimate terms with the author.

In so vast an array of subjects, it must necessarily happen that any biologist reviewing the volume should come upon statements he would prefer to modify, conclusions he would wish to combat. But the conception of physiology taken by the author, and the all-embracing treatment he has adopted seem to us so admirable from the point of view of stimulating thought, and so beyond praise in these evil days of narrow specialism, that we have thought it a duty, as we found it a pleasure, to describe rather than to discuss the volume. We believe that Verworn's "General Physiology" is the most notable book we have read for many years, and that it, and the successors it will call into existence, will have a permanent influence on biological teaching.

P. C. M.

SOME NEW BOOKS.

FOSSIL FISHES IN THE BRITISH MUSEUM.

CATALOGUE OF THE FOSSIL FISHES IN THE BRITISH MUSEUM (Natural History). Part III. By Arthur Smith Woodward. Pp. xlii, 554, pls. xviii. London, 1895. Price £1 1s.

THE Catalogues published by the Trustees of the British Museum are held in special esteem by students of natural history. As a rule, they are much more than their modest title denotes; for instead of being merely a systematic enumeration of the species and specimens in the British Museum, they are often a comprehensive treatise on all the forms of the particular division of the animal or vegetable kingdom to which they refer. The Catalogue of Fossil Fishes prepared by Arthur Smith Woodward occupies a prominent place among these publications. That which L. Agassiz attempted more than half a century ago and completed with such brilliant results, A. S. Woodward endeavours to repeat in the light of the most modern principles and the present state of knowledge. How enormous, however, has been the increase of palæontological material since that time—how much our knowledge of fossil fishes has grown and deepened—may best be realised by comparing any section of Agassiz's "Recherches sur les Poissons Fossiles" with the Catalogue of the British Museum now before us. Not without a certain amount of sorrow is one convinced by this comparison how fleeting and short-lived are the most important works in the domain of natural history, and in this category may undoubtedly be placed Agassiz's great volumes on fishes. Of the classification of fishes based upon the skin-structures, which L. Agassiz proposed, scarcely anything remains. The orders of Cycloidei and Ctenoidei were long ago shown by J. Müller to be entirely untenable; the Placoidei were limited and defined in a different manner; and that of the Ganoidei alone, the establishment of which Agassiz regarded as the most important result of his long-continued researches, received stronger anatomical support from J. Müller and Carl Vogt, and withstood all the attacks from different sides until quite recently. Its limits have indeed been reduced considerably in course of years; the Placodermi, Dipnoi, and Acanthodi have been excluded and the close relationships of the Ganoidei and Teleostei have been more and more emphasised. Following Kner, Owen, and Cope, A. S. Woodward has also given up this last remnant of the system of Agassiz; his Ganoidei are abandoned, and their former members are divided among the sub-classes of Ostracodermi, Dipnoi, and Teleostomi. Whether the direct opposition of the Crossopterygii to the Actinopterygii will stand the test of time, may indeed be doubted; and likewise the future can only decide whether the complete fusion of the higher ganoids with the bony fishes is to be regarded as a noteworthy step in advance. The fundamental difference between the cartilaginous fishes (Elasmobranchii) and all other fishes becomes more and more recognised; the latter, on the other hand, like the birds, comprise a series of forms so closely related that hitherto no agreement has been arrived at concerning the definition of the larger sub-divisions. In the first, and in part of the second, volume of his Catalogue, A. S. Woodward has treated the fossil Elasmobranchii; in half of the second volume he has dealt with the completely extinct Ostracodermi, the Dipnoi, the Crossopterygii, and part of the Chondrostei. The classes, sub-classes, orders, families, genera, and species, are well defined; all the fossil forms, including those not represented in the British Museum, are enumerated; the synonymy is critically determined and the literature completely summarised. The third volume contains the remainder of the Chondrostei, all the other ganoid fishes, and part of the Mesozoic bony fishes. In a further volume the later Teleostei are to follow. The most interesting groups from the phylogenetic and morphological points of view are included in the three volumes now published, so that the significance of A. S. Woodward's work can already be completely appreciated. Since the author follows no theoretical course, and contemplates no systematic reform according to his own ideas, but attempts more especially to present the facts in well-arranged and general order according to the latest phase of our knowledge, his Catalogue will be of permanent value in the literature of palæichthyology, and will serve as an inexhaustible source of information, not only for palæontologists and geologists, but also for zoologists and embryologists.

A space of four years intervenes between the appearance of the second and third volumes—a short period of time for the arrangement of the varied and difficult materials which are treated in Part III. For the Chondrostei, it is true there are available the important earlier works of R. H. Traquair; among the Protospondyli, Aetheospondyli, and Isospondyli, Woodward in many cases has had to determine the fundamental method of classification, and to submit to careful critical revision the families, genera, and species represented. Traquair's remarkable researches among the Palæozoic heterocercal scaly ganoids have led to the unexpected result that there exists so great an anatomical resemblance between these fishes covered with typical ganoid scales and the Acipenseroids, that no doubt can exist as to the genetic connection between the two. A. S. Woodward adopts Traquair's views completely, and unites under the heading Chondrostei both the heterocercal-tailed Palæoniscidæ, Platysomidæ, and Catopteridæ, and also the recent sturgeons and paddle-fishes (Polyodontidæ), besides an extinct Mesozoic family (Belonorhynchidæ) with a diphycercal tail. As common characters are enumerated the incomplete ossification of the vertebral column, the smaller number of supports than rays in the dorsal and anal fins, and the more distinct segmentation of the pectoral girdle by the formation of an infra-clavicle and clavicle; or, as Gegenbaur has lately correctly named these bones, a clavicula and a cleithrum. In addition to these principal characters there are still others of less importance, namely, the presence of baseosts in the pelvic fins, the small extension of the preoperculum on the cheek, and the sub-division of the hinder expansion of the maxilla.

With the exception of the Belonorhynchidæ all the Chondrostei have a beautifully heterocercal tail. In the dermal skeleton there is the greatest possible variation. In the Palæoniscidæ, Platysomidæ, and Catopteridæ, the body and tail are completely covered with rhombic, very rarely cycloidal scales; only the aberrant Permian *Dorypterus* appears to have been scaleless. In the Belonorhynchidæ true scales are wanting, but four rows of small bony scutes extend along the trunk; in the Mesozoic Chondrosteidæ, of which A. S. Woodward figures a finely preserved specimen from the Lower Lias of Lyme Regis, the upper lobe of the tail is covered with fulcra and scales as in the living Polyodontidæ, while the rest of the body is naked. In the Acipenseridæ, besides this covering of the caudal lobe, there are several longitudinal series of large bony plates with smaller star-shaped ossifications between. No one will deny that the Chondrosteidæ, Polyodontidæ, and Acipenseridæ stand in the closest genetic connection, though the future of the Belonorhynchidæ is still very doubtful; but that these cartilaginous ganoids of J. Müller, so remarkably different from the typical ganoids, may probably be derived from the Palæozoic Palæoniscidæ, is one of the most important results of the always exact researches of R. H. Traquair. Nevertheless, whether it is correct to place these primitive scaly forms in the same order as the cartilaginous ganoids, appears doubtful, since even A. S. Woodward points out that between the Triassic Catopteridæ and the older Palæoniscidæ there is as close a connection as between the former and the earliest representatives of the Lepidostei. In any case, it is no breach of existing rules of classification to arrange the primitive ancestral forms in a special group opposed to one comprising their later descendants, which are specialized in various directions.

The Lepidostei or Lepidosteoidei, Pycnodonti, and Amioidei, as hitherto understood, are divided by A. S. Woodward into the three sub-orders of Protospondyli, Aetheospondyli, and Isospondyli. The Protospondyli correspond to the Lepidostei of Huxley, with the exception of the Aspidorhynchidæ and Lepidosteidæ, for which Woodward establishes a special sub-order (Aetheospondyli), which, however, he regards as of only provisional significance, since "the recognition of this group is a confession of ignorance," in consequence of the uncertainty of the origin and relationships of the two families placed here. The name Aetheospondyli is in allusion to the unique variations of the vertebral centra from the bi-concave or amphicœlous to an opisthocœlous type.

The Protospondyli form an unusually numerous derivative series from the primitive Chondrostei, or Heterocerci, as I have termed them. Their vertebral column is never completely ossified but shows different stages in the process of ossification, in part most remarkably suggestive of those observed among fossil Amphibia. In outward aspect and squamation the Protospondyli are most closely connected with their fore-runners, but the caudal fin loses its conspicuous heterocercy, the upper lobe is atrophied, and the caudal becomes hemi-heterocercal or only internally heterocercal; the number of supports in the dorsal and anal fins becomes exactly equal to that of the dermal rays; the clavicle and cleithrum are fused together; the opercular apparatus, *i.e.*, the preoperculum, is reduced, and the baseosts of the pelvis disappear. Most of the families of Protospondyli are closely connected, so that their definition is difficult; they were probably already differentiated at the beginning of the Mesozoic period.

The section on the Protospondyli abounds in new and important observations; it forms the main part of the third volume. The subdivision of this great order from which the typical Teleostei have arisen, into the families of Semionotidæ, Macrosemiidæ, Pycnodontidæ, Eugnathidæ, Amiidæ, and Pachycormidæ, is much better than all previous attempts at classification. The Semionotidæ correspond to the Stylodontes and Sphærodontes of A. Wagner, and comprise fishes with thick shining rhombic ganoid scales, which are closely related to the Catopteridæ in their anatomical characters and their geological distribution. They arise in the Upper Permian and attain their maximum development in the Trias, Lias, Jurassic, and Lower Cretaceous. The osteology of most of the genera is treated with great completeness, and the skull and skeleton of *Lepidotus* are specially described in a remarkable way. A restoration of the complete fish and several drawings of the head, leave very little more to be learned concerning this grand and widely-distributed fish. The genus *Dapedius* is treated in a similar manner, new and important facts being added concerning the skeleton of the trunk. The comparatively small family of Macrosemiidæ includes only seven genera with slender trunk, enamelled scales, and pointed teeth, especially distributed through the Jurassic rocks (*Ophiopsis*, *Histionotus*, *Legnonotus*, *Macrosemius*, *Petalopteryx*, *Propterus*, and *Notagogus*). The systematic position of the interesting Pycnodontidæ, ranging from the Jurassic to the Eocene, has hitherto been misunderstood by almost all authors. From their singularly deep and laterally compressed trunk, their peculiar scales, and their dentition, these notochordal fishes have mostly been regarded as a separate order equivalent to that of the Lepidostei. On account of a superficial resemblance they have often been considered as descendants of the Platysomidæ. The careful researches of Woodward leave no longer any doubt that the Pycnodontidæ belong to the typical Protospondyli, and that they bear almost the same relation to the Semionotidæ and Macrosemiidæ as the Platysomidæ to the Palæoniscidæ. The two families form analogously differentiated branches of the Heterocerci and Protospondyli respectively, which were apparently not capable of further development and left no descendants. Traquair had already emphatically denied all genetic connection between the Platysomidæ and the Pycnodontidæ. A. S. Woodward determines the systematic position of the latter with absolute certainty, and the view of Egerton, which I had likewise adopted, is finally abandoned. The twelve genera of Pycnodontidæ, like those of the other families, are very carefully revised, a number of superfluous genera and species are relegated to the synonymy, and the whole of the widely scattered material is arranged in a masterly manner. Several genera are illustrated by finely executed figures.

Under the denomination Eugnathidæ, Woodward includes a number of Mesozoic fishes with imperfectly ossified vertebral column, a deeply cleft mouth, pointed teeth, and slender trunk, which begin in the Trias and become extinct in the Chalk. The ganoid scales are rhombic, sometimes rounded at the hinder angles, and of very variable thickness. The genera belonging here (*Eugnathus*, *Heterolepidotus*, *Allolepidotus*, *Ptycholepis*, *Caturus*, *Callopterus*, *Eurycormus*, *Neorhombolepis*, *Lophiostomus*) have hitherto been separated in different families, and their osteology has been insufficiently known. Some of the species until now referred to *Pholidophorus*, are transferred to *Eugnathus* or *Heterolepidotus*, and the great similarity between the skull of *Caturus* and that of *Eugnathus* is pointed out in a convincing manner. Woodward assigns small importance to the characters of the scales; among the Eugnathidæ we therefore find genera with thick polished rhombic ganoid scales and others with thin, cycloidal, deeply imbricating, enamelled scales. As among the Semionotidæ and Macrosemiidæ, the latest genera are characterised by the most advanced ossification of the vertebral column, which, as in *Amia*, results in the formation of complete centra.

Between the Eugnathidæ and Amiidæ the distinction is slight; the vertebral column in the latter is generally better ossified, and the dermal skeleton always consists of thin cycloidal scales. The two older genera, *Liodesmus* and *Megalurus*, begin in the Jurassic; the third, *Amia*, begins in the Lower Chalk and survives to the present day.

A. S. Woodward regards the Pachycormidæ, which appear first in the Upper Lias, as a remarkable modification of the thin-scaled Eugnathidæ. The vertebral column of these fishes, which are mostly large, is divided into very numerous short segments, but incompletely ossified, being formed either of half-vertebræ or ring-vertebræ. It turns upwards at the hinder end, without, however, being continued into the upper lobe of the powerful, deeply-cleft tail-fin; an unusually expanded hæmal arch at the basis of the lower lobe shows, notwithstanding the complete outward homocercy, the typical structure of the Protospondylic tail. The strong pectoral fins indicate a remarkable power of swimming. In the older genera (*Sauropsis* and *Euthynotus*) the jaws above and below are provided with stout conical teeth and are rounded off in front; *Hypsocormus* and *Pachycormus* are characterised by the strong development of the dentition, and in one species of *Hypsocormus* from the Oxford Clay of Peterborough the premaxilla is elongated into a prominent rostrum with powerful teeth, as in the Cretaceous genus *Protosphyræna*, where it becomes a long conical process. The union of this hitherto incompletely known genus with the Pachycormidæ is somewhat surprising and still needs further proof.

In the extensive order of Isospondyli Cope places a large number of true bony fishes from the Cretaceous, the Tertiary, and the present day. Woodward partly follows the celebrated American palæontologist, and deals in the volume before us with the three oldest families, the members of which Agassiz assigned to the Ganoidei. Until now indeed, the Pholidophoridæ have been generally recognised as ganoids. Like the majority of the Protospondyli their body is covered with rhombic ganoid scales articulated together; the vertebral column consists chiefly of ring-vertebræ; on the other hand, the want of a splenial and a coronoid element in the lower jaw points to their inclusion in the Isospondyli. The few genera are distributed through the Trias and Jurassic. The closely-related Oligopleuridæ range from the Jurassic to the Upper Chalk. In many respects they are suggestive of the Amiidæ; their scales are thin and cycloid, their vertebral column is completely ossified, but not with separate pleurocentra and hypocentra like those of *Amia* in the caudal region. The Leptolepidæ have already been separated from the group of ganoids by Kner, Thiollière, Lütken, and most authors, and assigned to the Teleostei. They are very sharply separated from the Pholidophoridæ and Oligopleuridæ by the want of fulcra on the fins and by a considerable development of inter-muscular bones. The vertebral column is also completely ossified, consisting of amphicœlous vertebræ, and the tail is both internally and externally homocercal. The Leptolepidæ are remarkably similar to the Clupeidæ, but are distinguished from the latter by the parietal bones meeting in the middle line, by the simple, separate hæmal spines at the base of the tail, and by the stronger development of the enamel on the scales. The genera *Leptolepis*, *Aethalion*, and *Thrissops*, indeed, form the passage between the ganoids and the teleosteans.

The sharp definition of the principal groups (sub-classes and orders) within the great classes of the animal kingdom presents great difficulties, not only among the fishes, but also among the Invertebrata; we are, indeed, well aware that in reference to the rational subdivision of the Anthozoa, Crinoidea, Cystoidea, Brachiopoda, Lamellibranchiata, Gastropoda, Cephalopoda, etc., there are as wide differences of opinion among authors as in reference to the prime divisions of the fishes. The Palæichthyes of Günther may now be definitely buried, since A. S. Woodward has provided for us a complete summary of the Palæozoic and Mesozoic fishes, and no one who has followed the progress of ichthyological studies can conceal from himself the fact that the further recognition of the existence of the ganoids is seriously endangered now that the three best authorities on fossil fishes, Cope, Traquair, and A. S. Woodward, have pronounced against it. The families established by Woodward in the third volume are all defined and characterised with such care that they can, indeed, for the most part, be little affected by the varying views on classification. They include closely-related forms and represent natural stages in the course of development in this large class of vertebrates. Woodward's catalogue deserves the highest praise, not only for its completeness, but also for its critical acumen and the incomparable mode of handling of the material with which the author deals. When completed, this work will form the basis for all palæichthyological researches for the next decades. The beautiful restorations of eight Mesozoic genera in the text ought soon to banish from text-books the familiar figures of Agassiz. Like the eighteen lithographic plates, they are the work of the skilful and trained pencil of Miss Gertrude Woodward, and undoubtedly rank among the best pictorial representations of fossil fishes. KARL VON ZITTEL.

THE BRAIN AND "BRAINS."

THE GROWTH OF THE BRAIN; A Study of the Nervous System in Relation to Education. By Henry H. Donaldson, Professor of Neurology in the University of Chicago. Contemporary Science Series. Pp. 369. London: Walter Scott, Ltd., 1895. Price 3s. 6d.

THIS excellent little book covers a field even wider than its title implies. Considerable advances have been made in recent years in our knowledge of the comparative anatomy, the minute structure and development, and the physiology, both human and comparative, of the central nervous system. Psychology has been pursued from the experimental rather than the metaphysical side, and education has become a science as well as an art. Professor Donaldson has collected a large body of facts and statistics from all these departments of knowledge, and has so marshalled them as to illustrate very fully the development of the central nervous system and the physiology of education.

The freshness of the book lies, not so much in new and original matter, of which there is little, but in the treatment and grouping of facts already established, and in the logical deductions drawn from them. The introductory chapters deal with the facts of growth in general, and are illustrated by numerous tables and curves. The absolute weights of the central nervous system and its chief component parts are then discussed from various points of view, after which its curves of growth are given, showing that by the seventh year, practically before formal education has begun, the brain has already reached nearly to its adult weight. The influence of brain-weight as a factor in determining intelligence receives critical discussion. The minute structure and development of the nervous system is next considered, and particular attention is devoted to the relative volumes of the nerve-cells and their processes in comparison with the embryonic germinal cells from which they arise. From the best statistics available (Meynert, His, and others) it is deduced that there is no need for the production of new nerve-elements after the third month of fœtal life, subsequent increase in size depending upon the enlargement of already formed cells. It would thus appear that environment and training have little or no influence in producing new cells, but produce their result by perfecting the development and inter-relationship of pre-existing materials. These considerations are employed with some success in explaining the phenomena of the growth of the brain, and the differences in the brain-weights of the sexes and the different races of mankind. The architecture of the nervous system, the arrangement of its structural elements into systems, and the development of the latter, form the subject of several chapters, which conclude the anatomical and larger section of the book.

The later chapters deal with function and its development, treating them, not from the point of view of the text-book of physiology, but rather from the psychological side. This part of the book is fully as well written and suggestive as the preceding, and leads up, after a chapter on "fatigue" and one on "old age," to the consideration of the education of the nervous system. It may be regretted that more space is not devoted to this last subject, since it is the one to which the whole book has led up, and further, that it is dealt with in so general a manner. The value of the book to the educationalist would have been considerably enhanced by a chapter on the practical outcome of the considerations which have been enforced. Nevertheless, the work will be of much interest to those teachers who have sufficient knowledge to master its technical details, while the psychologist and physician will find it a well-written and valuable *resumé* of neurological science.

Milk for German Babes.

Grundriss der Krystallographie. By G. Linck. 8vo, pp. vi., 253, with two coloured plates and numerous figures. Jena: G. Fischer, 1896. Price 9 marks.

This is a text-book intended for young students and beginners, but we doubt whether it will be a favourite book with those for whom it is intended, unless the German student is a hardier person than we imagine. Too much information is squeezed into too small a space; an attempt is even made to give an intelligible account of the large subject of Chemical Crystallography in the last eleven pages, after the geometry and physics of the subject have been packed into the first 230 pages. On the very first page, where it is merely stated that tourmaline becomes electrified by friction, Professor Linck thinks it necessary to insert after the word "Turmalin"

$$(n\ Si_{12}\ O_{63}\ B_6\ Al_{16}\ R_4\ H_8 + n\ Si_{12}\ O_{63}\ B_6\ Al_{10}\ Mg_{12}\ H_6).$$

This we quote in order to illustrate, not so much the process of squeezing into too small a space, as the superfluity of information.

In some matters the author is fully up to date, *e.g.*, in the reference of the optical characters of crystals to the geometry of the Indicatrix; in others he is lamentably behind the times, as in the retention of the Naumannian system of notation. It is true that the Millerian symbols are also given, but we had hoped that, since the publication of the classic works of Mallard, Liebisch and Groth, no text-book would introduce the more cumbersome notation except as a thing of historical interest. The diagrammatic representation of the various types of symmetry by means of shaded areas does not appeal to the eye like perspective figures, or like stereographic projections. That the projection on a sphere should not be even mentioned is an omission which is almost unpardonable in a modern text-book of crystallography.

The author introduces a new law under the name of Eutropy, with the following signification:—In a series of analogous compounds, each of which contains a different element taken from the same horizontal line (in Mendeleef's series), while they are all alike in other respects, their crystals constitute a similar series in which all the crystallographic properties alter in a regular manner with the increase or decrease of the atomic weight of the characteristic element. This statement has been recently elaborated by Professor Linck and one of his pupils in *Ostwald's Zeitschrift*, but seems scarcely yet established on a sufficiently wide basis to be given as a general law in an elementary text-book. It is simply an extension of the accurate work recently done on the sulphates by Mr. A. E. Tutton.

We have pointed out various shortcomings of this book in the interests of the readers for whom it is intended, but must in justice add that in the matter of information it is remarkably complete and well suited for more advanced students. The classification of twin-crystals on p. 24 seems both logical and lucid. A word of praise is due to the figures, and especially the coloured plates, which are excellent; but when all is said the question remains—Why are not elementary text-books on Crystallography more readable?

Man and his Ancestors.

The Structure of Man: an Index to his Past History. By Dr. R. Wiedersheim; translated by H. & M. Bernard, with a preface by Professor Howes. Pp. xxi., 227, with 105 figs. London: Macmillan & Co., 1895. Price 8s.

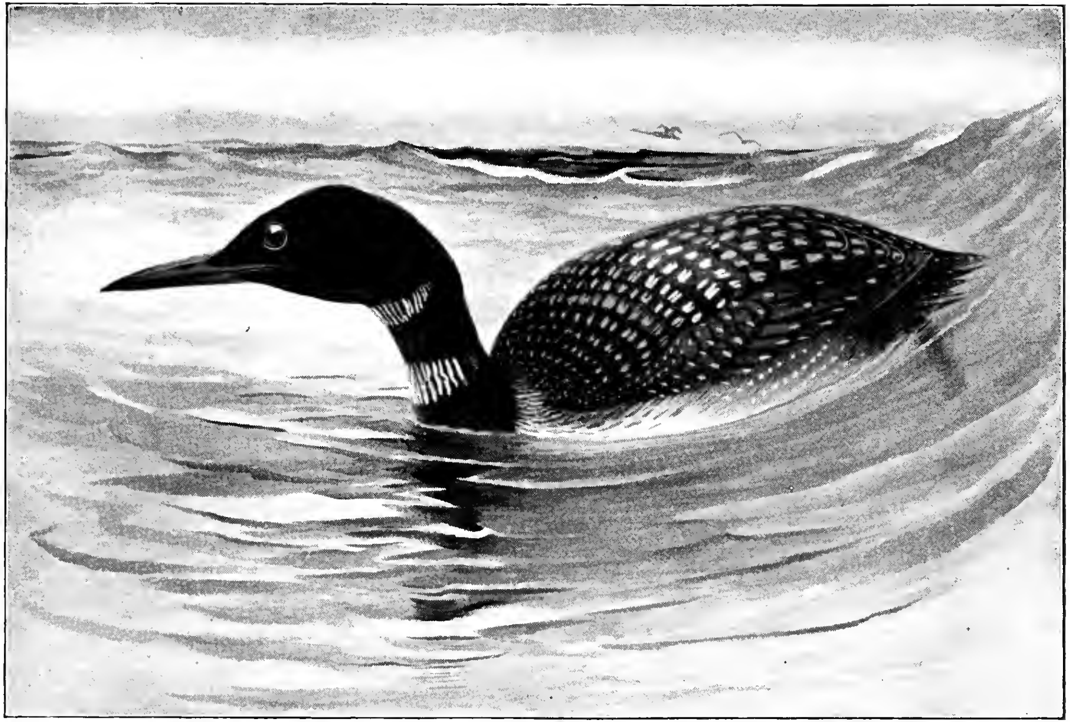
Professor Howes has, we think, been well advised in securing the competent assistance of Mr. and Mrs. Bernard in placing this highly interesting work in the way of those anatomists who are unable to read German. He has done a further service to those readers in adding a few notes on his own account; these notes are placed in square brackets, and are deftly woven into the text, so deftly that no one, were it not for the brackets, would have the remotest idea where Professor Wiedersheim left off and Professor Howes began. The book is practically a *resumé* of vestigial structures in man, and of certain rare reversions to what has been thought to be an ancestral condition. Thus, hairy men and women, supernumerary mammæ, and such like monstrosities occur in abundance, while the inferiority of the negroes, and particularly of the Veddas, is duly emphasised by the damning frequency of the occurrence of ape-like characteristics. Sometimes perhaps both the author and his editor become unnecessarily discursive. We have wearied for a considerable period of the pineal eye; and why, seeing that "the pineal gland of Anthropoids is identical in appearance with that of man," should we have three or four pages, illustrated, upon its general characters in reptiles and fishes? The glossary, too, appears to us to be a work of supererogation as an appendix to a book written for persons who presumably have some acquaintance with the general facts of anatomy. But as both the author and his editor are professors, they may have a lower and possibly more correct opinion of the knowledge possessed by those whom they address. Still, every student of anatomy must surely have heard of histology, of anatomy, and even of biology; definitions in five words would seem unnecessary—though, to be sure, we have heard of a candidate for a lectureship at a medical school who was perfectly aware of what was meant by Zoology and Botany, but could not understand what the advertisement meant by requiring a lecturer upon Biology.

British Birds for the British Public.

British Sea Birds. By Charles Dixon, with eight illustrations by Charles Whymper. 8vo. Pp. ix., 295. London: Bliss, Sands, and Foster, 1896. Price 10s. 6d.

There is a fascination for most minds in the study of the graceful and varied evolutions of the birds which haunt our coasts and estuary-rivers. Not only do we find a pleasure in studying their migratory movements. The annual return of the nesting-time suggests the possibilities of fresh visits to islands and surf-beaten skerries, upon which the beautifully mottled eggs of the sea-fowl are to be viewed amid their own characteristic environment. Mr. Dixon is the author of several volumes of popular essays on bird-life. The latest addition to their number is well written, and should be of service to those who are but slightly aquainted with the subject. The facts here woven together have no striking or unfamiliar features. We do meet with one or two startling statements, it is true, such as that the smew is to be seen, presumably in British waters, in flocks, consisting "of thirty or forty individuals." If Mr. Dixon had told us that this observation related to the river-reaches of Northern China, we could have accepted his statement without difficulty. As a matter of fact, we have never met with any large flocks of smews in Britain, though we have spent hours in watching the manœuvres of single individuals. *Small* flocks do appear in winter on certain Norfolk waters; but to speak of parties of "thirty or forty" birds visiting the British Isles, appears to be decidedly inaccurate. Many of Mr. Dixon's observations refer to the coast of Devonshire; if he had consulted the notes of the best of modern Devonian ornithologists, he would not have circulated the statement that the great northern diver feeds almost exclusively on fishes. As a matter of fact, it subsists largely on Crustacea. But these and similar blemishes do not detract seriously from the value of a book, which can, in any case, convey nothing new to the well-read ornithologist.

On the other hand, that large section of the public which is guiltless of any aquaintance with avian matters will find some pleasant and easy reading in Mr. Dixon's compilation. He is not without some personal knowledge of his subject, and has the knack of making the most of any observations recorded in his field-journals. Moreover, he writes in concise language, and scouts the long-winded sentences in which more learned naturalists are apt to clothe their thoughts. We object to the coining of new and unauthorised phrases. Mr. Dixon's adjective *avine* is not less objectionable to our judgment than Mr. Harvie Brown's new synonym of *vagratory* for migratory. But this has nothing to do with the scope of the pretty volume on our table. Perhaps its most useful feature lies in its treating of almost every species of bird that is to be met with near our seas. Mr. Dixon descants in brief but readable terms on the habits of all manner of ducks and wild-fowl. Not only so, but he introduces us to the haunts of the chough, the rock pipit, and other land birds. The usefulness of the volume would have been increased if Mr. Dixon had taken the trouble to tell the uninitiated how to distinguish between the different plumages of the ruff, or by what means to recognise the white-billed diver in its winter dress. Many similar points will occur to the professed ornithologist. But the author avowedly treats of a picturesque subject in a superficial manner, and it would be unfair to treat this volume as aspiring to claim a place among scientific works. It worthily fills the rôle of a popular educator in the most obvious details regarding the birds of



The Great Northern Diver.

(From Dixon's Sea Birds. Drawn by Charles Whymper.)

[*To face p.* 416.

which it treats, and is more free from mistakes than many popular works on natural history. The full-page plates of British Birds, one of which the courtesy of the publishers enables us to include (Plate VII.), are well executed, and will enhance the merit of the work in the eyes of holiday-makers, for whose consumption upon the beach this effort seems to have been chiefly intended.

Fossilised Botany.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History). The Wealden Flora. Part II. Gymnospermæ. By A. C. Seward, M.A., F.G.S. 8vo. Pp. viii., 259, 9 woodcuts and 20 plates. London, 1895. Price 15s.

In the first part of the Catalogue Mr. Seward described the Algæ, Characeæ, Equisetineæ, and Filicineæ of the Wealden, and, as no Angiospermæ have been discovered, part ii., including the Cycadeæ and Coniferæ, concludes the work.

In reviewing the book it is important to understand clearly what should be our point of view. Certainly not that of systematic botany. The catalogue is an admirable illustration of the present position of palæobotany, and its unhappy separation from the study of recent plants. Its author has, we doubt not, often regretted the many stairs which have to be traversed in passing to and fro between the great herbarium and the Geological Gallery at Cromwell Road. And, lest we should seem to depreciate its value, let us say at once that careful, thorough, and critical enumerations like the present will go a long way towards uniting the two branches of study, by demonstrating the unsatisfactory character of the present method, and, secondly, by affording material for a more comprehensive survey.

The author is not to blame for the faulty method, and his work must be criticised as an account of the gymnosperms of the Wealden flora. As such it is eminently useful. Every specimen is described in detail, while the numerous excellent plates are an additional help. Each family and genus is introduced by a valuable account of its occurrence and the literature relating thereto, with numerous critical remarks and often useful hints and warnings gleaned from a study of allied present-day forms. It is, however, hard to reconcile some of the author's scientific remarks *àpropos* of the great variations known to occur in some genera of Coniferæ, and the consequent danger of describing new species on unsatisfactory material, with his foundation of a new genus *Becklesia* (p. 179) on specimens which are "too imperfect to admit of any satisfactory generic or specific diagnosis." The more so as there are already two names in existence for specimens which "present a more or less close resemblance to *Becklesia anomala*." And why honour with a new binomial (*Pinites Ruffordi* sp. nov.) "a specimen of coniferous wood with the minute structure clearly preserved, and showing the characters of the genus *Pinites*"? Why not "Wood of *Pinites* sp."? There are several species of the genus in the same beds, and it seems probable that the wood belonged to one of them. What is gained by giving it a new specific name which is nothing more than a specimen label? The practice is, moreover, misleading, for it implies that there are a larger number of species of the genus in question in the given horizon than we have any evidence of.

As Mr. Carruthers has already pointed out in the *Journal of Botany* (May), Mr. Seward's neglect of principles generally recognised in botanical nomenclature is matter for regret. The specimens include leaves, scales, seeds, flowers, and stems, and are described in the order indicated. From the list at the end of the volume the Wealden flora is seen to contain about forty "species" and varieties, more than half of which are gymnosperms, while two are alga-like organisms, and one each is assigned to Charophyta and Bryophyta. Finally, the author says, "Looking at the Wealden plants collectively, we notice a very striking agreement with the flora of the underlying Jurassic strata, and it would be difficult to point to any well-marked or essential difference between the plant-life of the two periods. The evidence of palæobotany certainly favours the inclusion of the Wealden rocks in the Jurassic series." He adds a few words of regret that no light is thrown on the evolution of angiosperms, and suggests that the Wealden vegetation would seem to have been without any examples of the highest class of plants, and may be looked upon as the last of the Mesozoic floras in which the gymnosperms represented the limit of plant development. The inflorescence of *Bennettites* is the only indication of "a distinct advance in the differentiation of reproductive structures beyond the characteristic cycadean type."

The "list of works quoted" forms a useful bibliography; and a comprehensive and, so far as we have tested, accurate index concludes the text.

Education in Botany.

Elements of Botany. By J. Y. Bergen, A.M. 8vo. Pp. 275 and 57. Boston, U.S.A., and London: Ginn & Co. 1896.

This little book, which has grown out of a teacher's notes, is one of the right sort. The boys and girls for whom it is intended are made to acquire their knowledge by experiment and observation. They sow seeds, watch them growing, and study the conditions of growth. They examine buds and record what they see. They are told something of the wonderful relations which subsist between flowers and insects, and then encouraged to investigate some of the adaptations by which the plant benefits from a welcome visit or protects itself against an unwelcome one. Their powers of thought and observation are stimulated by suggestive questions—What is the use of this? or the reason of that? Why is the pulp of so many fruits eatable? Why are the seeds of many pulpy fruits bitter or otherwise unpleasantly flavoured? Why are the seeds or the layers surrounding the seed too hard to be chewed? A course like the one followed in this book will ensure not only a fair knowledge of the elements of botany, but what is of more importance, the best kind of education. So much for part i., comprising with its four appendices and index 275 pages. Part ii. is merely a small flora, including the commoner spring flowers of the middle and northern States, and adds little, if anything, to the general usefulness of the book.

New Serials.

To the many new serials hailing from Russia and recently noticed by us must be added *Annuaire Géologique et Minéralogique de la Russie* (Ezheghodnīk po Gheologhiī ī Mīneraloghiī Rossiī), edited by N. Krichtafovitch, and printed at Warsaw, but published at Novo-Alexandria, gouvernement de Lublin, Institut agronomique et forestier (price 10s. per annum). Vol. i., livr. 1, for 1896, is before us; it is a 4to, printed in Russian and French (or German) in parallel columns. The contents are arranged in six sections, each with independent pagination, as follows: Memoirs and original Notes, 23 pp.; Bibliography of Russian Geology for 1895, 96 pp.; News of Expeditions, 13 pp.; Personalia and Obituaries, 16 pp.; News of Russian Museums, no pages in this livraison; Advertisements of Sale or Exchange, 2 pp. To some extent this ground is covered by Professor Nikitin's useful *Bibliothèque géologique russe*, to which the present work appears to be a rival, a fact to be regretted. It is claimed that the abstracts will be much fuller than those in the *Bibliothèque*; but papers that have already been noticed in some accessible publication, such as the *Neues Jahrbuch*, are not again abstracted. In the palæontological lists, the names of new species are printed in broad-faced type, which seems to us a great improvement on the method followed by the *Zoological Record*.

Revista de la Facultad de Agronomía y Veterinaria (8vo, La Plata, annual subscription, 6 pesos m/n) was started as a monthly at the beginning of 1895. No. 7, which we have just received, contains a report submitted by Drs. Bernier and Griffin to the High Council of Hygiene for the province of Buenos Ayres, in which they recommend certain regulations for checking the spread of contagious diseases among domestic animals. The laws on the subject are more stringent in other countries than in Buenos Ayres, and protection can only be secured by the enforcement of sanitary laws. The report embraces rules for the declaration of contagious disease and the penalties for non-compliance, the manner and duration of the isolation of suspected cases, the sacrifice and burial of infected animals, and a scale of compensation for animals so destroyed. The article, although occupying only a few pages, should not be missed by sanitarians. The number also contains a paper on the disinfection of cattle-trucks, by Dr. Bernier, and other interesting matter.

The Illinois Wesleyan University at Bloomington, Ill., has started a magazine devoted to the interests of graduate and non-resident students, entitled *The Illinois Wesleyan Magazine*. We mention it here since it seems possible that occasional articles of interest to our readers may be found in it. Part ii. contains a short note on the home study of geology, by R. O. Graham, and a doctorial thesis on the problem of latitude, by O. J. Bond.

We record, though they contain little of scientific interest: *Boletin del Museo-Biblioteca de Filipinas*, 4to, about one sheet to each part, published at Gunao 12 (Quiapo) Manila; and *Travel*, a monthly, of which the first number was issued on May 1, 1896, by Horace Marshall & Son, 125 Fleet Street, London. It is an 8vo, of 58 pages, sold for 3d.

Literature Received.

The Student's Lyell, J. W. Judd: Murray. Germinal Selection, A. Weismann: Open Court, Chicago. History of Mankind, pt. viii., F. Rätzel: Macmillan.

Catalogue xxxiii.: Friedländer. Bees of the Genus Perdita, T. D. A. Cockerell: *Proc. Acad. Nat. Sci. Philadelphia*. The Polynesians and their Plant-Names, H. B. Guppy: *Vict. Inst.* XIXth Report on Noxious and Beneficial Insects, S. A. Forbes. The Mediterranean Flour-Moth, W. G. Johnson: State Entom. Office, Illinois. Blissus Leucopterus, F. M. Webster: *Journ. Cinn. Soc. Nat. Hist.* The American Lobster, F. H. Herrick: U.S. Fish Commission. Les Musées de l'Avenir, A. L. Herrera: *Mem. Soc. Sci. "Alzate," Mexico*. Catalogue, xv.: Geographical Botany: Dulau. Horse's Foot, Frog Structure, A. E. Mettam: *Veterinarian*. Garnets, T. H. Holland: *Rec. Geol. Surv. India*. Crambidæ of N.A., C. H. Fernald. Address, H. Woodward: Geol. Soc. London. Fish Culture, J. J. Armistead: Royal Inst. Cave-Drawings in Palmer Goldfields, R. L. Jack: *Proc. Roy. Soc. Queensland*. Report for 1895: Albany Mus., South Australia. Aphelininæ of N.A., Grass and Grain Flies, L. O. Howard. The San José Scale, L. O. Howard and C. L. Marlett; The Honey Bee, F. Benton. Proc. Ann. Meeting Assoc. Econ. Entomologists: U.S. Dept. Agric.

Memorias, Soc. Ant. Alzate, Mexico, t. ix., nos. 1, 2, 3, 4, 5, & 6; Minn. Botan. Studies, Bull. ix., pt. viii.; Notarisia, April; Nature, April 30, May 7, 14; Knowledge, May; Revue Scientifique, April 18, 25, May 2, 9; Irish Naturalist, May; Feuille des jeunes Naturalistes, May; Amer. Journ. Science, May; Naturæ Novitates, April; Amer. Nat., April, May; Science, April 10, 17, 24, May 1; Scott. Geogr. Mag., May; Science Gossip, Feb.; Naturalist, May; Westminster Review, May; Amer. Geologist, May; Botan. Gazette, April; Review of Reviews, May; Biology Notes, April; Photogram, May; Psychological Review, May; Oxford Univ. Sci. Club Journal, 38.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Mr. Frederic Du Cane Godman has been elected a Trustee of the British Museum.

We note the following appointments:—Dr. A. A. Kanthack, of St. John's College, to be Deputy Professor of Pathology at Cambridge, while Professor Roy is unable to lecture; Mr. Robert Harrison, to be Assistant Secretary to the Royal Society, in place of Mr. H. Rix, resigned; James G. Lawn, Instructor in Mine Surveying at the Royal College of Science, London, to be Professor of Mining at the South African School of Mines; Dr. L. Joubin, to be Professor of Zoology to the Faculté des Sciences, Rennes; Dr. H. Prouho, to be Professor Adjunct of Zoology to the Faculté des Sciences, Lille; Dr. A. Fleischmann, to be Extraordinary Professor of Anatomy and Zoology, and Director of the Zoological Institute at Erlangen; Dr. Ludwig Kathariner, of Würzburg, to be Professor of Zoology and Comparative Anatomy at Fribourg University; Dr. Hermann Henking, to be Extraordinary Professor of Zoology at Göttingen University; Dr. G. Rörig, Teacher in Entomology at the Agricultural High School at Berlin, to be Extraordinary Professor of Zoology in Königsberg University; Dr. Zuber, of Lemberg University, to be Extraordinary Professor of Geology; Professor F. S. Monticelli, of Sassari University, to be Professor of Zoology at Cagliari University; Procopianu-Procopoiici, to be Inspector, Dr. Theodorescu and Madame Malinescu, to be Assistants, at the Botanic Gardens, Bucharest; Dr. Victor Schiffner, to be Extraordinary Professor of Systematic Botany in the German University at Prague; Drs. H. Harms, Th. Loesener, and P. Graebner, to be Assistants in the Imperial Botanic Museum at Berlin; Drs. R. Wagner and A. I. Grevillius, to similar appointments in the Botanic Institutes of Munich and Münster, respectively; Dr. Fr. Siche, to be Professor of Pomology in the Pomological Institution at Kloster-Neuberg; L. S. Cheney, Instructor in Botany at Wisconsin University, to be Assistant Professor of Botany in the College of Pharmacy; Dr. R. H. True, Instructor, to be Assistant Professor of Pharmacognoscy in Wisconsin University; Dr. Henry Skinner, to be Professor in the Department of Insecta in the Philadelphia Academy of Natural Sciences; Dr. H. F. Reid, of Cleveland, Ohio, to be Associate Professor of Geological Physics in Johns Hopkins University; Professor E. B. Delabarre, of Brown University, to be Director of the Psychological Laboratory of Harvard University, during the absence of Professor Münsterberg next year; J. E. Lough, to be Instructor in Experimental Psychology, and C. M. Bakewell, to be Instructor in Psychology at Harvard; Dr. H. Newland to be Fellow of Columbia University in Geology, P. A. Rydberg in Botany, H. E. Crampton, jun., and J. H. Macgregor in Zoology, and S. J. Franz and L. B. McWhood in Psychology.

The following changes have recently been made on the staff of the Geological Survey:—A. Strahan, to be Geologist on the English branch, in place of J. R. Dakyns, who has retired after 34 years' service; C. T. Clough, to be Geologist on the Scottish branch, in place of the late Hugh Miller. These gentlemen are succeeded as Assistant Geologists by Mr. T. Crosbee Cantrill, B.Sc., and Mr. E. H. Cunningham-Craig, in England and Scotland respectively.

Dr. Molengraaf, of Amsterdam, whose work in South African geology is well known, has been appointed State Geologist by the Transvaal Government. It is more likely than not that the Geological Survey will be persevered in longer in the Transvaal than it was in the Orange Free State, as the inducement of having gold finds always in view is strong in the Transvaal and did not exist in the Orange Free State.

THE great age of Dr. James Hall, of Albany, does not prevent the Committee of the New York Legislature from recommending that the State Geological Survey be placed entirely under his direction.

THE Royal Belgian Academy of Sciences has elected Professors E. Strasburger, E. D. Cope, E. J. Marey, and Sir A. Geikie as honorary members, and Professor J. J. Fraipont as corresponding member.

THE Zoological Society of New York has elected as its first honorary members Sir William Flower, Professor Alexander Agassiz, and Professor J. A. Allen.

MR. W. JAMES HORNADAY, to whose work we alluded in our supplement on Taxidermy as a Fine Art, August, 1894, has been appointed director of the proposed Zoological Park at New York, whither he will carry the experience gained in connection with the establishment of the National Zoological Park at Washington. The question he will be called upon to decide is: Where is the park to be placed?

THE vacation class under the direction of Mr. Garstang, at the Plymouth Marine Biological Laboratory, to which we called attention on p. 148, proved a great success. Fifteen students from Cambridge, Oxford, Owens College, and University College, London, attended. It is proposed to hold a similar class next August. We regret to hear that no students availed themselves of Mr. Church's proffered instruction in Marine Botany; it is a subject that does not pay in examinations.

THE first session of the Bahama Biological Station under the direction of Professor Charles L. Edwards, of Cincinnati, was held during the summer of 1893, at Bimini Islands, Bahamas. "For the coming season," says *Science*, "it has been decided to locate the laboratory at Biscayne Bay, Florida," which is in the same latitude as the Bimini Islands, and has the same climate, clear water, and subtropical fauna and flora. The course, which consists of lectures, practical work in the laboratory, and observation of the organisms in their natural surroundings, will begin on June 22. A collecting department has also been established to supply outside students and institutions with material.

THE Museum of Practical Geology, Jermyn Street, was opened on a Sunday for the first time on May 10. The number of visitors was 511, which is by no means unsatisfactory considering the technical nature of the museum. The British Museum, and its branch, the Natural History Museum, were first opened on a Sunday on May 17, from 2.30 to 7 p.m. The hours of opening will vary at different times of the year. The British Museum was visited by 1,790, and the Natural History Museum by 2,398. At the latter building guides were sold, and to counteract their natural dryness the refreshment bar was permitted to be open. The hours of opening of the South Kensington and Bethnal Green Museums have been extended to 7 p.m. We may complete our list by mentioning that the National Gallery was opened on Sunday, May 3, from 3 to 6 p.m., and will continue so to be open on Sunday until September 15. We notice that Dr. Farquharson has been enquiring in the House of Commons whether it is the case that some of the officers at the National Gallery are employed more than six days in the week in consequence of Sunday opening. How this can be, when the omniscient Mr. Stead tells us in the *Review of Reviews* that "no officer shall be employed more than six days a week," we fail to understand. Such action was certainly not contemplated by those who passed the resolution in favour of Sunday opening, and we can hardly suppose that there is any foundation for those rumours concerning the National Gallery and other national institutions. The *Westminster Review* for May contains an article by Stoddard Dewey, entitled "The Triumph of Sunday Opening," as well as remarks on the present situation of Sunday opening from the Bishop of Winchester, Canon S. A. Barnett, Lord Hobhouse, G. J. Holyoake, and Mark H. Judge.

THE Museum of the Canadian Geological Survey at Ottawa contains a number of valuable specimens, by no means confined to rocks and fossils. During 1895 it was visited by nearly 27,000 people, and has therefore some popularity. The building, however, is too small for the proper exhibition, and even preservation, of the collections. Dr. G. M. Dawson, in his *Summary Report* recently issued, urges that provision should be made by the Government for the proper accommodation of the specimens.

IN connection with the office of the Iowa Geological Survey at Des Moines, a museum has been established, chiefly devoted to the economic geology of the State. Samples of building-stones, brick-earths, clays, and minerals from the lead and zinc regions have been gathered together. A large number of photographs of geological interest have been made, and copies of these are offered at cheap rates to the various schools and colleges of the State.

AN appropriation of $500,000 has been made by the Government of New York for building a third wing to the American Museum of Natural History.

THE American correspondent of *Nature* states that Castle Garden, in New York City, has been converted into an aquarium, pure sea-water being filtered from the adjoining harbour through the underlying strata.

THE Oxford University Junior Scientific Club held a successful conversazione in the University Museum on Tuesday, May 26. The fifth Robert Boyle lecture will be delivered on Tuesday, June 2, by Prof. W. Ramsay, on Argon and Helium.

A COMPLAINT was made last year that geology was unrepresented among the new Fellows of the Royal Society. This year, however, we note in the list of selected candidates the names of Dr. G. J. Hinde, whose accurate work on minute and obscure fossil structures, places him in the front rank of living palæontologists; Professor H. A. Miers, of Oxford, late of the British Museum; and Mr. H. B. Woodward, of the Geological Survey. Other branches of natural science are represented by Dr. F. W. Mott, the lecturer on physiology at Charing Cross Hospital and Secretary of the Neurological Society; Dr. John Murray, of the "Challenger"; the Rev. T. R. R. Stebbing, whose lively notes on Crustacea are familiar to our readers; Professor Charles Stewart, of the Royal College of Surgeons; and perhaps we may reckon Professor Karl Pearson, who occasionally strays our way from the severer realms of mathematics.

WE have alluded in our Notes and Comments to some exhibits at the Royal Society's Conversazione on May 6. Others of special interest to our readers may here be mentioned. Dr. H. Woodward showed some collections made by Dr. Forsyth Major in Madagascar, among which the remains of *Æpyornis*, also two adult human skulls said to have been found together in a cave, though far removed from one another in their degree of evolution, attracted most attention. Dr. J. W. Gregory illustrated the geology of part of British East Africa with a map, sections, specimens, and some sketches made from his notes by Mr. Hallam Murray. Mr. Henry Balfour's interesting exhibit illustrating the structure and development of the composite archer's bow, better known as "Cupid's Bow," gained considerable distinction from a unique specimen of an Assyrian bow recently found in a tomb of the 26th Dynasty, at Thebes, Egypt. The Marine Biological Association was chiefly represented by various boring marine animals, while close at hand Mr. Walter Garstang amused the passers-by with his cunning little crabs, *Atelecyclus* and *Corystea*, which burrow beneath the sand and draw in a current of water through a sieve-tube formed by the interlocking of rows of hairs on the apposed antennæ. Professor

J. B. Farmer's exhibit of nuclear division in the spores of *Fegatella conica* was chiefly interesting as showing how the processes of cell-division are governed by ordinary physical laws, as though cells had no more life than soap-bubbles. The reconstruction of models from serial microscopic sections, by the methods that have at various times been described in NATURAL SCIENCE, has been advanced a stage by Mr. Francis Dixon's device of drawing his various sections on glass plates of a thickness proportional to the magnification of the drawing and the thickness of the section; these enable one to trace the arrangement of the various internal structures, such as the nerves. The wax model of an electrical nerve-cell from the spinal cord of *Malapterurus*, made from microscopic sections in the usual manner by Dr. G. Mann, was, with its many dendritic processes, a formidable looking affair. Professor Liversidge, of Sydney, exibited specimens and photographs of the polished and etched gold-nuggets showing crystalline structure, to which we have alluded in vol. vi., p. 11. Museum authorities will doubtless be glad to have the enlarge models of the lower jaw of *Amphitherium prevosti* from the Stonesfield slate which Mr. Pycraft has made for Professor Ray Lankester. Similar models of all the unique fossil mammalian jaws in the Oxford Museum are now to be purchased.

DR. A. GÜNTHER, late keeper of the Zoological Department of the British Museum, has been elected to succeed Mr. C. B. Clarke as President of the Linnean Society, London.

FROM the report of the Geological Society, London, we learn that the index of the first fifty volumes of the Journal is now almost ready to be sent to the printers.

THE new president of the Geologists' Association, London, Mr. E. T. Newton, has initiated a quarter-hour exhibition of objects of general interest before the customary reading of papers at the evening meetings of the Association. The object of the president is not the encouragement of the bringing of indiscriminate objects to be named, but rather the exhibition and brief description of objects instructive to the whole of the members.

THE Zoological Gardens, London, have received from Mr. E. E. Austen a specimen of the Oukari monkey (*Brachyurus rubicundus*) from the Upper Amazon. The Brazilians call this the English monkey, on account of its remarkably red face. It is not the scarlet-faced Oukari mentioned by Bates in his "Naturalist on the Amazons"; for that turns out to have been *B. calvus*, living further to the east. The westward extension of *B rubicundus* is as yet unknown, but the species of this genus appear to be confined to limited areas. Though living in high tree-tops, *Brachyurus* has a mere stump of a tail, so that it is easily distinguished from its long-tailed neighbours. It is one of the Cebidæ.

THE fine weather of last year, and various interesting additions to the Society's menagerie, had the effect of increasing the receipts of the Zoological Society, London, by £1,851 8s. 6d. as compared with 1894. A list of the animals received during the past twelve years has been prepared by Dr. Sclater, and is now in the printers' hands. The number of animals in the Gardens on December 31 last was 2,369, of which 768 were mammals, 1,267 birds, and 334 reptiles.

WE are not accustomed to look upon the unspeakable Turk as more advanced than the cute Yankee. Nevertheless, whereas the American House of Representatives has, after an animated discussion, returned the bill for the introduction of the metric system into the United States to the Committee, Turkey adopted that system on March 1 last, and has absolutely forbidden the employment of the ancient measures. The fact that the business men of Utah differ from the majority of their countrymen and unanimously agree with the Turk is not, of course, due to any subtle connection between polygamy and the ease of reckoning on a decimal system.

CORRESPONDENCE.

IS WACHSMUTH AND SPRINGER'S CRINOID-MONOGRAPH PUBLISHED?

Are you not in error when you state, as you do in your May number (p. 359), that "Wachsmuth and Springer's Monograph of the Crinoidea Camerata of N. America will not be published before August"? You can hardly be aware that a review of the work, by Charles R. Keyes, appeared in the *American Naturalist* for April (pp. 291–295), and stated definitely that the Monograph was issued, even giving 1895 as its date of publication. S. BERGMAN.

[This is an interesting question. We are well aware that Mr. Keyes has reviewed the Monograph in question, not only in the *American Naturalist*, but in the *Journal of Geology*, Chicago; further, that he has in both these places, and also in the *American Geologist*, given the date as 1895, and quoted the actual number of pages and plates. Nevertheless, our statement was based on authority no less than that of the surviving author of the Monograph, and we still believe it to be correct. Mr. Bergman must get his explanation from the Editors of our above-mentioned contemporaries, for whose methods of reviewing we are not responsible.—ED. NAT. SCI.]

A CORRECTION.

MR. H. HANNA asks us to state that in the Editorial Note on "Preserving Fluids," on p. 294 of our May number, the words "10 per cent. solution of chromic acid" should be "1 per cent. solution," etc.

NOTICE.

TO CONTRIBUTORS.—*All communications to be addressed to the* EDITOR *of* NATURAL SCIENCE, *at* 22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

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It will shortly be necessary to RAISE *the price of Vols. I.–IV. still further. Nos. after* 28 *(June,* 1894*) can still be supplied at* ONE SHILLING *each.*

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An Asterisk (*) indicates that a figure is given.