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INDEX.

An Asterisk (*) indicates that a figure is given.

The Subject Index to Articles, compiled in accordance with Melvil Dewey's "Decimal Classification" as adopted by the *Zoologischer Anzeiger* and the Concilium Bibliographicum at Zurich, and arranged for cutting up, will be found over-leaf.

January, 1896), Mr. T. D. A. Cockerell explains his reasons for adopting such a method in teaching entomology to the students of the New Mexico Agricultural College. So far as we can find out, systematic work, as such, is not a part of the biological course in any of the well-known British morphological laboratories. It certainly has no place in the courses prescribed for beginners, or for medical students, and although in these days, when the study of variation is receiving great attention, senior students can hardly avoid some species-work, still the species-work comes as an accidental appanage of the study of individual variations. While we are fully willing to admit with Mr. Cockerell that in the hands of a competent teacher species-work might become a valuable mechanism for education, we are not prepared to agree that it should be a substitute for a more general course. Still, to many minds the exact study of the concrete specific differences among a limited set of organisms would give a certain definiteness, and what would be appreciated as practicalness, to the study of biology. We should welcome the addition to an elementary course of the study of a prescribed set of species. A genus of reptiles, or bees, or butterflies, might be taken that included a limited number of species, and the characters of the species should be taught dogmatically and learned upon the specimens, just as the elementary student of anatomy learns the characters of human bones.

On the other hand, in the case of the advanced student, a larger and more scientific study of species should be as natural a part of his training as the study of embryology, or of dentition. Along with this the methods of proper description, the rules of nomenclature, and the chief difficulties in the way of identifying species, should be studied. The relation of individual variation to varieties and to species in a definite group should certainly be included. Morphology and the study of species cannot be divorced. At some period of his career the most abandoned morphologist, or the most devoted systematist, cannot avoid passing over into the problems of the other branch of biology, and this should be recognised in his training.

Habits as Diagnostic of Species.

Prior to Mr. Cockerell's study of *Perdita*, a genus of bees, seventeen North American species were known, two of which were not considered valid; he now recognises seventy species: twenty-six in both sexes, twenty-six only in the male, eighteen only in the female; twenty-three being from single specimens. Without examination of the material it may be presumptuous to criticise, but it must be confessed that in the absence of knowledge of nesting habits, insufficient evidence as to double broods, and silence as to the effects of parasites on structure, this wholesale coining of new species appears rash and likely to lead to confusion hereafter. It must, however, be admitted that Mr. Cockerell has done good service in calling attention to the value and importance of habits in the discrimination of species very closely similar in anatomical structure. Having laid it down as a rule that each species of *Perdita* visits normally but one species of flower, he remarks, "There is no essential difference between those characters called specific and those called varietal; in fact, the very same kind of difference which marks species in one group, may only mark varieties or mutations in another. Thus we come to see that the *essential distinctions between species are physiological* [the italics are our own], the morphological ones being only valid for diagnostic purposes just so far as they happen to coincide with the physiological." We are not quite sure that we fully understand what "physiological" means here; the context and instances lead us to suppose the word to mean "habits in relation to flowering plants." The chief examples are the two species, *P. zebrata*, found only on *Cleome serrulata*, and *P. bakeræ*, occurring on *Solidago* and *Helianthus*. These two species are stated to be extremely alike, especially in the female sex, nor was it until a specimen had been taken on *Solidago* that two species were recognised. It appears, however, that the genitalia have not been examined in this work, except as an afterthought; and, indeed, the tardy examination of the male genitalia of the two species in question at once revealed "apparently good distinctions." It is somewhat startling to find organs which of all others are likely to yield good distinctions so entirely neglected. In the separation of species from species nothing can be more efficient than structural alterations which may render sexual intercourse between diverging groups a physical impossibility. In view of this admission Mr. Cockerell's "physiological species" is an unwarranted and unjustifiable expression. Nevertheless, it shows the importance of accurately observing the habits of living animals, inasmuch as differences being known in this respect may lead to a reasonable suspicion of structural distinctions, and to more careful search among a few examples for features which might otherwise be overlooked or only ascertained by dissection and ruin of every specimen. For instance, if doubt were felt as to any specimen being *P. zebrata* or *P. bakeræ*, a note stating it to have been found on *Cleome serrulata* would at once determine in favour of the former without the extraction of the male genitalia, now that it is known that these present good distinctions.

Evolving Species.

It is tolerably clear that Mr. Cockerell is right in recognising two species in the case just mentioned, though he does not attach so much importance to genitalia as others would in similar cases, yet, in discussing those and other instances of like kind which he has treated in like manner, he states, "We have, indeed, the process of evolution going on under our eyes, the puzzling forms being those which have only lately segregated themselves and have not yet developed striking peculiarities." Now, if the process of evolution is going on under our eyes, surely it is not correct to treat the *evolving* species as though already *evolved*; in other words, according to his own showing, Mr. Cockerell should have grouped both forms under one specific name, or at the most have designated one as a variety of the other. It is a curious instance of two errors, one of omission and the other of commission, leading to a correct result: close similarity of species such as these can be adequately explained by "convergence" and "arrested divergence." We should like to know how Mr. Cockerell would have treated the entire Animal Kingdom had we been blessed with preserved specimens of all the forms that have peopled this earth from the beginning. Judging by his present remarks, it looks as though offspring and parent would find themselves under different names with "n.sp. Cockerell" tacked on, especially if the enterprising younger generation consumed carrots while the parents stuck to thistles. Let it not be thought that we consider Mr. Cockerell's *results* wrong: it is the style of argument and confessed neglect of important structural characters that we condemn, but pardon for the sake of the otherwise valuable and suggestive paper in which they occur.

Natural History *versus* Systematic Work.

We are unconscious of guilt in the matter referred to by Professor Williston in his interesting letter, printed on page 70 of this number. We quite agree with him that the time has gone when it was possible for instructed morphologists and systematists to sneer at each other. In the present case, we think that the sneers he finds in our review are due to a strained reading of it: the italics into which he has put the words, "every other scientific man," are his own, and give the phrase a meaning we did not intend; the expression, "a necessary evil," is also Professor Williston's, and not ours. Our remarks had a definite reference to schoolboys, and we remain unshaken in the conviction we expressed, that those of them who confine their attention to collecting all the forms they can lay hands upon, and determining them, as is the custom of their kind, by comparison with pictures in a book, are not engaged in a pursuit of such educational or scientific value as those who observe the habits and investigate the structure of the animals and plants around them.

Although we understand it as a fair retort to what Professor Williston imagines us to have implied, we cannot see great value in his assertion that, at "the present time, the 'systematist' represents the highest type of the naturalist." The real naturalist, whatever be the chief direction of his work, occasionally pursues other branches of the subject, and in any event gains the respect of other naturalists by the quality rather than by the subject of his labours.

American Criticism of Romanes.

Professor Brooks is not the only American biologist who dissents from the views expressed in the last volume of Romanes' "Darwin and after Darwin." In *Science* (1896, pp. 438 and 538), Professor Mark Baldwin, a distinguished authority upon psychology, gives weighty reasons against Romanes' interpretation of instincts as lapsed intelligence, as, in fact, the inherited memory of acquired habits. Professor Baldwin's criticism is so condensed that it would be impossible to give a short account of his arguments. He discusses the relation of intelligence to coadaptations, the relative utilities of instinct and intelligent actions, and all the points that Romanes raised in support of his assumption of the Lamarckian factor. He comes to the conclusion that "on the more general definition of intelligence, which includes in it all conscious imitation, use of material instruction and that sort of thing (the vehicle of 'social heredity') . . . we still find the principle of natural selection operative and adequate, possibly, to the production of instincts and reflexes."

Retzius on the Inheritance of Acquired Characters.

Dr. Gustaf Retzius devotes a chapter of his latest publication ("Biologische Untersuchungen," neue Folge, vii., Jena, 1895), to the question of the inheritance of acquired characters. After a brief historical introduction, he describes the investigations of Manouvrier, Collignon, Sir William Turner, Arthur Thomson, and Havelock Charles into a number of peculiarities of human skeletons. The characters are all well known to anatomists, and are such as the presence of an additional facet on the distal end of the tibia, where it rubs against the neck of the astragulus in cases like that of the Veddah, who is able to bend his foot nearer the shin than is possible for most men; or that condition of the knee where the facets on the upper end of the tibia are not horizontal, as in normal Europeans, but are inclined backwards. It has been shown that these and a number of other conditions are common among the lower races; they have been found in fossil skeletons, and among some of the monkeys. Recently it has been argued that some of the characters are excellent instances of an inheritance of acquired characters. Dr. Havelock Charles, for instance, associates the bent condition of the knee with the habit among many of the lower races of resting in a sitting posture, with the knees bent extraordinarily far outwards. He concluded that the abnormal condition was a result of the peculiar attitude, and, as he found it to exist in embryos of the races which had the adult habit, he suggested that a character acquired by adults had been transmitted to descendants. It occurred to Dr. Retzius that abnormalities found among so many different races, among ancient and modern men, could scarcely be a character acquired recently and convergently. He examined a large number of Swedish embryos, and found among them well-marked traces of all the peculiarities; in some cases, indeed, the fœtus showed the Veddah and Hindu peculiarities in an absolutely typical form. He believes, therefore, that the bent tibial facets and accessory articulation with the astragalus, and so forth, are not instances of an inheritance of acquired characters, but are an atavistic inheritance of conditions once universal.

Dr. Retzius believes, in fact, that a reversed account of the true state of affairs has been given. It is modern conditions, the habit of sitting on chairs, and so forth, that is gradually altering the typical character of the bones of the lower limbs. The modern fœtus retains the ancestral condition, and the modern characters are acquired later in life. On the other hand, although we do not quite follow his argument, he thinks that an instance of the existence of the Lamarckian factor is to be found in the changes occurring in ourselves. He is severe, however, on those writers who attach great importance to the changes produced by mechanical factors, by strains and stresses and so forth. He insists upon the historical factor, upon the internal forces that direct the development. We commend his chapter, of which this is only the slightest sketch, to our readers who are interested in heredity.

Warning Colours and Mimicry.

Mr. Frank Finn has continued his experimental investigations into the palatability of warningly coloured insects (*see* Nat. Sci., vol. viii., p. 231). His most recent experiments are published in the *Journal of the Asiatic Society of Bengal* (1896, p. 2). Using the common garden lizard of India, *Calotes versicolor*, both in captivity and in freedom, he tempted its appetite with all manner of plain and parti-coloured insects. The details of each experiment are given, and they certainly corroborate Mr. Finn's conclusion that, in the case of butterflies, at any rate, warning colours and unpalatability so far as lizards are concerned do not go together. Mr. Finn was careful to use common butterflies, and the lizard in question is accustomed to take butterflies in the natural state. We hope that Mr. Finn will proceed with his experiments. Warning colours, mimicry, and so forth are among the chief contributions of the much-praised field-naturalist to the theory of evolution, and, like many of the conclusions of the field-naturalist, they require the more careful investigation of the trained expert.

American Entomology.

In our June number we gave some account of the Chinch-bug, *Blissus leucopterus*. Mr. S. A. Forbes' Report on Noxious and Beneficial Insects of the State of Illinois for 1893–4 is chiefly devoted to details of experiments in innoculating Chinch-bugs with fungoid disease. The idea of using fungi as allies against insect pests has been worked in America for several years, but the results do not seem to have been as satisfactory as might have been expected. Naturally, the insects are most injurious in dry weather, while the fungus will only flourish when the air is moist. And the spread of *Sporotrichum globuliferum* among Chinch-bugs in Illinois was not shown to be hastened by artificial innoculation; under favourable conditions the disease was propagated among the insects from spores normally present.

The Mediterranean Flour Moth, *Ephestia Kühniella*, Zell., is quite a modern discovery, having been described only in 1879. Mr. W. G. Johnson (*App. to 19th Rep. of State Entom. Ill.*) has just issued an interesting summary of our knowledge of the moth, which has already given rise to a bibliography of seventy-nine papers. The species multiplies in flour-mills to an alarming extent, and the armies of caterpillars, trailing after them silken threads, bind the meal into tangled masses, stop the machinery, and require the strongest measures in order to destroy them. When the moth was first found in German mills, the Continental naturalists suggested North America as its original home, but the Transatlantic entomologists are not eager to accept this honour for their country, and point out that the insect did not trouble American millers until some years after it had appeared in Germany and England. Curiously enough, the American states most affected, New York and California, are the width of the Continent apart. Before appearing in these, however, it established itself in Canada. The colloquial name of the insect suggests the Mediterranean shores as its home, and there seems reason to suspect that it may have spread from South European ports. But like many other "domestic animals" its origin remains a mystery, which naturalists might like to see cleared up, though millers would probably prefer that future research on the subject should cease from want of material.

Messrs. L. O. Howard and C. L. Marlatt have given in Bulletin No. 3 (n.s.) of the U.S. Department of Agriculture a full account of the San José Scale-insect (*Aspidiotus perniciosus*, Comst.) First observed in 1870 in California, whither it was believed to have been introduced from Australia, this coccid has spread eastward to the Atlantic states. Its rapid rate of multiplication, and the difficulty of checking its ravages, have made it one of the most dreaded enemies of the American fruit-grower. In the Pacific region, the insect can be, to some extent, destroyed by washes, but in the east it is often necessary to burn infested trees to stop the plague from spreading. The life-history of the scale, its habits, and its natural insect-enemies (a minute hymenopteron and a ladybird) are described in the thorough manner which we expect from the Washington Division of Entomology.

Bulletin No. 2 of the same series is devoted to the Proceedings of the seventh annual meeting of the Association of Economic

Entomologists. The union of the workers in the different American States in such an association must be highly beneficial, and European students of the subject are welcome as foreign members. The address of the President, Mr. J. B. Smith, of New Brunswick, N.J., dealt with the general prospects of the science and the best means for making the researches of naturalists useful to farmers. Several papers of considerable interest were read.

Systematic work of a high order is turned out by several of the American economic entomologists. The first two bulletins of the new "Technical Series," issued by the U.S. Department of Agriculture to replace the scientific papers formerly published in *Insect Life*, are written by Mr. L. O. Howard, and deal with the North American Aphelininæ (a sub-family of Chalcididæ) and Eurytominæ. From the Massachusetts Agricultural College, Dr. C. H. Fernald has sent us a monograph of the North American Crambidæ, excellently illustrated with structural figures and coloured plates.

THE SUN-HATERS.

IN his presidential address to the Biological Section of the Australasian Association for the Advancement of Science, held at Brisbane in 1895, Professor Arthur Dendy dealt with some of the features of that part of the fauna to which he has applied the term "cryptozoic." This word is but a few years old, and refers to Kipling's "life of the Middle Jungle, that runs close to the earth or under it, the boulder, burrow, and tree-bole life," and includes the species which, for purposes of protection or in search of food, frequent dark, humid cool haunts, sheltered from the light of day. To give a more comprehensive definition than this is hardly possible, seeing that the cryptozoic fauna imperceptibly blends with what by way of contrast may be called the "phanerozoic," just as the littoral fauna of the sea blends with the pelagic, and the pelagic with the bathybial.

According to Professor Dendy, the members of this fauna have been derived from nearly all the principal groups of the animal kingdom, the only character which they possess in common being their hatred of exposure. So, too, have recruits been levied from many distinct faunistic groups; but it is possible to classify the members of this heterogeneous mob into four sections, distinguished by their mode of origin. (1) Representatives of typically terrestrial groups of animals which are dominant at the present day. These may be found at all stages of development, and include many insects, spiders, slugs, snails, and the like. (2) Surviving members of extremely ancient groups which are now almost extinct, *e.g.*, *Peripatus*, and possibly scorpions. (3) Immature forms of terrestrial animals which are not cryptozoic in the adult condition; or, in other words, the larvæ of phanerozoic species. (4) Isolated representatives of typically aquatic groups of animals which have as yet become but little modified in accordance with their new mode of life. Of this section, the most interesting representatives are the land Planarians and land Nemertines, and the woodlice. It is to these animals and *Peripatus*, both of which he has made special objects of study, that Professor Dendy chiefly confines himself in his address; merely bestowing a passing remark upon the insects, spiders, centipedes, millipedes, snails, earthworms, not to mention vertebrates, that frequent the cryptozoic haunts of Australia and New Zealand. After discussing what is known of the habits of the *Peripatidæ*, the author touches upon the question of the generic and specific distinctions of this interesting family. We venture to think, however, that his opinion on the former topic is robbed of much of its value by his apparent failure to realise that the only criterion we have as to the importance for purposes of classification of a structural character is its constancy. Apart from that attribute, Nature knows nothing of good or bad, great or small.

In conclusion, Professor Dendy urges upon naturalists in Australia and New Zealand the advisability of making the most of their time and opportunities in securing representatives of the cryptozoic fauna ere it be exterminated by the wholesale destruction of forests that is going on. "For, when the clearing process is complete and the last logs have disappeared from the ground, we may expect to lose sight for ever of many peculiar forms which formerly dwelt there."

Recent Work on the Foraminifera.

Continuing the work on the Crag, referred to by us in our February number, H. W. Burrows published a paper dealing with the stratigraphy of the Crag of Suffolk, with especial reference to the distribution of the Foraminifera, in the *Geological Magazine* for November, 1895. In conjunction with his colleague, Richard Holland, he has now enabled us to deal with Prestwich's, and with Clement Reid's division of these strata from the point of view of their Foraminifera. As these beds are treated from their geographical, as well as from their stratigraphical, relations, the paper has considerable value. Other Pliocene Foraminifera have been examined by Fornasini in the *Memorie d. R. Accad. Sci. Ist. Bologna*, volumes v. and vi. (1895, 1896), who presents us with his views on *Bigenerina robusta*, *Textularia candeiana*, and *T. concava*. His papers are illustrated with two excellent plates. A further service has been rendered by Fornasini in the elucidation of O. Costa's paper "Foraminiferi della marna del Vaticano," 1855 (1857). He discusses this in *Palæontographia Italica* for 1895, and re-figures many of the doubtful forms. Costa's interesting unnamed *Truncatulina* ("Paleont. Napoli," part 2A, pl. xxi., f. 11) has also occupied Fornasini's attention, and he has determined it to be the *T. variabilis* of d'Orbigny; this paper appears in the *Rivista Ital. Paleont.*, April, 1896. A privately-printed note on

Frondicularia frondicula, n.sp., also appeared from the pen of this enthusiastic worker in February, 1895, but has only just reached us. Frederick Chapman continues his monograph on the Gault forms (*Journ. R. Micros. Soc.*, 1896) and presents his views on the *Cristellariæ* and *Polymorphinæ* of this deposit. As regards *Polymorphina* we hope shortly to be in the possession of a masterly and elaborate account of this genus from the pen of Professor Rupert Jones and Mr. Chapman; a paper on the subject having been read before a recent meeting of the Linnean Society. The paper is, in part, a continuation of the 1869 paper of Brady, Parker, and Jones, published by the same Society, and deals chiefly with those wild-growing forms familiar to students of the group. The authors have also devoted considerable time and attention to *Ramulina*, a closely-related form, and the publication of the paper will give, for the first time, a connected account of this interesting genus. In the *Geological Magazine* for September, 1895, Professor Jones, when reviewing some Reports of the Geological Survey of Iowa, took the opportunity of calling attention to the wide range of certain Cretaceous Foraminifera in the two hemispheres.

The working out of reticulate Rhizopoda in Australia is continued by Walter Howchin, who treats of three new Carboniferous forms, *Cornuspira*, *Nodosaria* and *Frondicularia*. We cannot accept the *Cornuspira* because of the chambering shown in the figure, but the *Frondicularia* is interesting as carrying back the genus from Liassic times. These tests come from the shales of the Irwin River, and are described and figured in *Trans. R. Soc. S. Austral.*, 1895. In the same paper Howchin figures a *Haplophragmium* and a *Patellina* from the Cretaceous of Hergott Springs, 441 miles north of Adelaide. We do not see how the first specimen can be separated from the common and very variable English species; the *Patellina* is of a much greater interest. A list from the Eocene beds of Cape Otway, at p. 114 of the same journal, shows 64 forms.

A new author on this group, Henrik Munthe, contributes two papers on Foraminifera to the *Geol. Fören. Stockholm Förhandlingar* (xviii., 1896). Munthe treats of the faunas of the "Yoldia mergel" and the Chalk, and wisely contents himself with listing known forms, and not making new names.

As a matter of considerable interest, we may conclude this note by mentioning that Mrs. Williamson has presented to the Zoological Department of the British Museum the almost complete series of figured specimens illustrative of the late Professor W. Crawford Williamson's Monograph of British Recent Foraminifera (Roy. Soc., 1858). The series also includes the types of his *Lagenæ* (1848); Levant (1848); and his papers on the structure of the test. The specimens are, in most cases, loosely mounted in cardboard cells, but Mr. Sherborn, who was consulted about the slides, has, we understand carefully ascertained the identity of the types.

The Rabbit Plague in the United States.

The great plains and deserts of the Western United States are inhabited by several species of large hares, locally known as "Jack Rabbits." Although they are by no means so destructive or so impossible to cope with as are the rabbits in Australia, they are sufficiently abundant to do great damage, especially to vineyards and cultivated crops. The National Department of Agriculture has recently issued a bulletin bearing the name of T. S. Palmer, M.D., the assistant chief of division, and dealing with the whole question of damage, habits, and means of destruction. It is illustrated by useful maps and plates, and, like all the bulletins of the Agricultural Department of the United States, makes us mourn the inefficiency of what we are pleased to call our own Department of Agriculture.

The various species of "Jack Rabbits" are all more or less alike in habits, and all feed largely upon bark or herbage. "Among the greasewood on the alkali flats, north-west of Great Salt Lake, or on the cactus-covered deserts of Arizona, the Jack Rabbits are almost as fat and sleek as when feeding in the alfalfa patches and vineyards of Southern California. If necessary, they can travel long distances for food, but, as they seldom drink, scarcity of water causes them little inconvenience, and the juicy cactus 'pads' or ordinary desert herbage furnish all the moisture necessary to slake their thirst. They are fond of vegetables and alfalfa, and, when these can be had, they quickly abandon their usual food and establish themselves near the garden or cultivated field. Their fondness for tender bark makes them particularly destructive in the orchard and vineyard, where they are likely to do irreparable injury by girdling the young fruit trees and vines." The best means of preventing their ravages, and the only means which may be relied upon, is the use of rabbit-proof fences. Occasionally, under favourable circumstances, large numbers may be destroyed by drives. Descriptions of some of the largest drives are given in this pamphlet, and it seems that twenty thousand have been killed at a time. But such methods only reduce numbers; they cannot exterminate the pests. Bounty laws were found on the whole to be unsatisfactory, as indeed, is the Australian experience. Enormous sums of money have been expended with very little benefit, and it seems impossible to prevent systematic fraud. Poisoning and the introduction of diseases have failed, and it appears that co-operation among farmers is the best means, while advantage should be taken of opportunities when the rabbits are already reduced in numbers by natural epidemics or by specially hard seasons. The Report urges strongly the commercial utilisation of rabbits, so making the creatures bear part of the burden of their own extermination.

A Danger of Clover.

The intestinal calculi and hair balls of horses and cattle are well known, but Mr. F. V. Coville, of the U.S. Department of Agriculture, has recently called attention to a new source of trouble in the hairs of the calyx of the crimson clover, *Trifolium incarnatum*. Up to the time of flowering these hairs are soft and flexible, but they afterwards become stiff and almost needle-like in character. If hay made from over-ripe clover is fed to cattle, these hairs, which are barbed, form balls of a tough, felt-like consistency three or four inches in diameter, which ultimately cause death through peritonitis or some related ailment. The first deaths from this cause in the United States were noted in 1895, and farmers are cautioned against allowing this clover to become too ripe before making it into hay.

The tops of the spineless cactus, *Anhalonium Lewini*, of Southern Texas, which contain an active poison, serve as articles of trade among the Indians, who use them as an intoxicant or stimulant during their dances or religious ceremonies. Mr. Coville considers that, in the absence of spines, this bitter, poisonous property serves as a protection against animal enemies.

The Horse's Hoof.

The hoof of quadruped mammals is so unique in its way that any contribution towards a knowledge of its histology and development is always welcome. Professor Mettam, in his presidential address to the Scottish Microscopical Society, published *in extenso* in the *Veterinarian* of the current year, gives an account of his original observations on the subject, and lays special stress on the mode of development of those horny lamellæ which are to be seen running in a vertical direction on the inner surface of the wall of the hoof of the horse. The surface of contact of the corium or dermis with the epidermis is, in the early stages of development, smooth and devoid of ridges. This has always been assumed in the past, but it has been left for Professor Mettam to demonstrate the fact, and to fix the age at which it is most clearly seen, viz., at seventy or eighty days in the case of the equine fœtus. When the corrugations first appear in the surface of contact, they arise by the dipping of the rete Malpighii of the epidermis into the corium, and not by outgrowths of the corium into the epidermis, as has hitherto been held. The horny laminæ are the cornified cores of these epidermal ingrowths, and remain standing out from the inner surface of the wall of the hoof after the removal, by maceration or other artificial means, of the uncornified inner layers of the epidermis. The laminæ are simple at first, but secondary ridges soon develop upon the lateral surfaces. Professor Mettam also gives an account of the Pacinian and other corpuscles found in the sensitive frog of the foot, and the comparison which he draws between the histological structure of the sweat glands of the horse's frog and that of the interdigital glands of the sheep and the ceruminous glands of the external ear is interesting.

"International" Congresses.

The provisional programme of the International Congress of Psychology, to be held at Munich from August 4 to 7, has been issued. It gives the titles of 102 papers; more will follow. Shortly after this congress, the Fourth International Congress of Criminal Anthropology will be held at Geneva, August 25 to 29. Applications for membership should be sent to Mr. Maurice Bedot, Musée d'histoire naturelle, Geneva.

We have already drawn attention to the "International Congress of Miners and Geologists," to be held at Buda-Pesth at the end of September next. We now find that a congress with the still more imposing title, "The Fourth International Hydrological, Climatological, and Geological Congress," is to be held at Clermont-Ferraud about the same time. Needless to remark that neither of these meetings have anything to do with the International Mining Congress, recently held at Aix-la-Chapelle, or with the "Congrès géologique internationale," nor have any geologists of our acquaintance been invited to either of them. An international congress, conducted in the usual manner, is at its best a lop-sided affair, since the indigenous representatives are always in an overwhelming majority, while the people who really care about the subjects discussed curiously contrive to withhold both their persons and their sympathy, leaving some magniloquent motion intended to revolutionise the universe to be carried by an unintelligible enthusiast in a bare quorum of somnolent sufferers. But when it comes to two international congresses on the same subject, meeting at the same time, we should say the term "international" was about played out, even as an advertisement.

The Zoological Society's Report.

The Report presented to the sixty-seventh Anniversary Meeting of the Zoological Society of London is a highly satisfactory document. There is a considerable increase in the number of Fellows, no less than 197 joining the Society in 1895, the largest number elected since 1877. Professor Christopher Aurivillius, of Stockholm, and Professor Max Weber, of Amsterdam, have been elected Foreign Members, and Messrs. E. Büchner, J. E. Matcham, R. R. Mole, A. J. North, T. E. C. Remington, F. E. Schulze, and Alfred Sharpe, Corresponding Members. The fine weather and the acquisition of a giraffe increased the receipts for admission to the Gardens by £1,333, and a proportionate increase is also shown in the riding fees and in the refreshment department. Among the more interesting sources of income are admissions, £15,639; rides, £762; rent for refreshment rooms, £975. Of expenditure the following are of interest: Provisions, £3,558; animals, £1,541; menagerie expenses, £3,349. Something like £700 was saved by the low price of hay and other fodder during the year, and the bulk of this sum was expended in new animals. The extraordinary expenditure consisted of £500 for the giraffe, and £1,149 for drainage works. This latter sum was spent in settling the long-vexed question of the drainage into the Regent's Canal. The Gardens now drain straight into the new Gloucester Gate sewer, and the trouble of the past fifty years has been brought to a termination, satisfactory at once to the vestries of St. Marylebone, St. Pancras, the Directors of the Canal Company, and, most important of all, to the inhabitants of the neighbourhood. About one hundred persons are employed in the care and maintenance of the menagerie and Gardens, and the public will miss the popular keeper of the lions, Seth Sutton, who has been pensioned off after nearly forty years' service. 665,326 persons visited the Gardens during 1895. The last £1,000 due on the mortgage debt has now been paid off, and the Society's freehold premises, valued at £25,000, are free and unencumbered. There is also a sum of £2,000 on deposit, and out of this we are promised a new house for ostriches and cranes.

In view of the great educational work carried on by the Zoological Society through their Gardens, and the general public interest in animals at the present time, as evidenced by the fact that no less than three popular monthly Natural Histories are now publishing, we reprint the following list of provisions purchased by the Society for the animals during 1895:—

Clover Hay ..	113¼ loads	Maw Seed ..	28 cwt.	Onions ..	3 bushels
Meadow Hay	131 ,,	Buckwheat ..	6 qrs.	Watercress ..	3,436 bunches
Oats	144 qrs.	Ground Nuts ..	29 cwt.	Nuts	33½ pecks
Wheat ..	43½ ,,	Barley Meal ..	3 ,,	Lettuce ..	229 doz.
Maize.. ..	70 ,,	Oatmeal ..	2 ,,	Apples ..	138 bushels
Bran	350 ,,	Milk ..	5,120 qts.	Pears ..	2½ ,,
Canary ..	15 ,,	Eggs ..	23,954	Grapes ..	1,156 lbs.
Hemp ..	11¾ ,,	Horses	200	Dates ..	1,395 ,,
Rape	1 ,,	Goats	197	Oranges ..	169 hundred
Millet.. ..	3¾ ,,	Flounders	2,184 lbs.	Carrots ..	132 cwt.
Barley ..	28¼ ,,	Whiting	26,520 ,,	Potatoes ..	59 ,,
Bread..	5,515 qtns.	Shrimps	1,252 qts.	Cherries ..	9 boxes
Biscuits ..	302 cwts.	Fowl-heads	7,512	Marrows ..	35 doz.
Rice	78 ,,	Rough Fish	9,667 lbs.	Bananas ..	1,149 ,,
Oilcake ..	56 ,,	Greens	37 bush.	Melons ..	50
		Cabbage ..	260 doz.		

The Royal Horticultural Society's Show.

As a brilliant spectacle, the Royal Horticultural Society's Show at the Temple Gardens was an undoubted success. The Society did not send us a ticket, but we were present on the opening day. We hope that the number and apparent splendour of the visitors resulted in an equally splendid financial success, and the desired "influx of new members, animated by the single desire . . . of improving and advancing the best and legitimate interests of all branches of gardening." Since its foundation in 1804, much useful work has been done by the Society. Besides experimental cultivation for the improvement of varieties of flowers and fruits, carried on continuously at Chiswick, many plants have been introduced from abroad. Don, Douglas, Fortune, names familiar to botanists if only from their frequent commemoration in generic or specific names, were only three of the Society's most zealous and successful collectors. Don collected extensively on the West Coast of Africa, and afterwards in South America and the West Indies. To Douglas, who visited North America, and especially the Pacific coast, we owe the introduction of many conifers—the Douglas Pine (*Pseudo-Tsuga Douglasii*) from British Columbia, *Pinus Lambertiana*, *P. insignis*, *P. ponderosa*, and others; among shrubs the familiar flowering currant, and many well-known garden flowers besides—Gilias, Clarkias, Godetias, lupines, Eschscholtzias, etc. To Fortune, who went to China in 1842, we owe the "Chusan Daisy," the parent of our Pompon chrysanthemums; the Japanese anemone, *Weigelia*, and that pretty spring flower the *Dielytra*. Fortune also made careful observations on tea cultivation, and subsequently entering the East India Company's service, by his experiments in the north-west provinces of India, laid the foundation of the tea-growing industry in India and Ceylon. John Reeves, who had visited China more than twenty years before, sent home the beautiful *Wistaria sinensis*, of which the original plant is still growing in the Society's garden at Chiswick.

We cannot enumerate the glories of the Temple Show. There were quaintly marked tulips, glaring begonias, soft-coloured carnations, and a bewilderingly bright bank of orchids—one lady thought "there was something almost spiritual" about the latter. But the prettiest thing, in our opinion, was a little Alpine garden arranged by Backhouse, of York. In spite of the fact that plants were rather mixed, the Californian *Darlingtonia* and *Calochortus* with European gentians, it looked like a little bit of nature that had got in by mistake.

Henry Woodward on Crustacea.

In Dr. Henry Woodward's Presidential Address to the Geological Society, a vast amount of learning is compressed into the twenty-eight pages which deal with the "Life-history of the Crustacea in later Palæozoic and in Neozoic times." Those at all new to the subject will be astonished at the wealth of genera and species now known of fossil Malacostraca, and at the distant dates to which the familiar groups of crabs and crayfishes, of shrimps and woodlice, can be traced back. In the period of the Greensand, an isopod, resembling the well-known *Bopyrus* now living, had already learned to take up its lodging free of rent in the carapace of a prawn. The well-tasting *Squilla mantis* of the Mediterranean has its recognisable ancestry in the Coal Measures, in the Chalk, in the London Clay. The palæontology of Crustacea, as it is more and more investigated, promises to be full of instruction in regard to the slow, the far-stretching, the complicated evolution of life. Unfortunately the fossil remains of this class are often very obscure in many of the details that would seem most instructive. That such remains are not more abundant may be thought surprising, considering how prolific most crustaceans prove themselves to be, and that they frequently shed their entire integument. The reason for the scarcity may be found in the fact that they are a food so very acceptable in the animal kingdom, and that even the cast shells are devoured, either by their late owners or by other creatures.

In complimenting the vigorous official activity of some aged American geologists, Dr. Woodward makes pathetic allusion to a rule in our own Civil Service which shows scanty respect to age, for at a definite date "Comes the blind Fury with the abhorred shears and slits the thin-spun life." Free countries are ever famous for logical consistency. That is why we in England consider that prime ministers, archbishops, lord chancellors, are at the zenith of their powers at sixty-five, while at that age we think it proper to dismiss from office the geologist, the botanist, the palæontologist, as though the mystic date on a sudden turned into foolishness and flaccidity all their ripe experience, their stores of knowledge, their energy, their judgment and acumen.

An Ancient Octopod.

A very remarkable and beautiful fossil has been recently dug out of the alluvium in the Museum of the Geological Society, London, and figured and described by Dr. H. Woodward in the May number of its *Quarterly Journal*. It is no less than a complete octopus from the Cretaceous beds of the Lebanon. Collected in 1842 by T. J. Newbold, it was named in manuscript by J. de C. Sowerby in 1846, and referred to in 1877 by Louis Lartet, since which time it has been again buried and lost till rediscovered a few months ago. The octopus, which bears Sowerby's name *Calais newboldi*, shows its eight arms, each furnished with suckers, the umbrella or web, beaks, funnel, fins, and ink-bag, and is in a singular state of preservation. The fins which are triangular, one on either side of the body, and not united behind, form the diagnostic character of the genus, and their wing-like appearance has suggested its name, for Calais was one of the winged sons of Boreas. The specimen is the oldest known representative of this division of the Cephalopoda.

I.

How and Why Scorpions Hiss.

TO many residents in India, especially to those interested in natural history, it is possibly a well-known fact that the large black scorpions of that country will frequently emit distinctly audible sounds under the stimulus of fear or of anger. Possibly, indeed, the circumstance has been regarded as so well known that few have considered it as deserving of special mention. For example, in the following passages, published in *Nature*, in 1879, in connection with the suicide of scorpions, the observer is evidently unaware of the interest attaching to the words that we have italicised. After describing how he procured a specimen of "the common black scorpion of Southern India" [doubtless *Scorpio fulvipes*], and placed it for safety "into a glazed entomological case," Mr. W. G. Bidie says . . . "taking a common botanical lens I focussed the rays of the sun on its back. The moment this was done it began to run hurriedly about the case, *hissing and spitting in a very fierce way*. This experiment was repeated some four or five times with like results, but on trying it once again the scorpion turned up its tail and plunged the sting, quick as lightning, into its own back." It will be noticed that the "hissing and spitting" of the scorpion are here referred to quite incidentally, and are merely thrown in as an item of "corroborative detail, to give artistic verisimilitude to the narrative"; and it may be safely assumed that the observation would never have been recorded in this case had it not been for its intimate connection with the fancied self-destruction of the chief actor in the tragedy described.

This little anecdote has been quoted, not because it is the first record of the 'hissing' powers of the Indian scorpions, but because it affords an illustration of the possibility of the fact being a matter of common knowledge to many of those who had fallen in with these animals in the Oriental Region prior to 1877. Possibly, indeed, the occurrence had been noticed in print before that date; but Professor Wood-Mason evidently believed the fact to be new to science when he read a paper on the "Stridulation of Scorpions," before the Entomological Society of London in September of that year. At all events, there is no reason to suppose that the organ by which the 'hissing' is produced had been previously discovered or described; and as a tribute to the acumen of this naturalist it may be added that he found the organ and foretold its function before he was aware of the ability of scorpions to emit special sounds of any kind. An opportunity of verifying this prediction first presented itself at Bombay, when he was on his home journey from Calcutta. Here he procured two black scorpions, and, placing them face to face on a small metal table, goaded them into fury, whereupon they immediately began to beat the air with their great pincers and simultaneously to emit sounds, which were distinctly audible to the bystanders, and "resembled the noise produced by continuously scraping a piece of silk-woven fabric, or, better still, a stiff tooth-brush, with one's finger nails." In another place the sound is said to be "almost as loud as, and very closely similar to, that made by briskly and continuously drawing the tip of the index finger backwards and forwards in a direction transverse to its coarse edges over the ends of the teeth of a very fine-toothed comb." And, finally, in describing the situation and structure of the organ which produces the sound, Wood-Mason says: "The apparatus is situated—the *scraper* upon the flat outer face of the basal joint [segment] of the palp-fingers; the *rasp* on the equally flat and produced inner face of the corresponding joint of the first pair of legs. On separating these appendages from one another a slightly raised and well-defined large oval area of lighter coloration than the surrounding chitine is to be seen at the very base of the basal joint of each; these areas constitute respectively the *scraper* and the *rasp*. The former is tolerably thickly, but regularly, beset with stout conical sharp spinules, curved like a tiger's canine, only more towards the points, some of which terminate in a long limp hair; the latter crowdedly studded with minute tubercles, shaped like the tops of mushrooms."

It is a pity that this brief preliminary account was never followed by a more detailed and illustrated description of the organ in question at the hands of its original discoverer. But since death has now unhappily rendered this an impossibility, it is undesirable that there should be any further delay in figuring this remarkable instrument, and in publishing a short explanation of certain points in its structure which do not appear in the account cited above. In the first place, however, for the sake of those readers of Natural Science who are not familiar with the details of a scorpion's anatomy, it is proposed to add a few lines on this subject so as to make clear to all the mechanism and structure both of Wood-Mason's organ and of two others that have recently been discovered in some African species, but hitherto neither figured nor described.

Attached to the cephalothorax, or forepart, of a scorpion's body, are six pairs of appendages, four of which on each side are set apart for locomotion, and constitute the legs properly so called. The basal segments or coxæ of these legs are welded together and closely in contact, so as to be capable of but little movement. But immediately in front of the first leg there is a large and powerful limb variously known as the chela, pincer, or palp (the palp-finger of Wood-Mason), which is used for seizing and holding prey, and is for this reason loosely jointed to the body, and capable of extensive movements, up and down and from right to left; and since the hinder surface of its basal segment is closely applied to the front or adjacent surface of the corresponding segment of the first leg, it necessarily slides over it when the pincer is in motion. In this spot, therefore, the conditions for the production of a stridulating organ are most favourable, for, as was explained in the article entitled "Musical Boxes in Spiders" (Nat. Sci., vol. vi., p. 44, Jan. 1895), sound-producing organs in the vast majority of Arthropoda are developed exclusively where friction occurs between two adjacent chitinous areas. In addition, however, to the great pincers, all scorpions possess a second pair of highly-mobile appendages. These are the mandibles or cheliceræ, which

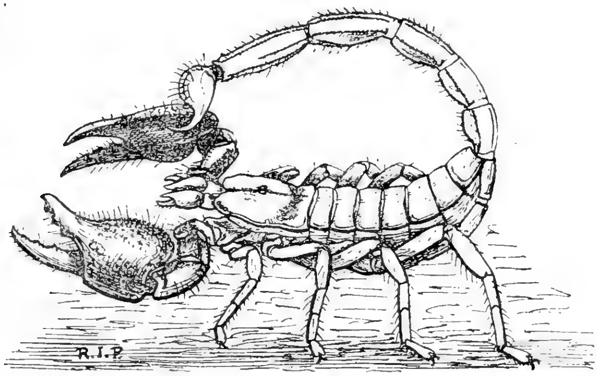

Fig. 1.—Indian Scorpion (*Scorpio swammerdami*) Stridulating; two-thirds natural size.

have the form of small three-jointed pincers, lodged beneath the front margin of the carapace or head-shield, and capable, like the chelæ, of considerable movement in all directions, and especially of extension and retraction in a line with the long axis of the body. When moved in this way the inner surface of the one can be rubbed against the inner surface of the other, and the upper surface of both against the anterior edge of the carapace. It is here that the new compound organ to be described has been developed in the large S. African scorpions of the genus *Opisthophthalmus*.

Returning, however, for the moment to Wood-Mason's organ: As has been explained, this exists between the basal segments of the first leg and of the chela, and may easily be detected by the naked eye when these two appendages are pulled apart from each other. The keys or notes (the scraper of Wood-Mason) occupy the yellow area on the coxa of the chela (*see* Fig. 2, A), and, as in the case of the large so-called *Mygale* spiders, they are simply modified hairs, as may be clearly seen by examining those situated close to the edge of the area in question. Here the hairs are simply thickened and compressed at the base, the remaining part being normally slender, though sometimes slightly curved; but in the fully formed notes the distal part of the bristle is bent at right angles to the basal part, which is enormously expanded and flattened from side to side (*see* Fig. 2, C and D). Here and there amongst the notes rises a normal bristle, showing that all the hairs, presumably to allow free room for vibration, have not become involved in the formation of the instrument. It may also be noticed from the figure that the ends of the hairs are bent in the same direction and keep clear of each other. Their appearance, indeed, reminds one forcibly of a number of weathercocks or streamers before a stiff breeze, or of the heads of a crowd of stork-like birds all gazing in the same direction. When the chelæ are waved up and down, the tips of these notes catch against the roughness of the contiguous area on the basal segment of the first leg (Fig. 2, B), and, being thrown by this means into a state of

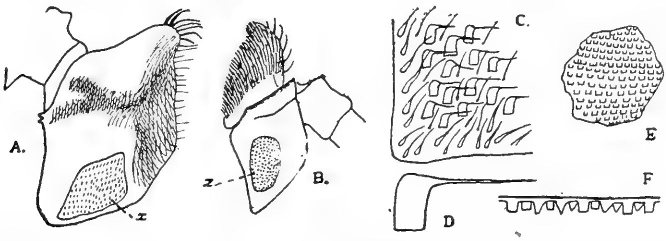

FIG. 2.—STRIDULATING ORGAN OF INDIAN SCORPION, *Scorpio swammerdami.*

A, Coxa of pincer, with key-board *x*. B, Coxa of first leg, with rasp *z*. C, Portion of key-board, showing notes. D, one of the notes. E, Diagram of portion of rasp, showing papillæ. F, Diagram of papillæ in side view.

vibration, produce the hissing or rustling sound that has been described. The roughness, when examined under an inch objective, appears to consist of a thick cluster of granules, but these when more highly magnified take the form of irregularly arranged, variously sized papillæ, shaped somewhat like a human incisor tooth (*see* Fig. 2, E and F). It should be added that the figures and descriptions here published are taken from an example of the largest-known Indian scorpion, *Scorpio swammerdami*. Probably the specimen examined by Wood-Mason—"a gigantic one from the Upper Godaveri District"—was also a representative of this species. But this is not certain, nor is it of any special importance, seeing that the organ is found in all the Oriental species of *Scorpio* ranging from Bombay to Borneo.

Curiously enough, however, in the species usually referred to the same genus inhabiting tropical Africa an analogous organ exists, which, although agreeing with the one just described in structure and, broadly speaking, in situation, yet differs both in the arrangement of its parts and in exact position, and has evidently originated entirely independently of the other in response to the stimulus of similar needs. Like the organ discovered by Wood-Mason, this new one is lodged between the basal segments of the pincers and of the first pair of legs. No doubt, too, a rustling sound is produced by the waving of the pincers and the consequent friction between the adjacent surfaces of these two segments. But in this case the notes or keys are situated upon the base of the first leg (Fig. 3, A) and the scraper upon the base of the pincer (Fig. 3, B). The arrangement is, consequently, exactly the opposite of that which obtains in Wood-Mason's instrument. The position, moreover, of the stridulating areas upon the respective segments is also different, the area upon the coxa of the first leg being situated, not upon the main part of the segment, but upon its maxillary process (*see* Fig. 3, B), and that upon the coxa of the pincer being moved a corresponding distance to the front (Fig. 3, A). The latter is thickly studded with minute spicules, and the former much more sparsely with notes, smaller than those that occur in the Indian species, but like them in origin and essential structure, being evidently nothing but hairs expanded at the base and bent over at the distal end. The form of these notes in the West African *Scorpio*

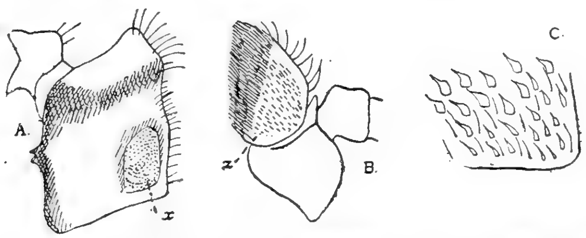

FIG. 3.—STRIDULATING ORGAN OF AFRICAN SCORPION, *Scorpio africanus*.
A, Coxa of pincer with rasp, *x*. B, Coxa of first leg with keyboard, *z*, on its maxillary process. C, Portion of keyboard enlarged to show the notes.

africanus is shown in Fig. 3, C, but in some of the other species the terminal part is longer and thinner.

The scorpions possessing this organ are distributed in equatorial Africa from Senegambia to the Congo on the west, and from Abyssinia and Somaliland to Lake Nyassa on the east. The Saharan region to the north of this area is occupied by the allied genus *Heterometrus*; but in this form no stridulator has been detected. Ranging, however, over the whole of S. Africa to the south of the area occupied by *Scorpio*, occurs the genus *Opisthophthalmus*, of which most of the species possess a well-developed sound-producing organ totally different both in structure and position from those that have hitherto been discussed. The discovery of this organ was due to a lucky chance. In the course of a correspondence with Mr. G. A. K. Marshall, who has spent some years both in Natal and in Mashunaland, and has proved a most valued contributor to the national collection, my interest was aroused by some casual remark of his touching the stridulation of *Solpuga* and of scorpions, and, in reply to a question on the latter point, he wrote as follows :—"With reference to your inquiry as to the 'hissing' of scorpions, I have often heard this myself. Indeed, only three days ago, while walking into Salisbury from the Umfuli, I met one in the road which hissed at me on my approach. I watched to see from what part the sound proceeded, and it appeared to me to be caused by the movement of the mandibles alternately backwards and forwards. I did not catch the specimen, since it belonged to the species of which examples have already been sent to you—in fact, the only one that I have seen round Salisbury. I have also heard the common small black scorpion of Natal make a similar noise, and this is a generally well-known fact there. I have never examined a dead scorpion to find the stridulating organ, but from the action of the living creatures I presume it is very similar to that of *Solpuga*. The sound of the latter is, however, much harsher and more grating than that of the scorpion, which is best described as hissing."

An examination of the mandible of the species referred to—*Opisthophthalmus glabrifrons*—not only showed very clearly the position and structure of the sounding organ, but also furnished an explanation of the difference in tone between the stridulation of *Solpuga* and of this scorpion. In the former, as is well known, the harsh grating noise is produced by the friction of a set of hard coarse ridges, situated on the inner surface of the mandible of one side, against an exactly similar set upon the corresponding surface of the mandible of the other side. In position the organ of *Opisthophthalmus* resembles that of *Solpuga*, being situated upon the inner surface of the basal segment of the mandible, and a further resemblance lies in the fact that the part of the instrument on the right mandible is structurally similar to that upon the left. In this respect the instrument, as a whole, is quite different from the analogous instruments found in the species of *Scorpio* and in the stridulating spiders of the family Aviculariidæ, where two distinct structures, namely strikers and notes, are involved in the composition of the instrument.

A glance at the annexed figures will show that the organ in question consists of a set of delicate membranous notes, projecting upwards from near the middle of the inner surface of the basal segment (Fig. 4, A). In different species they vary, both in number and form, being sometimes racket-shaped, with a long stalk (Fig. 4, D), and sometimes heart-shaped, with scarcely any stalk at all (Fig. 4, E). The latter kind is found in *O. granifrons*, the former in *O. carinatus* and *O. nitidiceps*, while notes of an intermediate type occur in *O. glabrifrons* (Fig. 4, C). The number also varies in different species, and apparently in different members of the same species. For example, a specimen of *O. carinatus* from Otjimbinque has as many as eight (Fig. 4, B) on each mandible, while a second from the Umfuli River in Mashunaland possesses but five. Again, six were noticed in a specimen of *O. latimanus*, four in *O. pugnax* and *O. capensis*, three in *O. breviceps* and *O. glabrifrons*. But the exact systematic value of this new character has yet to be determined. Apart from the distinctive features pointed out, the notes in all the specimens examined are alike, being thin, flat, leaf-like, and finely striate. The edges, when entire, are evenly convex, though not infrequently they present a ragged appearance as if frayed from rough usage. That these notes are nothing but modified bristles there can be little doubt, though since they now occupy an isolated area practically free from hairs, the direct evidence of their origin is not so clear as it is in the analogous cases presented by the species of *Scorpio* and by the mygalomorphous spiders.

Of all the species of *Opisthophthalmus* contained in the British Museum two only, namely *O. wahlbergi* and *O. pallidimanus*, show no traces of this instrument. But in these, as in the other species of the genus, the upper surface of the basal segment of the mandible is raised at its distal end into a prominence thickly studded with bristles (Fig. 4, A and B); and when examined under a high power these bristles may be seen to be modified in exactly the same way as

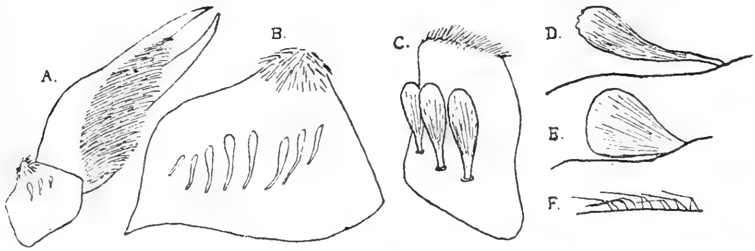

FIG. 4.—STRIDULATING ORGANS OF *Opisthophthalmus*.

A, Inner surface of mandible of *O. glabrifrons*, with three notes and bristly prominence on the basal segment. B, Basal segment, with notes and bristly prominence, in *O. carinatus*. C, Keyboard of *O. glabrifrons*. D, One of the notes of *O. carinatus*. E, One of the notes of *O. granifrons*. F, Some of the notes from the tuft of bristles of *O. capensis*.

are those that constitute the notes in the species of *Scorpio*—that is to say, the base is thickened and compressed, while the slender terminal portion is bent over at right angles as represented in Fig. 4, F. From what is known of the function of the similarly-constructed bristles in *Scorpio swammerdami*, for instance, it cannot reasonably be doubted that these bristles subserve the same purpose of producing sound in *Opisthophthalmus*, and in the absence of any specially-constructed scraper we may conclude that they are thrown into a state of vibration by scraping against the front edge of the carapace, as the mandible is forcibly withdrawn beneath it. There are thus two distinct stridulating organs within the limits of this genus. In some of the species, indeed, the two organs exist side by side, as may easily be seen by examining the mandible of *O. capensis*, the species that occurs abundantly in the vicinity of Cape Town.

Apart from this new organ, the most interesting feature connected with *Opisthophthalmus* is the characteristic from which the genus derives its name, namely, the backward position of the median eyes on the carapace. The cause of their migration from the middle of this plate has never been explained, but it is possibly connected with the peculiar habit of rubbing the mandibles backwards and forwards to produce the stridulation, the end in view, if the expression may be pardoned, being the keeping of the ocular nerves clear of the retractor muscles, which normally pass on each side of them towards the hinder portion of the cephalothorax.

Since the possible utility of the stridulating instruments in spiders has been recently discussed in some detail in the pages of Natural Science, it is unnecessary to do more than briefly touch upon the same topic in connection with scorpions. Suffice it, then, to say that since the organs that have been here described are equally well developed in both males and females, and appear in the young long before the attainment of maturity, there is no reason to suppose that they are of a sexual nature, serving, like the chirrup of the cricket or the call of the cuckoo, to inform the one sex of the whereabouts of the other. If this were the case, we should expect to find, firstly, that the organs were exclusively confined to one sex, or, at all events, better developed in it than in the other; and, secondly, that they put in an appearance either just before or simultaneously with the reaching of the adult stage. Again, in spite of the opinion of many authorities, who maintain that the existence of a sound-producing organ implies of necessity the existence of an auditory apparatus in the same individual, we can only assert again that there is not a particle of evidence that either the large spiders or the scorpions can hear the sounds that their own stridulating organs emit. All the available evidence goes to show that in these groups of arachnids the organ is brought into use when its possessor is under the influence of irritation or fright, exactly as in the case of the rattlesnake's rattle. Like the snake, too, both the scorpions and the spiders are furnished with highly-developed poison-glands, and it is a well-known fact in natural history that animals so gifted are frequently rendered conspicuous by bright and staring colours, so that they may not be destroyed by carnivorous creatures in mistake for other harmless and edible species. Nature, in fact, for purposes of protection, has labelled them with her poison-badge; and, apparently with the same end in view, she has supplied the rattlesnake and the large spiders and scorpions with a sound-producing apparatus, which, when in action, serves as a danger signal to meddlesome intruders, warning them to beware of hostile interference. But if, as has been suggested, it is the function of these interesting organs to act in this manner as an advertisement of the whereabouts and nature of the species that possess them, it is surely clear that their existence implies the existence of an auditory sense, not necessarily at all in the performers themselves, but only in the enemies that might otherwise destroy them. In exactly the same way it is absolutely unnecessary, and indeed impossible, for the katipo (*Lathrodectus scelio*), the little black poisonous spider of Australasia, to see the scarlet badge on its back, or the cobra the pattern on its hood, in spite of the fact that from the existence of these marks the existence of eyes to see them is to be inferred.

In conclusion, however, it must not be forgotten that the explanation here given of the probable function of the stridulating organs in the large spiders and scorpions is at present unsupported by any direct observations as to the protective effect of the sound. As a matter of fact, as Mr. Marshall informs me, the species of *Opisthophthalmus* are eaten in spite of their hissing by both baboons and roller-birds. But so also is the cobra killed by the mungoose, notwithstanding its poison-badge, and bees are devoured by frogs and toads, though decked with warning colours. Within the limits, indeed, of the animal kingdom it would probably be impossible to find a single instance of a protective feature serving to save its owner from the attacks of enemies of all kinds. The hypothesis, therefore, that the sound, like the scarlet band on the katipo, acts as a danger-signal need not be rejected on the grounds that monkeys which are partial to a diet of scorpions, and skilful enough to handle them without damage, pay no heed to the hissing when searching beneath stones for these animals and other vermin; and since the hypothesis affords both a simple and plausible explanation of the phenomenon, it may be provisionally adopted as a probable approximation to the truth, at all events until reasons can be shown for thinking that it is logically untenable, or until another and a better one is put forward in its place.

R. I. Pocock.

II.

An Introduction to the Study of Anthropoid Apes.—I. The Gorilla.

IT is possible that the recent addition of a young female gorilla to the Gardens of the Zoological Society of London may lead to a renewed interest in this bulkiest of Primates in the minds of many people; and if the interest aroused be sufficient to induce some of these to become better acquainted with the history of this alleged cousin of the human race, they will find it can be read only by picking their way through the European periodical and academical scientific literature of the last fifty years. Having been working at the anatomy of the higher Primates for a number of years past, and having in that time become acquainted with the better part of the literature dealing with this animal, it occurred to me that a short article, to act not only as a guide to work already done, but also as an index to the lines of future effort, might prove useful to some at the present time.

The Gorilla in Confinement.—Before getting well into the subject in hand, however, it would be better to dispose of what we know of the gorilla as a visitor to Europe. The example now in the Zoological Gardens is the third of its kind that has lived in England; its predecessor died after a short stay in the Gardens (*Proc. Zool. Soc.*, 1887, p. 559). The first gorilla came about 1860, and spent seven months in a menagerie in the north of England; its skin and bones are said now to rest in Ushaw College, Durham. It had the misfortune to be shown as a chimpanzee. In *Proc. Zool. Soc.*, 1877, p. 303, a fine drawing of it by Wolff is given. There have been at least five living gorillas in Germany. Four belonged to the Berlin Aquarium; Falkenstein's, which cost £1,000, lived there for fourteen months, and had been in confinement for over three years; Hermes' example lived two months, but was said to have been in the possession of a native chief for over six years; the other two lived for very short periods (25, 43, and 47). One lived for a short time in Paris (60). It will be seen that confinement in Europe is quickly fatal to the gorilla; this probably depends less upon the climate than upon its temperament, which is fierce, intolerant of bonds, and lacking the docility of the easily-confined chimpanzee.

Biological Beliefs, Methods, and Ends.—Scientific literature is becoming so bulky and unwieldy, with every prospect of becoming even more so, that it is of the utmost importance to come to some understanding as to the aim and end of such a study as that of the gorilla, and as to the methods by which the aim and end are to be attained. This is all the more necessary since our biological beliefs, our methods, our ultimate ends, are not those of the generations that have left the records with which we have now to deal. The creed, methods, and aims of the older anatomists were simple and primitive: they believed an individual could represent its race; the characters of any one average specimen were exactly the same as the characters of its species; their methods lay in the dissection and description of a certain type individual, with a commentary on its similarities and dissimilarities when compared with its neighbours. By a judicious grouping of similarities they sought to obtain a clear mental picture of the higher primates in their true perspective relationship, with man overtopping all and well apart from his anthropoid neighbours. In fact, this most laudable aim—the segregation of the human race—has occasioned the greater half of the research that has been done upon the anthropoids; the other half may be said to be due to museum-made strife over the number of gibbon, orang, and chimpanzee species. Hence the form in which we find the literature on the anthropoids—all more or less polemical. Now these creeds, aims, and methods are gone: they are dead as Bathybius. They have been gradually replaced by the tenets of a race of workers that refuse to accept one, two, or even five individuals, however selected, as fit to represent a species, as much as they deny the possibility of any one man embodying the characteristics of his nation. A species, they believe, can be represented in its full and absolute truth—were it possible—only by a dissection, description, and tabulation of every part of every living individual of that species. For example, if the individuals that make up the present living race of gorillas were superimposed muscle on muscle, artery on artery, brain-convolution on brain-convolution, the result would be, not the clear outline of a typical individual, but rather an amœboid form with a considerable amplitude of variation in certain well-defined directions. This newer mental picture of a species, then, is of an amœboid form with the lines of variation thrown out as pseudopodia, which may be regarded as feelers co-ordinating the race with its surroundings. Such a conception of the species by the modern biologist has necessarily led to a change in his methods. They are still, of course, dissection, description, and tabulation, though not of one, but of many individuals: few anatomists would accept less than one hundred individuals to represent a species. What is wanted first and most for the animal with which we are at present dealing is a thorough and minute dissection of one gorilla to act as a standard for future workers. There is only one description that nearly approximates to such a standard—Deniker's

(17); but, unfortunately, it is the dissection of a fœtal animal. Much of the work that has already been done, such as that of Owen and Hartmann, is almost useless for future purposes, as a list of the material used is never explicitly stated—the first essential—and only general statements are given. In short, Owen and his school may be said to have been anatomists of the individual; his successors were and are anatomical census-takers of the race.

The aim and end to which all such work as this should be directed is, I take it, to find out not only how the individual, but also how the race, moves, lives, and has its being; and any fact which helps towards this end deserves to be recorded. We wish to discover, also, how races have come into their present shapes and habits; how they are co-ordinated with their surroundings; and to what extent we may prophecy with truth as to how these races might be moulded in changed surroundings. Such studies pursued upon man's nearer neighbours ought to give some understanding of the methods by which he has attained his present form and position. But, besides these more philosophical problems, the solution of which leads only to a certain mental satisfaction, the anthropoids offer, in the simplicity of their mind and body, a clue to the more practical study of the elaborate psychology and physiology of man.

The Nervous System.—Seeing that the brain is regarded as the organ that keeps the individuals of the higher races sexually and socially congregated together in a group known as a species, and seeing further that the form of the brain is moulded by and dependent upon function, its study becomes of the first importance. About a dozen gorilla brains have been seen altogether: Bischoff (4, 5, 9), Broca (11), Chapman (14), Deniker (17, a fœtal brain), and Pansch (67) have given figures and descriptions of the convolutions; Féré (27), Gratiolet (32), Moeller (62), Thane (78), and Owen (66) have noted some points concerning it. As for the convolutions, we neither know their meaning nor what relationship they bear to function. They are probably of less value physiologically and morphologically than the basal parts of the brain, of the centres and tracts of which we know nothing. The cerebellum is still untouched. Waldeyer (85) has given us a splendid piece of research on the spinal cord, and Eisler's (24) account of the distribution of the nerves is very good. Hepburn (45) also gives a full account of the main nerves of the limbs. The microscopical structure and distribution of motor areas of the cortex of the brain are unknown.

The Muscles.—The muscles of the gorilla have been well described by Deniker (17) and Duvernoy (22); Hepburn (45) gives a full account of the muscles of the limbs. Partial descriptions have been given by Bischoff (7), Chapman (13), Chudzinski (16), Ehlers (23), Huxley (49*b*), Macalister (55), Ruge (70), Symington (76), and Wyman (87). As already pointed out, a standard dissection, to include at the same time the work already done, is still required.

The muscles ought to be treated in functional groups, their actions and nerve supplies being also noted.

Ligaments.—Ligaments have been described by Duvernoy, Deniker, Hartmann (39), and Macalister (55).

The Skull.—There are over 250 gorilla skulls in the museums of Europe and America. More or less partial records of over 100 of these are to be found in literature. Owen's descriptions are, perhaps, the best (64, 65, 66); others are given by Virchow (84), Bischoff (3 and 8), Deniker (17 and 18), Duvernoy (22), Giglioli (31), Halford (34), Hamy (35), Hartmann (40), Hervé (49), Török (80 and 81), Turner (83), and Wyman (87). Duckworth (20) has made an important contribution on the variations found in the gorilla skull. It may be safely said, by way of postscript to this list, that the skull has been the most sadly abused structure of the animal body. The present manner of description by angles and indices is a method that leads only to the accumulation of a mass of most useless, cumbersome material. The describers seem to have lost all sight of the skull as a functional organ, with its form adapted for its two main uses, as a brain cover and a tooth carrier. Its description, to be of use, must be given in relation to these two functions.

The Skeleton.—For a general description of the skeleton the text-books of Flower, Huxley, and Owen are still as good as any. More elaborate descriptions are given by Aeby (1), Deniker (17), Duvernoy (22), Halford (33), Hartmann (40 and 43), Heckel (44), and Mivart (61). Struthers has dealt with the variations in the vertebral column (74). Kneeland (50), Lucae (54), Slack (73), Swayne (75), and Wyman (87) have also made smaller contributions. From the elaborate and expensive lithographs of bones which are sometimes given with these papers, one would conclude either that the scientific societies had a superabundance of funds, which is unlikely, or that these lithographs are more permanent and convenient for reference than are the bones themselves. On the ossification and fixation of the epiphyses to the shafts nothing is known beyond Deniker's work.

The Teeth.—In the text-books of Tomes, Huxley, and Owen general descriptions of the teeth are given. Topinard has dealt with the cusps and fangs of the molars and premolars (82); Magitot (56 and 57) treats of the dentition of the gorilla. Duvernoy and Heckel also give a description of the teeth, while abnormalities are reported by Magitot (57), Gervais (*Journ. Zool.*, vol. iii., pp. 164–166; 1874), Bateson (*Proc. Zool. Soc.*, 1892), and in the *Trans. Odont. Soc.*, 1887, p. 266. Little is known of the dates at which the teeth cut the gum (*see* Famelart, 26).

The Alimentary System.—The mouth, tongue, and pharynx have been figured or described by Ehlers (23), Bischoff (7), Duvernoy (22), Chapman (13), and Deniker (17). The viscera of the abdomen have never been thoroughly described. The liver has been dealt with by Chudzinski (15), Flower (28), Virchow (84), Deniker (17), Bolau (10), Bischoff (7), and Huxley (49*b*). The alimentary canal has been observed, though only in a cursory manner, by Virchow (84), Deniker (17), Chapman (13), Bischoff (7), Bolau (10), Flower (28), and Hartmann (40). Macalister and Deniker mention the presence of salivary glands (!) But of the pancreas, the supra-renal bodies, the arrangement of the peritoneum and mesenteries, and the sympathetic system of the abdomen, we know practically nothing.

The Respiratory System.—A great deal has been written on the larynx and laryngeal sacs: Ehlers (23), Deniker (17 and 19), Bischoff (7), Duvernoy (22). The function of these sacs is unknown. The lungs are partially described by Ehlers, Bolau, Bischoff, Deniker, and Hartmann.

The Circulatory System.—One would scarcely expect to find any peculiar feature about the heart of the gorilla, and none has been recorded, yet one would expect that the disposition of the pericardium and its relationship to the diaphragm would be different from that found in man. Only Bolau, Deniker, Ehlers, and Bischoff make mention of the heart. Our knowledge of the arteries of the gorilla we owe to Deniker (17) and Eisler (24). This system, especially as regards the veins, requires much more attention.

The Lymphatic System and the Ductless Glands.—Of the lymphatic system nothing is known except in a most general way. The spleen has been figured by Bischoff (7) and Deniker; Virchow (84) alludes to it; so does Bolau. Deniker and Ehlers give a short description of the thyroid; the thymus, supra-renal bodies, pineal and pituitary bodies, the carotid, and coccygeal bodies have never been described.

The Genito-Urinary System.—The kidney of the gorilla, like that of the other anthropoids, has only one papilla, and has been described by Deniker (17), Virchow (84), Bolau (10), and Ehlers (23). Its microscopic structure and development require to be investigated. The bladder and its relationship to the pelvis and pelvic fascia have not been noted. The testicle is cursorily described by Ehlers and Chapman, but the prostate and the urethra have not been examined. Duvernoy, Ehlers, Huxley (49*b*), Owen (*Proc. Zool. Soc.*, 1859), and Chapman have described the external genital organs. The reproductive system of the female requires examination, although Bischoft (6), Deniker, Bolau, Ehlers, and Hartmann (42) have already made contributions to this subject.

Organs of Sense.—These are not likely to show any marked differences from those of man; yet it would be well to give them the attention they have not yet received.

External Characters, Configuration, and Proportions.—Pigeon-holing systematists have devoted most of their attention to this aspect of the gorilla, so that a great part of literature is devoted to these more superficial and accessible characters. Very good figures of the gorilla are given by Hartmann (40), by Wolff (*Proc. Zool. Soc.*, 1877), Bolau (10), Chapman (13), Deniker (17), Du Chaillu (21), Falkenstein (25), Lenz (53), Meyer (58), and Owen (66). The ear has been figured by Deniker, Ehlers, Bischoff, Hartmann, Owen, Lenz, and Bolau. The hands and feet have been dealt with by Hepburn (46), Chapman, Hartmann, Deniker, Bolau, Owen, Huxley (49*a*), Lucae (54), and Hermes. There was a silly question once raised whether the lower extremities were furnished with hands or feet; an index to the literature on the question is obtainable from Huxley's and Lucae's articles. The hair and its changes with age, as well as the pigment of the skin, and the method of its appearance and manner in which it is deposited and spread over the body, require some more observation, notwithstanding the elaborate descriptions of Lenz (53), Alix (2), Bischoff (7), Bolau (10), Chapman (13), Deniker (17), Du Chaillu (21), Ehlers (23), Famelart (26), Hartmann (40), Hermes (47), Meyer (58), Owen (66), Savage (71), and Wyman (87). Measurements are given by Bischoff, Hartmann, Bolau, Hermes, Deniker, Meyer, Owen, Chapman, Huxley (49*a*), and many others, but the subject and records are both alike unsatisfactory.

Psychology.—The intellectual and emotional characters of the gorilla have not been studied so much as even the few opportunities have allowed. Hermes gives the best description of its habits in captivity, and our knowledge of its habits in its native haunts is due for the most part to Du Chaillu. For the great amount of material, and the knowledge of the gorilla which he brought home, Du Chaillu had little in return but malaria, quinine, and scientific abuse, so that we need hardly be astonished that he has not pursued the subject further. The best *resumé* of the habits of the gorilla is still that by Huxley (49*a*), although further information may be picked from the accounts of Falkenstein (25), Famelart (26), Franquet (30), Ford (29), Hartmann (43), Laboullay (51), de Langle (52), Reade (68), Reading (69), Savage (71), and Walker (86).

Distribution.—The gorilla is confined to the French and German territories north of the Congo: *see* Hartmann (43), Savage (71), Reade (68), Reading (69), Ford (29), St. Hilaire (72), and Famelart (26). The extent of its distribution eastwards is unknown.

Classification.—Of all the literature on the gorilla this part of it is most marked by incompetence and prejudice. Luckily, Savage, the scientific discoverer of the gorilla, had Wyman to advise him, and they named it *Troglodytes gorilla*—regarding it as a large, sensual and ferocious form of chimpanzee. That seems to me the true and permanent scientific name and estimation of the gorilla. Duvernoy, however, called it *Gorilla tschego*, Is. Geof. St. Hilaire gave the name *Gorilla gina*, and now we have seen over the gorilla's cage at the Zoological Gardens the name *Anthropopithecus gorilla*; who the sponsor is for this appellation, we do not know. The close relationship that exists between the gorilla and the chimpanzee came out very clearly in the famous dispute over "Mafuca." Mafuca was an animal in the Dresden Gardens labelled chimpanzee; Nissle (63) saw her and said she was a gorilla; Meyer, of Dresden, maintained she was a chimpanzee; Hartmann came from Berlin and declared her to be a gorilla; Bolau came from Hamburg and certified her to be a chimpanzee. The difference between the gorilla and the chimpanzee cannot be so very great when four such authorities cannot make up their minds in common. Koppenfels (59) accounted for the difficulty of distinguishing between the two by alleging that hybrids occur (a fact which I should not be astonished to find substantiated), and sent a skin and skull of such a supposed hybrid home from Africa to Meyer, who, however, did not agree that it was a hybrid. Local varieties will probably be found to occur; such seem to be the specimens described by Alix and Bouvier (2) under the name of *Gorilla mayema*. There may be distinct species of gorilla; but the specific characters ascribed by Alix and Bouvier to *Gorilla mayema* may be due to age, sex, individual, or local peculiarities of the two specimens described by them. At any rate, *G. mayema* cannot be accepted as a true species until it has been shown that the animals which possess its characters live, socially and sexually, apart from the common form of gorilla.

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2. **Alix, E., et Bouvier, A.**—"Sur un nouveau Anthropoide (*Gorilla Mayêma*) provenant de la région du Congo." *Bull. Soc. Zool. France*, 1877. t. ii., pp. 488–490. From an examination of a young female animal and the skin and skeleton of an adult female, they came to the conclusion that there were at least two species of gorillas—this one, *Gorilla mayema*, and the more common one, *G. gina* of I. G. St. Hilaire. Abstract in *Compt. Rend.*, 1878, t. lxxxvi. pp. 56–58.

3. **Bischoff, T. L. W.**—"Ueber die Verschiedenheit in der Schaedelbildung des Gorilla, Chimpanse und Orang, vorzüglich nach Geschlecht und Alter." München: 1867. 4to, 94 pp., 22. pls. The skulls of two old male, three old female, and three young animals are partially described.

4. ————————.—"Uber das Gehirn eines Gorilla und die untere oder dritte Stirnwindung des Affen." *SB. Math.-Phys. Cl. Ak. Wiss. München*, 1877. Bd. vii., pp. 96–139, 6 figs. Pansch and Thane describe the same brain.

5. ————————.—"Das Gorilla-Gehirn und die untere oder dritte Stirnwindung." *Morph. Jahrb.*, 1878. Bd. iv. Suppl., pp. 59–73. An argumentative article, the author being in doubts as to the brain described by Broca having really been a gorilla's brain.

6. ————————.—"Ueber die äusseren weiblichen Geschlechts-und Begattungs-Organe des Menschen und der Affen, etc." *Abh. Math.-Phys. Cl. Ak. Wiss. München*, 1880. Bd. xiii., Abth. ii., pp. 209–274. Three young gorillas were examined.

7. **Bischoff, T. L. W.**—"Beiträge zur Anatomie des Gorilla." *Tom. cit.*, 1880. Abth. iii., pp. 1–48. Figs. of tongue, palate, larynx, heart, and abdominal organs are given. He used the body of a young female animal in a rather inferior state of preservation. This treatise is also published separately.

8. ———————.—"Ueber Brachycephalie und Brachyencephalie des Gorilla und der anderen Affen." *SB. Math.-Phys. Cl. Ak. Wiss. München*, 1881. Bd. xi., pp. 379-390, 2 figs.

9. ———————.—"Die dritte oder untere Stirnwindung und die innere obere Scheitelbogenwindung des Gorilla." *Morph. Jahrb.*, 1882. Bd. vii., pp. 312–322. (The author had the use of five gorilla brains—all that were in Germany at that time.)

10. **Bolau, H.**—"Die Menschenähnlichen Affen des Hamburger Museums." *Abh. aus dem Gebiete der Naturwiss. Hamburg-Altona*, 1876. Bd. vi., Festgabe pp. 61–90, 2 photo-plates. Bolau gives a description of the external characters and abdominal and genital organs of three animals, sent home from the Gaboon region in spirit. (See Pansch, 67.)

11. **Broca, Paul.**—"Etude sur le Cerveau du Gorille." *Revue d'Anthrop.*, 1878. Ser. 2, t. i., pp. 1–46, plates i.–iii. The brain was not in a good state of preservation, yet this is one of the best descriptions given. It was the brain of an adult male animal.

12. **Broesike.**—"Ueber die Krankheiten und Todesursache des Gorilla Mpungu." *SB. Ges. Naturforsch. Freunde Berlin*, 1877. Pp. 262–267. A post-mortem inspection of Falkenstein's Gorilla.

13. **Chapman, H. C.**—"On the Structure of the Gorilla." *Proc. Ac. Nat. Sci. Philadelphia*, 1878. Pp. 385–394. Gives figures of the face, head, hands, feet, and deep muscles of the sole. Dissection of a young male animal sent home in spirit.

14. ———————.—"Observations upon the Brain of the Gorilla." *Op. cit.*, 1892. Pp. 203–212. Gives 4 figs. A young brain sent to him in spirit by a missionary in the Gaboon.

15. **Chudzinski, T.**—"Note sur le Foie d'un jeune Gorille mâle, etc." *Bull. Soc. Anthrop. Paris*, 1884. Ser. 3, t. vii., pp. 608–616, 2 figs. See also p. 743 for note on this by Deniker.

16. ———————.—"Sur les Muscles peaussiers du Crâne et de la Face observés sur un jeune Gorille mâle." *Bull. Soc. Anthrop. Paris*, 1885. Ser. 3, t. viii., pp. 583–586.

16*a*. **Deniker, J.**—"Sur un fœtus de Gorille." *Compt. Rend. Ac. Paris*, 1884, t. xcviii. pp. 753–756.

17. ———————.—"Recherches Anatomiques et Embryologiques sur les Singes Anthropoides." *Arch. Zool. Exper.*, 1885. Ser. ii., t. iii. bis., Mém. 3, pp. 265, 8 pls. Published separately at Poitiers, 1886. Profuse illustrations of brain, skull, skeleton, viscera, and external characters. Deniker's is the best work upon the gorilla; he describes very minutely the anatomy of a fœtal animal, and used evidently the same fœtus in his description in *Bull. Soc. Anthrop. Paris*, 1884. Ser. 3, t. vii., pp. 447–451. He used the body of an adult gorilla for comparison during his dissection.

18. ———————.—"Sur le developpement du crâne chez le Gorille." *Bull. Soc. Anthrop. Paris*, 1885. Pp. 703–714.

19. **Deniker et Boulart.**—"Note sur les sacs laryngiens des Singes Anthropoides." *Journ. Anat. et Physiol.*, 1886. Vol. xxii., pp. 51–62, pls. iii.–iv.

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21. **Du Chaillu, P. B.**—"Explorations and Adventures in Equatorial Africa, etc." London: 1861. 8vo, xviii. and 479 pp., 27 pls. "A Journey to Ashango Land, etc." London: 1867. 8vo, xxiv. and 501 pp., 22 pls.

22. **Duvernoy, G. L.**—"Des Caractères anatomiques des grands Singes." *Arch. Mus. Hist. Nat. Paris,* 1855–56. t. viii., pp. 1–248. Three memoirs are given; (1) upon the skeleton, (2) upon the comparative anatomy of the great apes, and (3) a description of parts of the anatomy of an adult male gorilla and a young female animal.

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24. **Eisler, P.**—"Das Gefäss- und periphere Nerven-system des Gorilla, etc." Halle: 1890. 4to, 78 pp., 9 pls. Excepting Deniker's, this is the only description of the arteries and nerves of the gorilla in existence. Two gorillas were dissected.

25. **Falkenstein, J.**—"Ein lebender Gorilla." *Zeitschr. Ethnol.,* 1876. Bd. viii., pp. 60, 61, pl. ii. "Die Loango-Küste." Berlin: 1876. A photograph of his gorilla is given. Also "Die Loango-Expedition." Abth. ii., Leipzig, 1879.

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27. **Féré, C.**—"Deuxième note sur la Topographie cranio-cérébrale chez les Singes." *Journ. Anat. et Physiol.,* 1885. t. xxi., pp. 298–303. Gives outline of a gorilla brain.

28. **Flower, W. H.**—"The Organs of Digestion of the Mammalia." *Med. Times and Gaz.,* 1872. Feb. 24–Dec. 14. For gorilla see under March 23. Huxley and he base their descriptions upon the viscera of the same individual.

29. **Ford, H. A.**—"On the characteristics of the Troglodytes Gorilla." *Proc. Ac. Nat. Sc. Philadelphia,* 1852. Vol. vi., pp. 30–33. A note accompanying a skeleton sent from Glasstown, Gaboon River.

30. **Franquet, E.**—Appendix to St.-Hilaire (72). Pp. 91–97. External characters, habits, etc.

31. **Giglioli, E. H.**—"Studii Craniologici sui Cimpanze." *Ann. Mus. Civ. di Storia Nat. Genova,* 1872. Vol. iii., pp. 56–179, 2 pls. He employed three gorilla skulls for comparative purposes.

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33. **Halford, G. B.**—"'Lines of Demarcation' between Man, Gorilla, and Macaque." Melbourne: 1864. 4to, 21 pp. A purely polemical article.

34. —————.—"On the Skeleton of the Gorilla." *Trans. and Proc. R. Soc. Victoria,* 1866. Vol. vii., pp. 34–49. Male and Female in Nat. Mus., Melbourne.

35. **Hamy, E. T.**—"De l'épine nasale antérieure dans l'ordre des Primates." *Bull. Soc. Anthrop. Paris,* 1869. Ser. 2, t. iv., pp. 13–28.

36. **Hartmann, R.**—"Beiträge zur . . . Kenntniss der Sogennanten Anthropomorphen Affen." *Archiv. Anat. und Physiol. Leipzig,* 1872. Pp. 107–152. Historical, Ext. Charact., etc. 1875, pp. 265–303, pp. 723–744, Osteology. 1876, pp. 636–661, Bones of extremities.

37. —————.—"Ueber neues die anthropomorphen Affen betreffendes Material." *SB. Ges. Nat. Freunde Berlin,* 1876. Pp. 22–26.

38. —————.—"Beiträge zur Kenntniss der sogenannten anthropomorphen Affen, iv., v." *Zeitschr. Ethnol.,* 1876. Bd. viii., pp. 130–133; 1877, Bd. ix., pp. 117–128.

39. —————.—"Ueber das Hüftgelenk der Anthropoiden Affen." *SB. Ges. Nat. Freunde Berlin,* 1877. Pp. 85–89.

40. —————.—"Der Gorilla, etc." Leipzig: 1880. 4to, pp. 160. 84 figs of 28 skulls are given, with very good coloured illustrations and photographs of the external characters of the gorilla.

41. **Hartmann, R.**—"Ueber den Torus occipitalis transversis, etc." *SB. Ges. Nat. Freunde Berlin*, 1880. Pp. 159–162. A critical article.

42. ————.—"Ueber die Weiblichen Geschlechtstheile der Anthropoiden Affen und die Brunst der Affen im Allgemeinen." *Verh. Berl. Ges. Anthrop.* in *Zeitschr. Ethnol.*, 1886. Bd. xviii., pp. 431–433.

43. ————.—"Anthropoid Apes." Internat. Sci. Ser., London, 8vo, 1885, viii. and 326 pp. This volume contains all Hartmann's general results; a very good *resumé* of the literature on apes is given. Hartmann's work is of very little use for future purposes, owing to the fact that he deals only in general statements, and never gives a list of the material on which these statements are based.

44. **Heckel, Ed.**—"Etude sur le Gorille du Musée de Brest." *Revue d'Anthrop.*, 1876, t. v., pp. 1–20, pl. i.

45. **Hepburn, David.**—"The Comparative Anatomy of the Muscles and Nerves of the Superior and Inferior Extremities of the Anthropoid Apes." *Journ. Anat. and Physiol.*, 1892. Vol. xxvi., pp. 149–186, pl. iii., and pp. 324–356, pl. ix.

46. ————.—"The Integumentary Grooves on the Palm of the Hand and Sole of the Foot of Man and the Anthropoid Apes." *Op. cit.*, 1893, vol. xxvii., pp. 112–130. Numerous figures are given.

47. **Hermes, O.**—"Aus dem Gefangleben des Gorilla." *Zeitschr. Ethnol.* Berlin: 1892. Bd. xxiv., p. 576–582.

48. **Hervé, G.**—"Le Circonvolution de Broca chez les Primates." *Bull. Soc. Anthrop. Paris*, 1888. Pp. 275–314.

49. ————.—"Crâne du Jeune Gorille." *Op. cit.*, 1893. Pp. 387–389.

49*a*. **Huxley, T. H.**—"Evidence as to Man's Place in Nature." London: 1863. 8vo.

49*b*. ————.—"The Structure and Classification of the Mammalia." *Med. Times and Gaz.*, 1864, Feb. and March.

50. **Kneeland, S.**—"On the Skeleton of the Great Chimpanzee, *Troglodytes gorilla*." *Boston Journ. Nat. Hist.*, 1853. Vol. vi., pp. 336–347. Description of the skeleton of an adult male gorilla.

51. **Laboullay, G.**—Appendix to St.-Hilaire (72), pp. 83–91. Habits and proportions.

52. **Langle, F. de.**—"Mœurs d'un jeune Gorille." *Compt. Rend. Ac. Paris*, 1866. t. lxiii., p. 739.

53. **Lenz, H. W. C.**—"Die Anthropomorphen Affen des Lübecker Museums." Lubeck: 1876. 4to, 20 pp. Numerous photographs of museum specimens are given.

54. **Lucae, J. C. G.**—"Die Hand und der Fuss." *Abhand. Senckenbergisch. Naturf. Ges. Frankfurt*, 1865. Bd. v., pp. 275–332, 4 pls.

55. **Macalister, A.**—"Muscular Anatomy of the Gorilla." *Proc. Roy. Irish Acad., Science*, 1873. Ser. 2, vol. i., pp. 501–506. Only some of the muscles were noted; figures of the ligaments of the shoulder joint, pronator radii teres and short muscles of the hand are given. The body of a young female animal was used.

56. **Magitot, E.**—"L'Homme et les Singes Anthropomorphes." *Bull. Soc. Anthrop. Paris*, 1869. Ser. ii., t. iv., pp. 113–145. Deals with the teeth of the gorilla in part of the article.

57. ————.—"Traité des Anomalies du Système Dentaire, etc." Paris: 4to, 1877, iv. and 303 pp., 20 pls.

58. **Meyer, A. B.**—"Notizen über die Anthropomorphen Affen des Dresdener Museums." *Mitth. Zool. Mus. Dresden*, 1877. Pp. 223–247, 13 pls.

59. ————.—"Ein angeblicher Bastard zwischen Gorilla und Chimpanse." *Zoolog. Garten.*, 1881. Bd. xxii., pp. 231–236. Von Koppenfels' supposed hybrid.

60. **Milne-Edwards.**—"Sur l'existence d'un Gorille à la Ménagerie du Muséum d'Histoire Naturelle." *Compt. Rend. Ac. Paris*, 1884. t. xcviii., pp. 959–960. The first living gorilla in France.

61. **Mivart, St. George.**—"On the Appendicular Skeleton of the Primates." *Phil. Trans.*, 1867. Vol. clvii., pp. 299–429, pls. xi.–xiv.

61*a*. ————————.—"Contributions towards . . . Knowledge of the Axial Skeleton in the Primates." *Proc. Zool. Soc. London*, 1865. Pp. 545–592.

62. **Moeller, J.**—Beiträge zur Kenntniss des Anthropoid-gehirns." Berlin: 1891. 4to, 17 pp., 2 pls. (Moeller appears to have had access to fresh material, but as yet I have not seen his book.)

63. **Nissle, C.**—"Beiträge zur Kenntniss der sogenannten anthropomorphen Affen, III. 'Mafuca'—ein Gorilla." *Verh. Ges. Anthrop. Berlin* in *Zeitschr. Ethnol.*, 1876. Bd. viii., pp. 46–60.

64. **Owen, R.**—"On a New Species of Chimpanzee." *Proc. Zool. Soc. London*, 1848. Pp. 27–35. (Founded upon three skulls sent to him by Savage).

64*a*. ————.—"On the Gorilla (*Troglodytes gorilla*, Sav.)." *Op. cit.* 1859, pp. 1–23, characteristics and distribution of gorilla.

65. ————.—"Osteological Contributions to the Natural History of the Chimpanzees, etc." *Trans. Zool. Soc. London*, 1849, vol. iii., pp., 381–422, pls. lviii.–lxiii.: description of the skull of *Troglodytes gorilla* discovered by Savage. 1853, vol. iv., pp. 75–88, pls. xxvi.–xxx.: cranium of adult male from R. Danger, W. Africa. 1853 (?), vol. iv., pp. 89–115, pls. xxxi.–xxxvi.: jaws and vertebral column. 1862, vol. v., pp. 1–31, pls. i.–xiii.: bones of extremities. 1865, vol. v., pp. 243–284, pls. xliii.–xlix.: external characters.

66. ————.—"Memoir on the Gorilla." London: 1865. 4to. The description of the soft parts is based upon a young animal sent home in spirit and not in a good state of preservation. The external characters are described from three skins. The memoir contains the substance of Owen's articles in the *Transactions* of the Zoological Society for 1849,–53,–57,–62.

67. **Pansch, A.**—"Ueber die Furchen und Windungen am Gehirn eines Gorilla." Part of Bolau (10), pp. 84–90.

68. **Reade, W. W.**—"The Habits of the Gorilla." *Amer. Nat.*, 1867, vol. i., pp. 177–180. Popular note.

69. **Reading, J. H.**—"Habits [and Distribution] of the Gorilla." *Amer. Nat.*, 1884, xviii., pp. 1,277 and 1,278.

69*a*. **Rex, H.**—"Ein Beitrag zur Kenntnis der Muskulatur der Mundspalte der Affen." *Morph. Jahrb.*, 1887. Bd. xii., pp. 275–286, pl. xvii.

70. **Ruge, G.**—"Untersuchungen über die Gesichtsmuskeln der Primaten." Leipzig, 1877, fol., pp. 130, 62 figs. Supplementary to that work is an article specially devoted to the facial muscles of the gorilla in *Morph. Jahrb.*, 1887. Bd. xii., pp. 459–529, pl. xxiv.

71. **Savage, T. S.**—"Notice of the External Characters and Habits of Troglodytes Gorilla, a new species of Orang from the Gaboon River; Osteology of the same, by J. Wyman." *Boston Journ. Nat. Hist.*, 1847. Vol. v., pp. 417–443, 4 pls. of skulls. This (or rather, the short abstract in *Proc. Boston Soc. N.H.*, vol. ii., pp. 245–247, published Aug., 1847) is the first notice of the gorilla in scientific literature. A review appeared in *Amer. Journ. Sci. and Art*, 1849, 2nd series, vol. viii., p. 141.

72. **St. Hilaire, I. G.**—"Description des Mammifères Nouveaux, etc." *Arch. Mus. Hist. Nat.*, 1858–61, t. x., pp. 1–102. Including appendices by Franquet and Laboullay, q.v. He had six more or less complete animals to found his conclusions on. He names the gorilla—*Gorilla gina*.

73. **Slack, J. H.**—"Mammalogical Notices." *Proc. Ac. Nat. Sci. Philadelphia*, 1867, pp. 34–38. Some measurements of a gorilla skeleton.

74. **Struthers, John.**—"On the Articular Processes of the Vertebræ in the Gorilla, etc." *Journ. Anat. and Physiol.*, 1893. New ser., vol. vii., pp. 131–138. Deductions are drawn from an examination of twenty adult skeletons.

75. **Swayne, S. H.**—"Comparative Measurements of the Skeleton of Man and the Gorilla" *Proc. Bristol Nat. Soc.*, 1868, vol iii, pp. 39–41. Skeleton in the Bristol Museum.

76. **Symington, J.**—"Observations on the Myology of the Gorilla and Chimpanzee." *Rep. Brit. Assoc.*, 1889. London, 1890. Pp. 629 and 630.

77. ————.—"The Vertebral Column of a Young Gorilla." *Journ. Anat. and Physiol.*, Oct., 1889. New series, vol. iv., pp. 42–51. Two figs.

78. **Thane, G. D.**—"The Brain of the Gorilla." *Nature*, 1876, Dec., vol. xv., pp. 142–144. On the description by Pansch.

79. **Thomson, W.**—"*The Transversalis Pedis in the Foot of the Gorilla.*" *Austral. Med. Journ.*, Melbourne, 1864, vol. ix., pp. 15–24. The writer had never examined the foot of a gorilla.

80. **Török, A. von.**—"Sur le Crâne du jeune Gorille du Musée Broca." *Bull. Soc. Anthrop. Paris*, 1881, ser. 3, t. iv., pp. 46–57.

81. ————.—"Ueber den Schaedel eines jungen Gorilla. Zur Metamorphose des Gorillaschaedels." *Month. Internat. Journ. Anat. and Physiol.*, 1887, vol. iv., pp 137–176, 227–274; pls. iv–vi. For his "Neuere Beiträge zur Reform der Kraniologie" *see* vols. x., xi., and xii. (1893—94–95) of the same journal.

82. **Topinard, P.**—"De l'Evolution des Molaires et des Prémolaires chez les Primates, etc." *L'Anthropologie*, 1892, t. iii., pp. 641–710. Many figures are given.

83. **Turner, W., & Burt.**—"Exhibition of Three Skulls of the Gorilla, received from M. du Chaillu, etc." *Proc. Roy. Soc. Edinburgh*, 1865, vol. v., pp. 341–350.

84. **Virchow, R.**—"Ueber den Schaedel des jungen Gorilla." *Monatsber. Akad. Wiss. Berlin*, 1880, pp. 516–543, 8 figs.; also *SB. Akad. Wiss. Berlin*, 1882, pp. 671–678. Deals with the characters of three skulls of young animals.

85. **Waldeyer, W.**—"Das Gorilla-Rückenmark." *Abh. Akad. Wiss. Berlin*, 1888, art. 3, 147 pp., 12 pls., published 1889.

86. **Walker, R. B. N.**—Report of Meeting. *Proc. Lit. Phil. Soc. Liverpool*, 1866. No. xix., pp. 224–229. Remarks on skeleton presented by him to Liverpool Museum.

87. **Wyman, J.**—"Report on the Cranium of the Engéena (*Troglodytes gorilla*) . . . presented to the Society by G. A. Perkins; also on that belonging to the Essex County N. H. Soc." *Proc. Boston Soc. N. H.*, 1850, vol. iii., p. 179.

87*a*. ————.—"Observations on the Cranium of a young Gorilla." *Proc. Boston Soc. N. H.*, 1863, vol. ix., p. 203.

87*b*. ————.—"On the Skeleton of a Hottentot." *Tom. cit*, 1865, pp. 352–357. Measurements of pelvis and limb-bones. See also under Savage (71).

ARTHUR KEITH.

III.

The Lobster in Commerce and Science: its Name and Nature.[1]

LOBSTERS also are cannibals. Especially are the larval forms weak in moral sense. They prefer to feed on one another, it is said, even when suitable food of a different kind is offered them. The adults think nothing of chopping asunder a defenceless brother, neither have they any objection to filling their stomachs with lobster eggs. All this is not for want of outside enemies. As Dr. Herrick puts it, "Every predaceous fish which feeds upon the bottom may be an enemy of the lobster. The cod is one of the most destructive to small lobsters, after the larval stages are past." But, in truth, the origin of Dr. Herrick's interesting and finely illustrated volume is due to the fact that the lobster has another and more dangerous enemy than any fish, however predaceous. Its chief peril lies in that combination of cleverness and stupidity which man so often exhibits in meddling with other races. He is always clever enough to conquer, not always skilful enough to preserve. A fisherman was asked to explain where the marriageable maidens would be found if all the young girls in the world were perpetually destroyed. He thought the question not to the purpose, because a human mother does not bring forth on an average eleven children, whereas the lobster mother on an average bears eleven thousand. Some crustaceans produce eleven hundred thousand eggs, or many more. Whatever the number produced, an average of two or three of the offspring surviving to maturity suffices to maintain the numbers of any given species. It might seem almost needless to take precautions for saving so small a proportion of the whole yield of lobster spawn. Dr. Herrick and others who have studied the subject most closely are far from thinking so. Though there may be little reason to fear the extermination of a creature so prolific, it may be very easy to worry or scare it away from those regions where its presence is most desirable, and by sheer carelessness and want of thrift to destroy a valuable source of food-

[1] "The American Lobster: a Study of its Habits and Development." By Francis Hobart Herrick, Professor of Zoology in Adelbert College of Western Reserve University. Being Article I., extracted from *Bull. U.S. Fish Comm.* for 1895. Pp. 1–282, plates A.–J., and 1–54. Washington: Government Printing Office, 1895.

supply. The females carrying the extruded eggs on their swimmerets are rather ludicrously spoken of as 'berried hens.' The sale of these has sometimes been prohibited for short portions of the year. Recently, however, it has been ascertained that the eggs are thus carried for many months, with the result that a prohibition of bringing 'berried hens' to market at any time is now recommended. Regulations can rarely be made perfectly logical. Under that proposed, a lobster with the 'coral' still in its ovaries would be saleable, although it is as much the potential mother of millions as one with the eggs already extruded. But rules too stringent might destroy the industry they are intended to foster, while within due limits they may at least have an educational value.

To repair the ravages of waste, the artificial hatching of lobster-spawn is now being carried out with increasing success. Dr. Herrick's laborious and prolonged investigations enable him to give a fuller account than has hitherto been presented of the numerous moults and larval stages which intervene between the birth of the lobster and its adult condition. During the first three stages the larva is a 'schizopod,' the schism of the feet from which this title is derived supplying it with half-a-dozen pairs of double-branched appendages of the trunk. In these, one branch is adapted for swimming, the other is prepared for walking or grasping. Only in the fourth stage do the swimming-branches practically disappear, when the swimming-apparatus of the abdomen or tail is ready at length to take up the function which the trunk now lays down. The early forms, with their translucent cuticle, have means and opportunity of displaying changeful and agreeable colours. Later on, when the animal is an inch or more in length and the shell no longer transparent, there are brilliant hues of green and brown, and blue and white, due wholly to the pigments of the shell, and no longer, as at an earlier period, in part to the colouring of the internal organs. Among the adults, "occasionally red living lobsters are seen," though they are rarely as bright as those which have been boiled.

From a careful weighing of the evidence in regard to the size attained by lobsters, Dr. Herrick estimates that the greatest weight is about twenty-five pounds. At the price not uncommonly asked in England of a shilling a pound, a specimen of that weight would be expensive, though forty years ago, at Grand Manan, in the United States, it might have been had for a penny. The largest number of eggs carried by a female is supposed to approach, without quite reaching, a hundred thousand, about a pound weight of 'berries.' A female stripped of her eggs is likely to weigh less, it is said, than a female of the same length that has had no eggs of which to be stripped.

The differences between the European and American lobster are not considerable. Among them it may be noted that on the average the American is the larger, and that it has teeth on the underside of the rostrum; these are wanting in the European species. As to the names, Dr. Herrick is not entirely consistent throughout his volume, having probably written the bulk of it before he engaged in that discussion of nomenclature which appears on the eighth and ninth pages. On this point the remarks of Mr. J. T. Cunningham in the May number of NATURAL SCIENCE are very opportune, for he illustrates them from the two species here in question. In dealing with synonyms, Mr. Cunningham recommends us to "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." He does not explain what is to be done if one finds the most correct description under one synonym and the most correct classification under another. There is the same ambiguity in his appeal to "the latest and best authorities," since by the very references he gives he intimates (in a very gentle manner) that the latest authorities are sometimes not the best. The name *Homarus vulgaris* was given to the European lobster by Henri Milne-Edwards in 1837. The name *Astacus gammarus* was given to it in 1819 by Leach, who took over its specific designation from Linnæus. Dr. Herrick has persuaded himself to call it *Homarus gammarus* (Linn.), not in the least because he shares Mr. Cunningham's principles of nomenclature, which "would lead to mere anarchy and chaos,"[1] but from an accidental misapprehension of the authorities concerned. He says that "Latreille, in 1810, designated as the type of the old genus *Astacus* the species *A. fluviatilis* Fabricius (=*Cancer astacus* Linné), which is the European crayfish. In 1815 Leach began to dismember this genus by giving to the Norwegian lobster the name *Nephrops*. Later, in 1819, he proposed the generic term *Potamobius*[2] to embrace the true crayfishes, leaving the lobster alone in possession of the Aristotelian name." It is unnecessary to quote the whole of the long paragraph. It ends by saying that "Stebbing, apparently unaware of Latreille's restriction, proposed to restore the old terminology of Leach." Latreille's book, "Considérations générales, etc.," 1810, far from being overlooked, had, in fact, caused me some anxiety, though only for a moment. So far as *Astacus* is concerned it added nothing to previous knowledge, and in the "Table des Genres avec l'indication de l'espèce qui leur sert de type," it may fairly be argued that "*Astacus fluviatilis*, Fab.," is given not as *the* type, but merely as *a* type, an example, a specimen of the genus, the handiest one for a Parisian reader to recognise. But, if it be insisted that Latreille here intended to set up the crayfish as technically type of the genus, in preference to the lobster, of which his book makes no mention, the answer is simple.

[1] *See* Editorial Note, p. 302.

[2] Not *Potamobia*, as I supposed, until the well-informed American carcinologist Miss Mary J. Rathbun, called my attention to the inaccuracy.

His intention was inoperative, because he had been forestalled by an earlier writer. J. C. Fabricius, in his various writings, of which it will be sufficient to cite the "Species Insectorum," 1781, and the "Entomologia Systematica," 1793, consistently places *Astacus marinus* (*Cancer gammarus*, Linn.) as the first species of the genus *Astacus*, giving to *A. fluviatilis* invariably the second place. There can therefore be no reasonable gainsaying that he made the European lobster, and not the river crayfish, the type. From this it follows, in accordance with explanations given as well by Dr. Herrick as myself, and recently accepted by Dr. Arnold Ortmann, that the generic name of the lobster is properly *Astacus*, and that of the European crayfish *Potamobius*.

Dr. Herrick discusses very fully the structure and growth of the lobster's shell, and the manner of its exuviation. He controverts a prevalent opinion that the carapace is ruptured along the middle line to assist the process. "There is normally no rupturing of the shell in any part in the course of the molt. The entire exoskeleton, with the linings of the œsophagus, stomach, and intestine, comes off as a whole, and the animal leaves it by drawing the anterior parts of the body backward, and the abdomen and its appendages forward, through an opening made by the elevation of the carapace." A foot-note explains that the lining of the alimentary tract is, of course, ruptured. Also, though the carapace remains unbroken, it is made more pliable during the preparation for the moult by the absorption of the lime salts of the shell along the median line and other areas. The most surprising part of the process is the extraction of the gigantic muscles of the large claw through the narrow joints of the arm. They have to undergo distention and compression to an extraordinary degree. Their passage is compared to the drawing of a wire through the contracting holes of a draw-plate. "The muscles appear to be stretched out like a stick of candy, but, apart from their elasticity, they are probably aided in accomplishing this by the removal of water from the blood. The parts are very much distorted immediately after they are free, and are quite hard, but they soon take up water and assume their natural form, with a proportional increase in size."

Of the gastroliths Dr. Herrick says that they, "though often called crab's eyes, are found only in the crayfish and lobster, so far as known." This is probably said in forgetfulness of the account given by Patrick Browne of their occurrence in the land-crabs of Jamaica. Dr. Herrick carefully discusses their origin, structure, and use. After considering most of what has been written on the subject, he deems it likely "that the gastroliths in the lobster represent the lime which has been removed by absorption from the old shell preparatory to the molt, as well as, possibly, a small amount which may have entered the blood from the food during the molting period." Such a theory of their origin may, perhaps, dispense with any further explanation of their use. They can be regarded as waste products which in this way are most conveniently eliminated from the body. In opposition to a commonly received view, that they assist in supplying lime for the formation or hardening of the new shell, it is pointed out that the proportion they bear to the whole exoskeleton is so trifling that they cannot be of any practical service in providing calcareous matter for it. None the less, the position of the gastroliths is so peculiar that they are not easily thought of as mere offscourings. One lies on each side of the stomach in a pocket formed between the old cuticle which is about to be shed and the new one which is to take its place. Had they no purpose to serve but that of throwing off superfluous matter, one would expect them to be cast out along with the old lining of the stomach. But this is not the case, and it may therefore be conjectured that in the first instance they give support to the weak and soft new lining, and that, when presently their prismatic structure breaks up and falls into the cavity of the stomach, they then help to fill for a time what would otherwise be an aching void. The 'soft lobster,' after the exertion of shedding its tunic, may soon begin to feel hungry, and yet the feeding upon miscellaneous prey would not be without its serious perils when the stomach is just recovering from the delicate task of exuviation.

Without going into further details, it may be said in conclusion that, after a complete study of Dr. Herrick's volume, the reader will probably be disposed to regard its writer as "the latest and best authority" on the American Lobster.

Thomas R. R. Stebbing.

IV.

The Dewey Decimal Classification and the International Catalogue of Science.

THE rapid increase in the growth of scientific literature, and the consequent need for a systematic bibliography, have given rise to many schemes, more or less extensive, for keeping scientific workers informed, with as little delay as possible, of the publication of books and memoirs in their special departments. The history of works of this kind shows a gradual evolution, with ever increasing adaptation to the environment as regards completeness, classification, and rapidity of publication. To take an illustration from that branch of science with which I am most familiar:—The "Bibliotheca Historico-naturalis" of Engelmann, published in 1846, was succeeded, in 1861, by the "Bibliotheca Zoologica" of Carus and Engelmann. Then followed, in 1864, the *Zoological Record*, published annually, whilst in 1878 the fortnightly issue of the *Zoologischer Anzeiger* of Carus began, and is now continued with somewhat modified organisation in conjunction with the zoological bureau of Dr. H. H. Field.

In the case of a bibliography which is issued in sections, one of the most urgent needs is the classification of the titles, so that students may readily select the references which concern them; and of practical devices for securing this end, the use of a scheme with numbered divisions seems to have been generally approved. The advantages of such a system are obvious: when the list of classes has once been drawn up and the numbers affixed to them, the latter do duty for the headings of the former (*e.g.*, 595 may stand for *Arthropoda* or 853 for *Italian fiction*), with great advantage as regards brevity. Furthermore, a series of slips or titles, if arranged numerically, are thereby put in systematic order. Thirdly, the numbers with which one is habitually working become fixed in the memory and thus facilitate the looking up of references and the arrangement of facts and materials of all kinds; whilst, lastly, the ease of cross-reference is greatly increased. Hitherto the scheme based on these principles which has been most widely used, is undoubtedly the "Decimal Classification" of Melvill Dewey, and its adoption in the pages of this Journal, in those of the *Revue scientifique*, and of the *Zoologischer Anzeiger*, as well as some dozen other periodicals less connected with natural science, renders it appropriate to devote a little space to its exposition. This is the more needful as those who see the numbers for the first time, and who lack the patience or leisure to acquire a grasp of the system on which they are based, are very apt to be prejudiced against it, condemning it unheard as an artificial and cumbrous device.

The system consists in dividing the subjects on which books have been written into classes and fixing a number to each. There are ten main divisions; each of these is subdivided into ten, and each of these once more into ten, so that 1,000 so-called "sections" are formed. The "Natural Sciences" (in the wide sense of the term) occupy the sections, 500–599, whilst "Zoology" extends from 590 to 599, the several class-numbers being allocated thus:—

590. General Zoology.
591. Anatomy and Physiology.
592. Invertebrata.
593. Protozoa, Porifera, Coelenterata.
594. Mollusca, Brachiopoda, Bryozoa, Tunicata.
595. Articulata.
596. Vertebrata.
597. Pisces, Amphibia (Ichthyopsida).
598. Reptilia, Aves (Sauropsida).
599. Mammalia.

By the use of decimals, these sections are further divided into sub-sections to any degree of minuteness which may be desired; for instance, 595.3 is "Crustacea," subdivided thus:—

595.31 Entomostraca.
.32 Phyllopoda.
.33 Ostracoda.
.34 Copepoda.
.35 Cirripedia.
.36 Malacostraca.
.37 Arthrostraca.
.38 Thoracostraca.
.39 Gigantostraca.

By the mere addition of decimal places, any one of these may be divided and subdivided again, if at any time that be deemed desirable. The insertion of the decimal point makes the proper order of the divisions clear, and also makes it more easy for the eye to catch the main class-number. There is no profound mystery in this use of the decimal; it is nothing more than a practical convenience.

In order to indicate Geographical distribution, a series of numbers has been allotted to the different divisions of the earth's surface:—

.4 Europe.
.41 Scotland, Ireland.
.42 England.
.43 Germany.
&c. &c.
.5 Asia.
.6 Africa.
.7 North America.
.8 South America.
.9 Oceania.

These numbers, *always with the same signification*, can be added to the number belonging to any subject which admits of being considered geographically, whether it be poetry or periodicals, beetles or mosses; and numbers are provided for carrying out the subdivisions as far as the countries in the British Isles or the States of the American Union.[1]

Those who wish to see the whole system set forth should consult Dewey's original work,[2] and I may, perhaps, be allowed to refer any who are curious to see it applied to the literature of natural science, to an effort of my own to carry out its principles.[3]

Such, in briefest outline, is the Decimal Classification of Melvill Dewey, which has been published for more than twenty years, has been adopted by upwards of 300 libraries in America, in this country, and on the Continent, and is now used by Messrs. Lafontaine and Otlet in the various publications issued by the Institut International de Bibliographie at Brussels, and by Dr. Field in the work of the "Concilium bibliographicum" at Zürich. My own experience, extending over the past five years, enables me to speak of it with great confidence as a thoroughly practical scheme, though I confess, on first acquaintance, I regarded it with considerable suspicion; and I have never met anyone, who had given it a fair trial, that was not deeply impressed with its many valuable qualities.

It is, of course, obvious that Decimal classification and the Dewey classification are not necessarily united. Any number of schemes might be elaborated, and decimal class-numbers applied to them: in fact, within the last few months a rival champion has entered the lists against the American system, under the auspices of no less a body than the International Catalogue Committee of the Royal Society, and it behoves all who are interested in the conflict (which means practically all scientific men) to make a critical examination of the combatants before deciding which they will back. At the outset it may be observed that it is incumbent on the new-comer to show marked superiority over the present champion, for in its absence the well-known principle would be applied—namely, that it is better to adopt a classification which has been long in print and is widely adopted, unless the superior merits of the new one fully compensate for the change.

We may now proceed to examine a few sections of the Royal Society's scheme, confining our attention to those that relate to topics treated of in NATURAL SCIENCE. One of the most conspicuous features

[1] [In this Journal, the numbers indicative of geographical divisions have been added within round brackets, a method proposed, for the avoidance of confusion, by the Brussels Institute, and now generally adopted.—ED. NAT. SCI.]

[2] DEWEY, Decimal Classification and relativ index. Fifth Edition, 1894. Library Bureau, Boston, 146 Franklin Street, and London, 21 Bloomsbury Street. Price 25s.

[3] Manchester Museum Handbooks. Catalogue of the books and pamphlets in the Library. Manchester: Cornish. 1895. Price 2s. 6d.

of the Dewey scheme is the wide application of many of its groups of numbers: for example, each branch of science has the following divisions:—

.1 Philosophy, Theories, Nomenclature.
.2 Handbooks ("Compends" of Dewey).
.3 Dictionaries.
.4 Essays, Tracts.
.5 Periodicals.
.6 Societies ("Academies" of the Brit. Mus. Cat.).
.7 Study, Teaching, Museums.
.8 Collected Works.
.9 History.

These are applied alike to all main divisions from "Religion" to "Useful Arts"; whereas in the Royal Society scheme nothing is said of these subdivisions in Anthropology or Zoology, in Botany the Dewey plan is followed, and in Geology and its subdivisions we have:—

	Geology, General.	*Mineralogy.*	*Palæontology.*
.1	History, Philosophy.	Literature.	History, Philosophy.
.2	Handbooks.	Classification.	Handbooks.
.3	Dictionaries.	Nomenclature.	Dictionaries.
.4	Tracts, Ephemera.	Teaching.	Tracts, Ephemera.
.5	Periodicals.	Museums.	Periodicals.
.6	Societies.	..	Societies.
.7	Education.	..	Research and Education.
.8	Research.	..	Classification and Nomenclature.
.9	Museums.	..	Collections and Museums.

Here "teaching" and "museums," though intimately connected in practice, are disjoined, and no place is left for collected works.

Again, as we have already mentioned, the geographical numbers of Dewey form a single rational system of universal application, and therefore easily remembered, but here we have the following choice assortment:—

	Anthropology.	*Botany.*	*Zoology* A.	*Zoology* B.	*Geology.*
.1	..	..	Europe ..	Palæarctic ..	Europe.
.2	Europe ..	..	Asia	Ethiopian ..	Asia.
.3	Asia ..	..	Australia ..	Indian ..	Africa.
.4	Africa ..	Europe ..	Africa ..	Australian ..	Australia and Polynesia.
.5	America ..	Asia ..	N. America ..	Nearctic ..	N. America.
.6	Australasia and Oceania	Africa ..	S. America ..	Neotropical ..	S. America.
.7	Outlying Islands ..	N. America and Islands	Pacific Archipelago ..	Oceans beyond 100 fathoms.	Arctic.
.8	Widely diffused races	S. America and Islands	Atlantic Islands	..	Antarctic.
.9	..	Australasia & Polynesia	Oceans beyond 100 fathoms.	..	..

It seems hardly worth while to criticise these schemes individually; they may be allowed to answer one another. The alternative classification of zoology, however, calls for a few comments. There can be no doubt that although the faunistic regions of Wallace and Sclater may be more scientific, nevertheless the old political divisions are far more frequently used by zoological writers, and a scheme based upon them would be of far wider utility than one based on the other. Probably, however, works treating of the animals of regions will become more numerous, and an alternative scheme which provided for them in some simple manner would be acceptable. The only one of the Royal Society systems which deals with geographical divisions smaller than continents is Geology, where we have, for example, Europe divided thus :—

.11 Austrian Empire.
.12 British Islands.
.13 France and Belgium.
.14 German Empire, Holland, and Denmark.
.15 Italy, Sicily, and Malta.
.16 Russia.
.17 Scandinavia.
.18 Spain and Portugal, Balearic Islands.
.19 Turkey, Greece, Balkan States, and Islands of Levant.

The choice of an alphabetical arrangement here is rather incomprehensible; it separates Germany and Austria, and we fail to see that it presents any advantage to justify its adoption as against Dewey's :—

.1 Scotland and Ireland.
.2 England.
.3 Germany and Austria.
.4 France.
.5 Italy.
.6 Spain and Portugal.
.7 Russia.
.8 Norway, Sweden, Denmark.
.9 Iceland, Netherlands, Belgium, Switzerland, Turkey, &c.

Turning to the Animal Kingdom, we demur at the outset to the suggestion that a different classification should be adopted for recent and fossil forms, thus :—

	Fossil Zoology.	*Recent Zoology.*
.1	Protozoa, Porifera, Coelenterata.	Protozoa, Mesozoa, Porifera, Coelentera.
.2	Echinodermata.	Echinoderma.
.3	Vermes, Molluscoidea.	Polyzoa, Gephyrea, Brachiopoda.
.4	Mollusca.	Nematoda, Acanthocephala, Chætognatha, Gastrotricha.
.5	Arthropoda.	Plathelminthes, Nemertini.
.6	Fishes, Amphibia.	Chætopoda, Hirudinea, Rotifera.
.7	Reptiles, Birds.	Arthropoda.
.8	Mammalia.	Mollusca.
.9	Traces of Animals (footprints, etc.) Animals incertæ sedis.	Chordata.

The arrangement of recent animals is undoubtedly more up-to-date than that of Dewey, but as a working system it is vastly inferior to it, doubtless from want of experience on the part of the compiler. To devote a whole decimal place to the Nematoda, Acanthocephala, Chætognatha, and Gastrotricha, the titles referring to which in a year would probably fill a couple of pages of the *Zoological Record*, and to allot the same to the whole of the Chordata, the titles relating to which occupied seventy-five pages in the *Record* for 1894, shows a curious sense of proportion. The same fault is carried still further when we find that each of the orders of mammals requires four decimal places (in Dewey they require one or at most two), and reaches its climax when we arrive at 565.9395 for "Man," and are told it "will want much subdivision."

This is followed by two tables "showing how genera and species might be treated." I have puzzled over these for some time, but cannot make them out; but, as I am given to understand this idea was early dropped for an alphabetical arrangement, any criticism of them is unnecessary.

Time and space fail me to go into further details; but to sum up, the Dewey classification is not perfect, but has been long before the public and has been well tried, it may be had in print with an elaborate index, it is simple and consistent and is based upon practical experience of the subjects on which books and memoirs actually have been written, and of the proportional numbers required by each topic. The Royal Society's classification, so far as I have examined it, has none of these advantages: it is crude, incomplete, and inconsistent, largely because it is the result, not of practical experience, but of *à priori* consideration. I conclude with two passages from Dewey's own Introduction to the fourth edition of his tables:—

"The inexperienced user is very likely to feel entirely competent, after once reading the tables . . . to institute a series of improvements. Experience proves that nothing could be more disastrous. . . . Frequently, proposed changes, carefully studied out and submitted as improvements, are shown by our old records to have been adopted and used in the exact form proposed till considerations which had not been foreseen forced us to change the form as printed. Even after years of experience one is not safe in pronouncing on an apparent improvement without consulting the voluminous records of previous experiments."

"To make out a new set of heads would involve labor and cost vastly beyond the dreams of any person who has not tried exactly this work. The time actually spent on the tables as here printed, by various competent workers, would aggregate several years and cost thousands of dollars. The uniform and urgent advice of the experienced is to adopt a poorer scheme already made rather than undertake so herculean a labor. When done, the maker may possibly be better suited with it, but it is doubtful if many others will be. It is vastly wiser for any man whose time is of value, to use it in something more practically useful to himself and his library than in trying to construct a 'satisfactory' scheme of classification. No one ever yet wholly suited himself or any one else, and probably no one ever will. By adopting this scheme already workt out he saves much time and money, gains the immense advantage of using a system in common with hundreds of others, so that he may utilise their labors and investigations and share with them the economies of co-operation."

The Manchester Museum. Wm. E. Hoyle.

We are glad that we have succeeded in obtaining the foregoing article from Mr. Hoyle. Since the International Conference on scientific bibliography, to be held at the rooms of the Royal Society of London, on July 14 and following days, will probably spend much of its time in discussing what system of numerical indexing can be applied to the multifarious subjects of modern science, and since, so far as our experience goes, the majority of practical scientific men are not likewise practical bibliographers, we venture to think that Mr. Hoyle is doing a public service in furnishing this concise exposition of the Dewey system, and in showing how the substitutes hitherto proposed are found wanting from the practical point of view. In justice, however, to the compilers of the various schemes issued under the auspices of the Royal Society, it should be pointed out that these were merely intended to serve as a basis for discussion; and perhaps nothing worse should be said of them than that their compilation was a waste of time, since the basis of discussion ought properly to have been the Dewey classification itself. Moreover, the conflict between our contributor and the members of the Royal Society Committee is a very unequal one; for Mr. Hoyle has had more practical experience of the Dewey system than perhaps anybody in England, whereas the very distinguished gentlemen whose names are attached to the schemes which the Royal Society has submitted for criticism are the last people in the world to claim for themselves an acquaintance with practical bibliography in general, or with the Dewey system in particular.

It would be easy for us to add to the criticisms which Mr. Hoyle has already made, and to show many more points of inconsistency which the schemes offer, both with one another and with the Dewey system itself; but our space is too valuable to discuss propositions which it would never be possible to uphold seriously against some of the competent librarians and bibliographers who have been appointed by their respective governments to attend the Conference at Burlington House. Instead of criticising the details, we prefer to contrast this characteristically English mode of proceeding with the methods adopted by an eminent foreign bibliographer. For it is—is it not?—a thoroughly English custom to appoint a man who has spent his life in one branch of study to conduct skilled operations in an entirely different field. There is no doubt that, from the point of view of the newspaper public, the man who has got his first in the school of *literæ humaniores* at Oxford, will write a better leading article on, say, the potato disease than your mere biologist; but the journalistic method of getting up a subject in an hour or two, with the help of a few books of ready reference, is not the one that commends itself to the professed scientific worker. A better method is that followed by Mr. Marcel Baudouin, of the Institut International de Bibliographie Scientifique de Paris, the editor of *La Bibliographie Scientifique*, *Les Archives pr. de Chirurgie*, and the *Revue des Instruments de Chirurgie*. In the *Revue Scientifique* for May 30 he publishes various additions to, and further subdivisions of, the Dewey classification, so far as it relates to medical science. The following are the principles which have guided him in the establishment of these additions. Considering himself bound by a resolution passed at the Brussels Conference of bibliographers, to which we have previously referred, he has accepted without question all the indications furnished by Mr. Dewey in the book published by him. "No one," he says, "can accuse me of making innovations in a field that has already been explored and to a certain extent cultivated, or of bringing disturbance into a classification, conventional, it is true, but of which the principle must be admitted in its integrity and without contest for future time." But when he proceeded beyond the tracts already traversed by Dewey and was upon unbroken ground, Mr. Baudouin did not break loose from all restraint and act as an irresponsible innovator; on the contrary: "For these additions," he says, "I have impregnated myself as well as I could with the publications of Mr. Dewey, and the principles which have guided his representatives in Europe. For those parts of which he foreshadowed the possible subdivisions, I have blindly followed his indications, sacrificing my private opinions with the sole object of arriving at an international agreement. For the rest, whenever possible, I have respected the original idea which has ruled over the establishment of this classification in its entirety." Even when making subdivisions which, it might be thought, bore no relation whatever to Dewey's work, Mr. Baudouin has not forgotten what had previously been accomplished. The numbers which he has adopted have not been taken at random, but have been suggested by their use in other parts of the Dewey classification. He has, moreover, used numbers in a similar sense in different parts of his own divisions. It is obvious that this method is of considerable assistance to the memory, and is far superior to the absolute want of agreement which, as Mr. Hoyle has shown, obtains in the schemes put forward by our distinguished countrymen.

There is one sentence in Mr. Hoyle's paper on which we would lay special stress. "The Royal Society's classification fails," he says, "largely because it is the result, not of practical experience, but of *à priori* consideration." This point is emphasised in a letter which we have just received from Dr. Charles Richet, the editor of our esteemed contemporary, the *Revue Scientifique*. He regards it as the chief merit of the Dewey system that it has not been framed in accordance with purely scientific and philosophical ideas, but as the result of the experience of practical librarians. It may further be pointed out that a system which is frankly arbitrary is, for the purposes intended, superior to one that is charmingly philosophical. For our "little systems have their day," and what may seem admirable in the year of grace, 1896, is not likely to be regarded with anything but ridicule by our descendants in 1996. Nature, moreover, as we constantly have reason to regret, does not appear to have been constituted in accordance with our philosophical categories; to take but a single instance, one already hinted at by Mr. Hoyle—what confusion we should see if workers on different groups of the animal kingdom were requested to draw up schemes for the classification of geographical divisions suited to their own requirements!

We venture to summarise the argument by a quotation from the letter that Dr. Charles Richet has kindly addressed to us: "Those who believe it to be their duty to reform this system, or to replace it by another, do not think that the topsy-turvydom produced will have much greater weight than any doubtful progress they may make in the method of classification. After all (1) every classification is defective from the philosophical point of view; (2) every classification would be good if it were employed universally over a wide domain of knowledge. The latter will be the case with the Dewey system if we set ourselves resolutely to make our classification in accordance with his book. To my knowledge there are at least fifteen journals which employ it already."

However, to pass from a detail that can interest but few of our readers, to the other subjects of the Conference,—the following provisional suggestions have been issued by the Committee of the Royal Society. First, as we are glad to note, the idea of including applied science has been given up, and the catalogue is to be restricted to branches of pure science. It is no doubt difficult to distinguish between pure and applied science, but it is equally difficult to distinguish between applied science and mere commercial enterprise; and in confining themselves to pure science the Committee will probably find their task none too easy. Secondly, the catalogue is no longer, like the "Catalogue of Scientific Papers" issued by the Royal Society, to be "confined to papers in certain periodicals, or to books of a certain category." The method now in force at the Concilium Bibliographicum, Zurich, of issuing slips or cards conveying authors' titles, subject-matter, etc., as speedily and as frequently as possible, is proposed to be adopted; while a further issue in book-form may take place at intervals, parts corresponding to the several sciences being, if found desirable, published separately. The circular continues:—

"That, in order to secure the preparation and publication of such an International Catalogue, a Central Bureau shall be established under the control of an International Council.

"That the whole of the Catalogue shall be prepared and issued subject to the authority of the International Council, and that any particular undertakings which may be allotted to particular countries, institutions, or persons, shall be subsidiary to the work of the Central Bureau and subject to its control.

"That the cost of preparing and publishing the said Slip- and Book-catalogues at the Central Bureau during the years 1900–1904, in so far as these are not met by sales, shall be provided for by means of a guarantee fund, and that application be made to governments, learned societies, institutions, and individuals throughout the world, to assist in establishing such a fund."

Other questions to be decided at the Conference are the place of the Central Bureau, the mode of appointment and organisation of the International Council, the language or languages to be used, and the system of classification to be followed in the subject-index. Since it is difficult to estimate the cost of the work of indexing, it is suggested that a guarantee fund, of about £10,000, should be raised to cover a period of not less than five years, after which time the cost of the enterprise can better be determined.

We may hope that these proposals will be discussed by those whom the scientific world recognises as competent to deal with such peculiarly technical questions. We could name a number of men whose opinions would carry great weight; let us mention the names of M. Baudouin, H. Carrington Bolton, Victor Carus, R. Friedländer, Emil de Margerie, Paul Mayer, Michel Mourlon, S. Nikitin, P. Schiemenz, S. H. Scudder, and O. Taschenberg. We do not mention some skilled bibliographers of our own country, who, till a short time ago, we thought must have been known even to the Council of the Royal Society. By the courtesy of the Secretary of the Royal Society, the list of the delegates already appointed to attend the Conference has been forwarded to us. The names of the delegates for Austria, Germany, and Norway are not yet given. Among the other names, we are glad to see Dr. J. S. Billings and Professor Simon Newcomb, from the United States; Dr. E. W. Dahlgren, the librarian of the Swedish Academy; Professor August Heller, librarian of the Hungarian Academy; Dr. J. Deniker, librarian of the Muséum d'Histoire Naturelle, Paris; and Chevalier Descamps-David and Mr. Paul Otlet, both of the Institut International de Bibliographie at Brussels. But there are also in the list Mr. Avierinos M. Averoff, Greek Consul at Edinburgh; General Annibale Ferrero, Italian Ambassador in London; the Portuguese Minister in London; the Right Hon. Sir J. E. Gorst, M.P., Vice-President of the Committee of Council on Education; the High Commissioner for Canada; the Agent-General for Natal; the Agent-General for New Zealand; the Agent-General for Queensland; and the Swiss Minister in London. These are "all honourable men," deservedly distinguished, but do they know anything of the literature and bibliography of science, or the every-day needs of the working physicist, chemist, and naturalist? If their function is simply to promise the support of their respective governments, especially pecuniary support, then, in the interests of science, we undoubtedly offer them a hearty welcome to London; but when the Conference begins to discuss the Dewey decimal classification, or the best method of indexing new species of animals and plants, we hope that those who know something about the subject will be left to do the talking.

But, once again, to ambassadors, consuls, high commissioners, generals, professors, and librarians, we wish good speed and a successful ending to their discussions.

SOME NEW BOOKS.

"SEMPER ALIQUID NOVI EX AFRICA."

THE GREAT RIFT VALLEY: being the narrative of a journey to Mount Kenya and Lake Baringo, with some account of the Geology, Natural History, Anthropology, and future prospects of British East Africa. By J. W. Gregory. 8vo. Pp. xxi, 422, with maps and illustrations. London: John Murray, 1896. Price 21s.

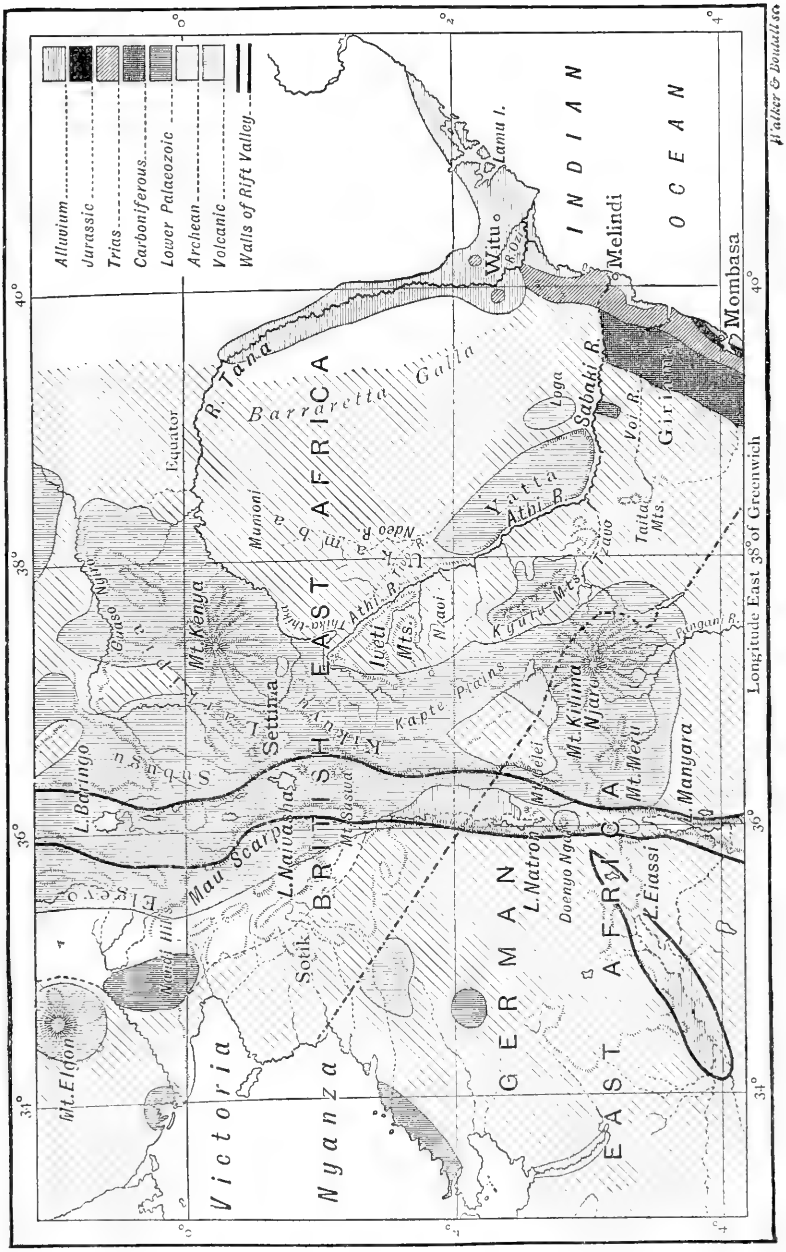
"IN pioneer exploration England has led the way, but in scientific geography we have always been beaten by our German rivals." So said Dr. Mill in the beginning of the present year, and the truth of his remark, unfortunately, cannot be disputed. Our success and our failure are equally due to national characteristics: to audacity, courage, and love of adventure on the one hand; to one-sided methods of education, and to caring little for anything which does not yield a direct return in money, or its equivalent, on the other. But on the causes it is needless to enlarge; it is a fact that, with a few notable exceptions, British explorers, too often, have added only to our geographical knowledge in the most limited sense of that term. It is, then, a relief to take up such a book as the "Great Rift Valley." Dr. Gregory possesses exceptional qualifications for the task of exploration: in addition to the tact, patience, determination and courage, the readiness of resource, and the coolness in danger, which are essential to success in any attempt to penetrate far into the Dark Continent, his scientific training has been thorough and yet wide. He is no mere specialist; he has won distinction alike in petrology and in palæontology, he has discussed with equal ability problems in Alpine geology, and in the distribution of life, past and present, on the surface of the globe. The trustees of the British Museum, in permitting him to join, as naturalist, an expedition which was designed to explore Lake Rudolf, acted wisely; and if that intention had been fulfilled, its results, doubtless, would have been more copious, though they could have hardly been more interesting, than those of the journey which was actually accomplished.

Dr. Gregory has divided his book into two parts: the one a narrative of his journey, the other a general account of the natural history of the country visited. This arrangement will undoubtedly make the book more popular, because scientific disquisitions in the midst of narrative are apt to be as grit in cake to the palate of the ordinary reader, especially at a time when mental digestion is too weak for any food which is not minced into paragraphs or spiced with attempts at epigram; it will also make the scientific information more readily accessible to those who desire to use the volume for purposes of reference. In one or two cases, we think, it would have been better, even at the risk of adding a few pages, to have entered a little more fully into particulars, instead of referring the reader to papers already published by the author in scientific journals, which often are only accessible to a limited number of readers; but the author has, as a rule, been successful in hitting the happy mean between brevity and diffuseness.

No fates could have seemed more adverse than those which awaited Dr. Gregory on his arrival in Africa: the well-equipped expedition destined for Lake Rudolf went to pieces before it had advanced more than a few days' journey from Mombassa, its leader apparently left it to shift for itself, and Dr. Gregory's sole recompense for having wasted full three months was a couple of bad attacks of fever. Most men would have quitted Africa in disgust. But that is not his way, so he determined to make a dash at Lake Baringo and Mount Kenya. 'Make a dash' is the right term, for his party, of necessity, was small and not too well provided, a belt of country over-run by the formidable Masai had to be crossed, and his time was short. It was, in fact, a record performance. The party, in going and returning, covered 1,650 miles in two days less than five months.

It was formerly held, as Dr. Gregory remarks, that the geology of Tropical Africa was exceptionally monotonous. It was a continent without a history, where, in truth, there was nothing new under the sun. This idea he shows to be very far from correct. No doubt the palæontological record is singularly deficient, for a large area is occupied by gneisses and schists, almost certainly representative of the Archæan era; another area, by no means small, is covered with great sheets of lava. There are, however, some stratified rocks; and the geological record becomes more complete towards the end of the Secondary era, though the explorer is seldom tempted to overload his porters with fossils. In fact, a very large part of Tropical Africa appears not to have been below the level of the sea since geological history began, and even its lacustrine deposits have yielded, as yet, nothing of palæontological interest. But there is much to reward the physical geologist. The country traversed by Dr. Gregory consisted first of the coastal plain, marshy and malarious, but in the British dominions fortunately narrow enough to be crossed in a couple of marches; then of a zone of foot-hills, also narrow. This is followed by a higher and very broad zone, a sandy, barren district, mostly covered with 'scrub.' To this succeeds the ancient backbone of the continent, a highland region of very old rocks which may be traced from the Drakensberg of Natal to the mountains of Abyssinia; possibly even through Eastern Egypt as far as Cyprus. Then comes the great zone of volcanic rocks—wide-spreading sheets of lava, which are crowned here and there by huge cones such as Kilima-Njaro and Kenya, and this is followed by a region, once also highland, but now broken by a series of north and south faults into the 'Great Rift Valley.' Its floor consists of "ancient and modern lavas of various ages, the alluvium of dried lake basins, recent river gravels, and deserts of loose drifting sand." Dr. Gregory was struck by the resemblance between the lava-plains and those about the Snake River of Idaho, and considers these to have been produced by the combination of eruptions from numerous centres, which he proposes to call 'plateau eruptions,' rather than by outpourings from fissures.

But the phenomena afforded by the Rift Valley are yet more interesting to the student of physical geology. The African lakes, as Dr. Gregory points out, fall naturally into two classes: one long and narrow, lying like fjords between steep cliffs; the other rounded in shape and with low shelving shores. Lakes of the former class occur on two lines, which pass on either side of the Nyanza and meet at Lake Rudolf. "Thence the line continues northward as a long strip of low



GEOLOGICAL SKETCH-MAP OF BRITISH EAST AFRICA, BY J. W. GREGORY.

Kindly lent by Mr. John Murray.

land, dotted with lakes and old lake basins, and sinking in places below the level of the sea." It may be traced along the Red Sea, itself like a magnified fjord, up the Gulf of Akaba, and on through the Dead Sea and the Jordan Valley, till it ends on the plain of Northern Syria, after a course of about 4,000 miles. The trough-like form of this sunken district is maintained throughout, and scattered over its floor is a series of over thirty lakes, of which only one has an outlet to the sea. A glance at the sketch-map in Dr. Gregory's volume at once recalls to memory the outline presented by more than one series of volcanic vents in the Pacific and Indian Oceans; and this African district, as we have seen, is a line of eruptive disturbances as well as of faulting. In the Rift region the effect of the latter process has been no less remarkable than unusual. Strips of country have been dropped down by a series of parallel faults, and thus a valley has been formed with precipitous and sometimes step-like sides. Here, then, the valleys often are due to rifts instead of to erosion; the mountains occasionally are formed of blocks instead of by folds, and in some cases the great earth movements have happened so recently that rock scarps 1,000 to 2,000 feet in height still stand bare and precipitous as though broken but yesterday, and straight lines and sharp angles still dominate the scenery.

Dr. Gregory believes that the making of the Rift Valley system was heralded by intense volcanic activity, when first trachytes, then andesites, were ejected. This probably occurred in some part of the Cretaceous period, and was followed in the Eocene by the first of the series of north and south faults which ultimately formed the Rift Valley. Afterwards, probably in the Miocene, came a second series of plateau eruptions (basaltic). Another series of faults, in the same general direction as the earlier one,. occurred in the Pliocene, when some of the lake basins were formed, while to the Pleistocene are referred the more recent volcanic eruptions (such as the crater of Kilima-Njaro, with a few cones which still give signs of activity), the last series of Rift faults, and the modern lakes. The basins of these are partly the result of differential movements athwart the general line of subsidence.

In connection with this subject Dr. Gregory makes some remarks upon the Jordan Valley and the Dead Sea, for these have an important bearing upon certain questions of zoological distribution. He believes that in former times a river flowed southward, from Palestine, along that part of the Rift Valley which is now occupied by the Red Sea, and entered the Indian Ocean near Aden. Probably this river, not far from its mouth, was joined by another from the Rift Valley, so that the equatorial lakes were in water-communication with the Jordan, and their fish could reach Palestine without entering the Nile. Dr. Gregory seems to shrink from claiming the Arabah as only a prolongation of the ancient valley of the Jordan, but he goes so near to it that we anticipate he will before long accept this as the simpler solution. Incidentally, also, he discusses the significance of that singular valley, the plain of Esdraelon, which severs northern Palestine and communicates with the valley of the Jordan by gaps, which are only about 300 feet above sea-level. He explains these, rightly in our opinion, as cases where one valley has been 'beheaded' by another, a thing of frequent occurrence in the Alps, but we doubt whether the streams flowing towards the Kishon have trespassed on the heads of the glens draining into the Jordan. As the fall to that river is at least three times as great as it is to the sea, and the course of the streams is much shorter, we think that these would be the more powerful agents of erosion, and would cut back into the region draining to the west.

Dr. Gregory touches on more than one question bearing upon the distribution of life, but into these, whether they relate to plants, to animals, or to races of men, space does not permit us to enter. South Africa, like other countries, has its Alpine flora, which sets in upon the mountains at about 11,500 feet. He inclines to explain this by assuming an elevation of the land rather than a general lowering of the temperature in former days, but the question, as yet, can hardly be regarded as closed. His observations on Mt. Kenya show that at any rate its glaciers once terminated some 5,000 feet below their present limit. Incidentally, also, in speaking of the extermination of the larger mammals, he offers a solution of one of the puzzles in Pleistocene geology—namely, the not unfrequent occurrence of large accumulations of bones belonging to animals of different species and different habits. These, by many geologists in the past, by Sir H. Howorth in the present, are regarded as the effects of a deluge. But Dr. Gregory points out that it is more probably the result of a defect, not an excess of water. He crossed a district called Laikipia, which had been described to him as one of the richest gamefields of Africa. "Here and there around a water-hole we found acres of ground white with the bones of rhinoceros and zebra, gazelle and antelope, jackal and hyena, and among them we once observed the remains of a lion. All the bones of the skeletons were there, and they were fresh and ungnawed. The explanation is simple. The year before there had been a drought, which had cleared both game and people from the district. Those which did not migrate crowded round the dwindling pools and fought for the last drop of water. These accumulations of bones were therefore due to a drought, and not to a deluge." In Central Africa, we presume, the bones would generally crumble away, but in some lowland regions drought might be succeeded by floods and the skeletons speedily entombed. Possibly, in such a country as Siberia, frost of exceptional severity might produce the same consequence as a drought in tropical climates.

Did our space allow, we would gladly dwell upon Dr. Gregory's exploration of the glaciers of Mount Kenya, where he pitched his camp for a few days at a height of some 15,000 feet, ascending on one occasion to about 17,200 feet, when he was turned back by difficulties which no solitary traveller would have been justified in encountering. Like Mawenzi on Kilima-Njaro, Kenya is a ruined volcano, the actual peak terminating in five pyramids, the highest of which is about 19,500 feet above the level of the sea. It is steep and precipitous, so that apparently it will not be ascended without some difficulty. We trust that when the Masai have been taught to behave themselves, some members of the English Alpine Club will find a way to the summit. Among Dr. Gregory's notes on natural history, some on protective resemblance and on the dispersion of plants are extremely interesting. The frontispiece shows that insects can rival the serpent in guile. His remarks also upon the capabilities of British Central Africa and upon the slavery question are worthy of careful consideration. As regards the latter, he emphatically affirms —what, as a nation, we are too prone to forget—that the moral and intellectual character of a race is not suddenly changed for the better by emancipation, so that the incautious gift of freedom may be for a time a curse instead of a blessing. But we must conclude—the book is one that will well repay study, and it shows that Dr. Gregory can write almost as well as he can explore.

T. G. Bonney.

Count von Götzen's Journey across Africa.

Durch Afrika von Ost nach West. Resultaten und Begebenheiten einer Reise von der Deutsch-Ostafrikanischen Küste bis zur Kongo-mündung in den Jahren 1893–4. Von G. A. Graf von Götzen. Mit zahlreichen Original-Illustrationen von W. Kuhnert und Sütterlin nach den Photographien, und 2 grossen Karten von R. Kiepert nach den Original-Aufnahmen des Verfassers. 8vo. Pp. xii., 418. Berlin: D. Reimer, 1895.

The active volcanic vents on the earth's surface are at least four hundred in number, counting only the principal cones, besides which numerous smaller vents usually occur in the neighbourhood of the larger orifices. According to some of the older authorities, active volcanoes are found only in islands, or in districts immediately adjacent to the seashore. But this rule, although it may be true in the majority of cases, is by no means invariable. Besides the existence of active volcanoes in the Thian-shan range in Central Asia, which, although once regarded as mythical, has been now completely established by the Russian savants, there are known to us at least three active volcanic districts in the far interior of Africa. On Lake Rudolf, according to the testimony of Count Teleki and Lieut. von Höhnel, there is a perpetually raging volcano on one of the islands, and a large volcanic tract adjacent to it. Donyo-Ngai frightens the natives of the region to the west of Kilimanjaro by its thundering noises and fiery ejections, and has several "smoking companions." And now an enterprising German explorer has reached the volcano of Kirunga, lying south of Lake Albert-Edward on the extreme eastern border of the Free Congo State, and has not only witnessed its eruptions from a distance, but has actually ascended to the rim of its crater.

Count von Götzen, a lieutenant in the Prussian Guards, who has achieved this notable feat of travel during his traverse of Central Africa from east to west, accompanied by Dr. W. von Prittwitz as chief of his staff, and Dr. H. Kerstrug as physician, and attended by a caravan of 620 natives of various origins, left the east coast at Bweni, near the mouth of the Pangani River (about 5° 50′ S. lat.), in December, 1893. It took the party eleven months and eight days to reach the Atlantic at the mouth of the Congo. Passing through the coast-district on to the Masai Plateau they arrived at Kondoa, in Irangi, at the end of January, 1894, and shortly afterwards crossed Baumann's route from south to north. Here the travellers' attention was attracted by the lofty mountain Gurui, which rose conspicuously to an altitude of some 10,000 feet to the left of their route, and a diversion to the west was made in order to ascend it. The attempt was not successful, but a height of over 3,000 metres was reached; and although Gurui is extinct, if it were ever a volcano, and no crater was observed, it is, no doubt, of volcanic origin, and has five or six small volcanic satellites on its southern slope.

At Vurumanangi, on February 10, the party climbed the steep ascent of the western edge of the great Rift Valley, which passes north to Lake Naivasha, and followed its western edge for several marches. Then, turning sharp to the left, they traversed another wide depression, the lowest part of which is occupied by the salt-lake of Nyarasa, and again ascended the plateau. Proceeding onwards they entered Unyamwesi, and on March 10 arrived at the Catholic Mission Station of Msalala, maintained by the "White Fathers" of Algeria. After a few days' rest here, another mission station in Uschirombo, further westwards, kept by the same society, was reached, and three weeks' rest was ordered, during which some of the carriers were changed and fresh provisions and new porters were obtained from the station of Mwansa on the Victoria Nyanza.

Thus recruited, Count von Götzen and his companions started again on April 14, 1894, with a party of 362 attendants, on their arduous journey through the furthest part of German East Africa, and on May 2 arrived on the Kagera River, the largest feeder of the Victoria Nyanza, and, in fact, the upper stream of the Nile. Two days later the party were safely ferried over the Kagera, here about 250 metres in breadth, in canoes, and the hilly but treeless plateau of Ruanda was entered. While the son of the ruler of Ruanda, who rejoiced in the name of Schirangawe, was easily visible, there seemed to be much difficulty in obtaining an interview with the great "Kigeri" himself, as this native potentate is called. This, however, was effected a few marches further on, and Luabugiri was found to be a veritable giant, wonderfully well-proportioned, and of a light brown colour, like most of the Wahumas, but very shy and not easy to deal with.

After leaving Luabugiri's residence, of which a good illustration is given, the travellers pushed on straight for Mount Kirunga, and, shortly before arriving at its foot, met with a serious difficulty in the shape of a bamboo forest of the densest description. It was not until June 12 that a start was made for the ascent of the mountain, first on an elephant-hunter's path over blocks of lava, and then through very dense forest. Here grey parrots (*Psittacus erithacus*) were noticed for the first time, showing that the limits of the western fauna were being entered upon. Above the forest open ground at length appeared, and after several days of arduous toil the party stood on the edge of the crater of Kirunga, and gazed upon a sea of congealed lava with a large orifice of active eruption in the middle of it. The larger diameter of the oval crater of Kirunga was estimated at 200 metres, and the smaller at 150 metres, while the lava-bottom was calculated to lie from 200 to 300 metres below the rim on which the party stood. The height of the summit of the mountain was estimated at 3,470 metres. To the east of Kirunga were seen the summits of two other lofty mountains—Navunge and Karissimbi, while, according to the map attached to the volume, Mount Ufumbiro of Stanley lies further off behind these mountains, just on the outside edge of the German territory.

After descending from Kirunga the travellers encamped on the shores of Lake Kivu. This hitherto unexplored lake lies at an altitude of about 1,485 metres, immediately to the north of Lake Tanganyika, into which it is believed to drain. A whole chapter is devoted to an account of it and its lovely islands, which appear to be rich in animal and vegetable life of every description.

The main object of the journey having now been accomplished, a grand consultation took place as to the best route of return to Europe, and only after much discussion it was determined to proceed westwards to the Congo. This was, as may be well believed, by far the hardest and at the same time the least interesting portion of the journey, and three whole months were taken in its accomplishment. Starting on June 28 from Kirunga on Lake Kivu, the party crossed into the water-basin of the Congo about five days later, and found themselves on the sources of the Lŏwa, which runs into the Congo at about 1 deg. S. lat. The great wood-district of the Upper Congo thus entered on was crossed far to the south of Stanley's route. Great difficulties from the dense nature of the forest and from the failure of provisions were encountered, and Count von Götzen and his companions would hardly have got safely through had they not found a party of Manyema encamped on the road, by whom they were assisted forward. Ultimately the Congo was reached at Kirundo, about a hundred miles above Stanley Falls Station, on September 21. Here the travellers were most hospitably received by Baron Dhanis and the officials of the Congo Free State, and, travelling by canoes and steamers, reached the mouth of the Congo, and returned to Europe.

We need not follow Count von Götzen in his disquisition upon the Congo Free State and its successful war with the Arabs, of which he gives a lively account; but we must say a few words about the Appendix to his work, in which are contained several memoirs on the natural history collections made during the expedition. These collections do not appear to have been very extensive, but it will easily be understood that upon such an arduous and prolonged journey it was impossible to convey much more than what was absolutely necessary for the existence of the expedition. Of plants, a collection was made on Kirunga at and above an altitude of 2,000 metres, and has been worked out by Professor A. Engler and his associates at Berlin. These plants are referred to seventy-nine species, so far as they can be accurately determined, and twelve of these are described as new to science. The plants, Professor Engler tells us, belong altogether to types which are found on the other high mountains of tropical Africa—such as *Rubus*, *Trifolium*, *Scheflora*, *Malabaila*, *Æolanthus*, *Pycnostachys*, *Cineraria*, and *Senecio*. These genera are also characteristic of the highlands of Abyssinia, Kilimanjaro, and the Cameroons.

Professor C. A. Tenne likewise gives an account of the rocks and minerals brought home by Count von Götzen; and Dr. Karl Käseberg describes the Coleoptera, which do not appear to have been very numerous, but embrace a few new forms. Finally, we may say that the volume is beautifully illustrated, and furnished with two excellent maps which show the route taken by the expedition from the Indian Ocean to the Congo, and the exact dates on which it arrived at and departed from every station. P. L. S.

Some Serials.

Our bright and useful contemporary, *Science Gossip*, has emerged from the difficulties to which we have previously referred, by handing over the business control to the Nassau Steam Press, Ltd., 60 St. Martin's Lane, London, W.C., and by omitting the March, April, and May numbers. The June number, which begins vol. iii., contains the first part of an article, by the Editor, on the portraits of scientific men at the National Portrait Gallery, illustrated by Miss J. Hensman. We extract from this number the following editorial note:—

"We sincerely hope that the rumour is unfounded, which Sir Henry Howorth refers to in Natural Science. It is to the effect that the special collection of British Animals at the British Museum of Natural History at South Kensington is to be distributed into the general collection. We feel certain that the result would be most disastrous to the encouragement of natural science studies in this country. We know it is a department which is constantly referred to in an unobtrusive manner by many young naturalists, who thus spare the time and patience of the courteous assistants in the students' rooms. Rather let us hope the collection may eventually be increased by making it a completely typical reference collection, where those of the large number of persons who cannot visit the museum on weekdays may on Sundays compare their captures and obscure specimens for identification. No such opportunity elsewhere occurs in London. That the general public are interested in and educated by the special British collection, one may easily find by listening to the surprised and intelligent remarks made by visitors on seeing gathered together the animals which occur in their own country."

We are sorry to record the death, after a brief existence of six months, of the *Scientific African*, owing to the fact that its editor is called elsewhere to seek his livelihood. It does not appear that the editing of scientific publications is a more remunerative employment in Africa than it is in other parts of the world.

We announced some time ago that the *Annuaire Géologique Universel* of Paris was about to be discontinued from want of support. We are glad to find that this is only partially the case. The fact is that the want of support makes it impossible to carry on the work as heretofore, and the Editor, Dr. L. Carez, announces in his introduction that vol. xi. will be limited to the geology of France. We are now, therefore, quite without a general Geological Record, and likely to remain so until the example of the Zoological Society is followed by geologists.

The Classification of Physiology.

We have received, too late to mention in our article on the Decimal Classification, a report presented to the Société de Biologie de Paris by Messrs. Blanchard, Bonnier, Bourquelot, Dumontpallier, Dupuy, Malassez, and Richet. It is an attempt to extend the numerical classification of physiology, in accordance with Dewey's book, under nos. 581.1 and 612. No attempt has been made to deal with the useful section 591. In what it has attempted the compilers have followed the admirable example of Mr. Baudouin rather than the harum-scarum methods of the Royal Society Committee. "We have sought," they say, "so far as was in our power, to establish parallel series. Thus, the general divisions of physiology are those which agree with the other general divisions of the Dewey classification. There is also a certain parallelism between the numbers: thus, memoirs on comparative physiology carry the zoological numbers. Absolute parallelism was impossible, since different subjects do not always lend themselves to identical classification. Certain numbers have been left blank in such a way as to permit future extension of the classification. . . . To sum up, the classification of memoirs on physiological work by the decimal system is, as a rule, extremely simple, and in those cases where it is difficult, it is clear that the memoir in question would be difficult to class under any classification whatever." The classification is provided with a summary index, which renders it of still greater value. We presume that those interested in the matter can obtain a copy by applying to Dr. C. Richet, 15 Rue Université, Paris.

Literature Received.

Catalogue of the Madreporarian Corals, vol. ii., H. M. Bernard; Catalogue of Snakes, vol. iii., G. A. Boulenger: Brit. Mus. (Nat. Hist.). Thoughts on Evolution, P. G. F.: Sonnenschein. How Plants Live and Work, E. Hughes-Gibb: Griffin. Elementarcurs der Zootomie, B. Hatschek and C. J. Cori; Sporozoenkunde, von Wasielewski; Anatomie der Wirbelthiere, pt. i., A. Oppel: Jena, Fischer. Flora of Dumfriesshire, G. F. Scott-Elliott: Dumfries, Maxwell.

Report: Free Library, Bootle. Report: Colombo Museum. Report for 1895: Wood's Holl Lab. Geology of Woodbury Co., Bain; Geology of Warren Co., Tilton: *Ann. Rep. Iowa Geol. Survey*. Studies from Psychological Lab. Yale University, iii. *Proceedings Roy. Soc. Victoria*, vol. viii. Weasels of E. North America, Mammals from Lake Edward, Florida Deer, O. Bangs; Lemmings of genus Synaptomys, American Bears, C. H. Merriam; Violets of Atlantic Coast, C. L. Pollard; Mammals of Columbia, V. Bailey; Additions to Flora of Washington, T. Holm; New Species of Madagascar Plover, C. W. Richmond: *Proc. Biol. Soc. Washington*.

La Naturaleza, ii., nos. 8 and 9. The Ornithologist, June. Popular Science News, Jan. to June, 1896. Nature, May 21, 28, June 4, 11. Literary Digest, May 16, 23, 30. Revue Scientifique, May 16, 23, 30, June 6, 13. Irish Naturalist, June. Feuille des j. Naturalistes, June and July. Naturen, April, May. Nature Notes, May. Amer. Journ. Science, June. Naturæ Novitates, May. American Naturalist, June. Victorian Naturalist, April. Science, May 8, 15, 22, 29, June 5. Scott. Geogr. Mag., June. The Naturalist, June. Westminster Review, June. American Geologist, June. Botanical Gazette, May. Knowledge, June. Biology Notes, May. Photogram, June.

OBITUARY.

GABRIEL AUGUSTE DAUBRÉE.

BORN JUNE 25, 1814. DIED MAY 29, 1896.

EXPERIMENTAL Geology has lost, by the death of Professor Daubrée, one of its foremost exponents—a man who may be regarded as having been almost the founder of the French synthetic school. Much of his long life was devoted to the prosecution of chemical, physical, and mechanical experiments, whereby he sought, with singular success, to imitate in the laboratory many of the phenomena of nature. Light was thrown by his researches upon various subjects, which in an exceptional way need illumination; such as the origin of mineral veins, the thermal and dynamic metamorphism of rocks, and the nature and affinities of meteorites.

Daubrée was born at Metz, but received his scientific training at the Polytechnic School in Paris and passed thence to follow the profession of a mining engineer. At the age of only twenty-five he was called to the chair of mineralogy and geology, then recently created at Strasbourg—a position which he held for upwards of twenty years. Early in his career he suggested an explanation of the origin of deposits of tin-ore, insisting on the important part which compounds of fluorine had probably played in their production, and supporting his views by appeal to experiment. For his observations on the recent formation of iron ores in lakes and bogs he received the medal of the Dutch Society of Sciences at Haarlem. The distribution of gold in the Valley of the Rhine was another subject which occupied his attention, and while at Strasbourg he prepared a geological map, with description of the department of Bas-Rhin. His most successful efforts in synthetic mineralogy were those in which he studied, under circumstances of much difficulty and some danger, the action of superheated water on glass, and thereby produced artificial crystals of quartz, augite, and certain zeolitic minerals. The production of zeolites during historic times was strikingly demonstrated by his classical study of the action of thermal waters on the brickwork at the old Roman Baths of Plombières.

In 1861 Daubrée followed Cordier as professor of geology in the Natural History Museum in Paris, and was elected into the French Academy as Cordier's successor. Subsequently he became professor at the School of Mines, and in 1884 he retired with the title of Honorary Director of this institution.

Professor Daubrée was a prolific writer, his best known work being a large treatise published in 1879 under the title of "Etudes synthétiques de Géologie Expérimentale," wherein he collected the results of his experimental work which had been recorded in the *Annales des Mines* and other scientific journals. The year after this publication he received from the Geological Society of London the Wollaston Medal, appropriately awarded during the presidency of Dr. Sorby, whose work as an experimental geologist had run to some extent in a parallel direction. Another of Daubrée's important works was his three-volume treatise entitled "Eaux Souterraines," which appeared in 1887.

Professor Daubrée was formerly a frequent visitor to England, where he was endeared to a large circle of scientific friends, many of whom are now passed away. Twenty years ago he delivered an address on his favourite topic at the Science Conferences held in connection with the Loan Collection of Apparatus at South Kensington. A man naturally of simple habits and warm affections, unaffectedly modest, yet saturated with scientific enthusiasm, Daubrée lived and died beloved as a friend by those who knew him, and admired by all as an original investigator of the first rank.

F. W. R.

FRIEDRICH GERHARD ROHLFS.

Born April 14, 1831. Died June, 1896.

ROHLFS, one of the most celebrated explorers of the northern part of the African Continent, was born at Vegesack in 1831. Taking up medicine as a profession he entered the French Foreign Legion, and acted as surgeon to the forces employed in Algeria from 1855 to 1860. Adopting Mohammedan costume and custom he made an expedition through Morocco in 1860, and from that time onwards continued his explorations of northern Africa. Among other places visited by him may be mentioned Abyssinia, Tripoli, Egypt, the Libyan desert, and the Sahara. In 1870, Rohlfs made his home at Weimar, and subsequently resided there when not on his travels. He had visited America, and in 1884–85 was German Consul at Zanzibar. He published numerous books on his travels.

HENRY BARGMAN POLLARD.

Born 1869. Died June 14, 1896.

WE deeply regret the premature death of this investigator, who was accidentally drowned while bathing at Dover. He had received his first appointment last year as lecturer on biology in Charing Cross Hospital. Dr. Pollard was a Scholar of Christ Church, Oxford, whence he obtained a research scholarship on taking his degree. He proceeded to study in the Anatomical Institute of the University of Freiburg, and next, in 1892, occupied the Oxford University table in the Naples Zoological Station. In 1893 he returned to England, first to work in the Biological Laboratory of University College, London, and then becoming Berkeley Fellow of the Owens College, Manchester. His original researches dealt mainly with the anatomy and development of fishes, and he arrived at very heterodox views on certain morphological questions. His first memoir, on the anatomy and phylogenetic position of *Polypterus* (*Zool. Jahrbücher*, 1892), advocated the close affinity of this fish with the ancestry of the Amphibia. In his next memoir (*op. cit.*, 1895) he considered that the tentacles of the higher fishes were homologous with the oral cirri of *Amphioxus*. He also investigated the "lateral line" system of the Siluroids, and made many observations on the development of the suspensory apparatus of the jaw in some of the higher bony fishes.

THE Rt. Hon. THOMAS LYTTLETON POWYS, fourth Lord Lilford, died on Wednesday, June 17, aged 63. He was president of the British Ornithologists' Union, and, at Lilford Hall, near Oundle, in Northamptonshire, he had a remarkably fine collection of birds, both alive and dead. It is not long since his work on the birds of his own county was published. British ornithologists will regret the loss of so prominent a colleague.

WE regret to learn of the death of Mr. H. C. LEVINGE, of Mullingar, Ireland. At one time an enthusiastic collector of Indian ferns, he afterwards gave himself up to the study of the Irish flora, to which he added several species. Mr. Levinge will be greatly missed by the many botanists to whom he extended his hospitality and his help.

THE well-known professor of zoology and anthropology at Moscow, ANATOLY BOGDANOFF, died last April, at the age of 62. He was the author of a "Chrestomathy of Zoology," the founder of the "Society of Lovers of Natural Sciences," and editor of the valuable publication "Materials for the History of Zoology."

WE have also to record the deaths of: on May 21, in Bohemia, CARL M. BALLING, a distinguished metallurgist, and writer of a number of treatises; on January 14, at Brussels, ANTOINE DUVIVIER, a distinguished student of Coleoptera; Dr. HERMANN STIEDA, assistant in clinical surgery at the University of Tübingen, aged 28; on February 11, at Chestnut Hill, Mass., Dr. D. D. SLADE, lecturer on comparative osteology at Harvard University, aged 71; General T. L. CASEY, a well-known coleopterologist, in Washington, on March 25; H. E. BAUER, an authority on Brazilian geology, in Xiririca, on February 21; Rev. H. WALLER, an ardent researcher among African flora, in Northamptonshire, on February 22; J. FLOHR, a collector of Mexican Coleoptera, in Vera Cruz.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

We note among recent appointments:—J. H. Ashworth, to be Lecturer in Zoology at Owens College; Dr. P. Vuillemin, to be Professor of Botany at Nancy; Dr. Dannenberg, to be Privat-docent for Mineralogy and Geology in the Technical School at Aix-la-Chapelle; Dr. G. Karsten, of Leipzig, to be Privat-docent in Botany in Kiel University; Dr. O. L. zur Strassen, to be Privat-docent in Zoology at Leipzig University; Dr. E. Albrecht, to be Assistant in Anatomy in Munich University; Dr. H. Enders, of Breslau, to be Professor of Anatomy in the University of Halle; Professor A. Zimmermann, of Tübingen, to be Privat-docent of Botany in Berlin University; Dr. K. Busz, of Marburg, to be Professor of Mineralogy; Professor R. Semon, of Jena University, to be Prosector for Comparative Anatomy, Histology and Embryology; J. Briquet, to be Director of the Delessart Herbarium in Geneva; Dr. H. Baumhauer, of Lüdingshausen, to be Professor of Mineralogy in Friburg, Switzerland; W. W. Rowlee, Instructor in Botany in Cornell University, to be Professor; Dr. George A. Dorsey, of the Peabody Museum, to be Curator in the department of Anthropology at the Field Columbian Museum, Chicago, his place being taken by Frank Russell; Harry Landes, Professor of Geology in the State University of Washington, to be State Geologist; Dr. E. B. Sangree, to be Professor of Pathology and Bacteriology in the Vanderbilt University, Nashville, Tenn.; Dr. N. L. Britton, to be Director of the New York Botanical Gardens, being succeeded as Professor of Botany at Columbia University by Professor L. M. Underwood; Dr. Frank Boas, to be Lecturer on Physical Anthropology in Columbia University.

Mr. Clements R. Markham, President of the Royal Geographical Society, has been raised to the dignity of K.C.B.

Sir Archibald Geikie was one of those made an honorary D.C.L. of Oxford at the Encœnia on June 24. The Buda-Pesth University has conferred honorary degrees on Mr. Herbert Spencer, Sir Joseph Lister, Lord Kelvin, Professor Pierre Berthelot, Dr. W. Roux, Mr. J. S. Billings, and Professor R. Virchow. Durham University has conferred the honorary M.A. degree on Mr. Richard Howse, Curator of the Newcastle Museum, and that of D.C.L. on Dr. Dallinger, F.R.S.

The Rolleston Memorial Prize of the Universities of Oxford and Cambridge has been awarded to Mr. H. M. Vernon, B.A., of Merton College, Oxford.

Mr. J. C. Willis, late Frank Smart Student of Caius College, Cambridge, has been appointed Director of the Royal Botanic Gardens of Ceylon. The value of the Frank Smart Studentship, hitherto £90 a year, is immediately to be raised to £100 a year by the original founders, Mr. and Mrs. Smart, of Tunbridge Wells, as a testimony of their satisfaction at the results of their endowment.

We regret to learn that Professor F. Jeffrey Bell has found it necessary to resign the Chair of Comparative Anatomy and Zoology in King's College, London, in consequence of the effects of influenza. We are informed that no successor will be appointed at present, but that the post will remain vacant, its duties being undertaken by other members of the staff.

THE Austrian Academy of Sciences has elected as honorary members Professor G. G. Stokes and Mr. C. L. Griesbach, the Director of the Geological Survey of India, who is now home on furlough.

WE have received the programme of the summer course that is to be held in Jena during August. The natural science section, which begins on the 3rd and ends on the 15th, is for teachers who have had an academic training, and is open to foreigners. The following lectures are announced: Principles of Natural Philosophy from the Modern Standpoint, Dr. Auerbach; the Structure and Life of Plants, illustrated by experiments suitable for schools, Dr. W. Detmer; Introduction to Microscopic Botany and Experiments in Plant-Physiology, Dr. W. Detmer; Introduction to Modern Zoology, with practical work, Dr. Römer; with other lectures on physical, psychological, and philosophical subjects.

THE seventh session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences, under the direction of Professor H. W. Conn, will be held at Cold Spring Harbour, Long Island, for six weeks, starting on July 3.

THE Geological Survey of Kansas, carried on under the auspices of the University by Professor E. Haworth and his assistants, has published its first volume. This may be had by sending the cost of postage (22 cents) to Chancellor F. H. Snow, University of Kansas, Lawrence, Kansas.

THAT excellent idea of half covering the skeleton with a papier-maché representation of the outline of the fleshy parts, of which so fine a specimen is to be seen in the man and the horse in the Central Hall of the British Museum (Natural History), is likely to be applied to the Cetacea. At least, we imagine that this method of exhibition is to be one of Sir William Flower's improvements, for we have noted a beluga treated this way in the old whale room. No doubt when the new whale gallery is opened we shall see for the first time the appearance of these huge animals in the flesh, and Sir William Flower will once more have shown that in his opinion the Museum belongs to the public quite as much as to the curator. It is surprising how much energy is being spent at the Museum, and when we consider the lethargic nature of museums as a rule, it is remarkable to see how rapidly the science changes and improves at the Natural History Museum.

WE saw, a short time ago, that some new museum buildings were projected at Brighton, not before they were wanted. Miss Agnes Crane informs us that the plans are indeed passed, but that the money has not been borrowed; and we now learn from the *Brighton Herald* that the Town Council has some idea of carrying out an alteration and enlargement of the public library and news-room, leaving the museum and art gallery for some future occasion. Even if the plans are carried out, there will not be so large an extension of the natural history portion of the museum as is desirable, since a large room, already taken from it for pottery exhibits, will not be returned to it, but incorporated in the new art gallery. This is the more to be regretted, as, when the site is once covered, there can be no further extension. A guide to the Brighton Museum will shortly be published, and the new illustrated catalogue of the Booth bird-collection of British birds is now out at the price of 1s.

WE have received the Report of the Trustees of the South African Museum for 1895. Pending the arrival of Mr. W. L. Sclater, the newly-appointed curator, who will superintend the transference of the collections into their new building, L. Peringuey has been acting curator. Constant attention has kept in check the various insect pests, especially the "incredible numbers of that scourge of zoological collections, the *Anthrenus* beetle," and Mr. Peringuey naturally looks forward with relief to the air-tight iron and glass cases, on Dr. A. B. Meyer's system, which will form a feature of the new fittings. These cases are to be supplied by Chubb and

Son's Safe Company, and it is estimated that the total expense connected with them will amount to £7,500. In view of the greatly increased requirements of the new museum, the annual subsidy has been raised from £1,600 to £2,000. During the past year the number of visitors was 38,054, some 8,000 more than had previously been registered. The increase is in part attributed to recent events in the Transvaal. "Visits from the inhabitants of Cape Town are comparatively rare." Among recent additions is a skin and skeleton of the square-nosed rhinoceros, *R. simus*, presented by the Hon. C. J. Rhodes, and to be mounted at his expense by Rowland Ward and Co. It is intended to model this with the nose six inches from the ground, and the apex of the horn touching the ground, a position vouched for by Mr. Selous. Mr. Peringuey points out the difficulty of acquiring fresh specimens of the large South African Mammals: elephants are dangerous, hippopotami are eaten by crocodiles, Tsitutunga antelopes live in malarial marshes, the gemsbok is protected by game-laws, and the attention of our mighty hunters is directed to the Matabele. Dr. G. Corstorphine, the keeper of the geological and mineral department, has re-arranged the minerals, and has personally obtained many specimens from the chief South African mining areas. It is intended that the collections made by the officers of the Geological Commission shall be stored in the museum, and, so far as desirable, placed on exhibition, while in time maps, diagrams, and sections will be available for illustration of the local geology. Some remains of fossil reptiles obtained by Mr. E. H. L. Schwarz from the Prince Albert district of the colony are being developed by him. The services of a mason, a taxidermist, and an artist modeller are much to be desired at this museum. We are glad to see that the Trustees encourage co-operation with other local institutions. Mr. Corstorphine has given several demonstrations to the South African College students, and hopes in the new museum to be able to extend them to others of the public. The entomological collection and library have been placed at the disposal of the Government Entomologist, with the suggestion that the museum should benefit by his researches. The Trustees also suggest "that the services of the Marine Biologist be secured in the same manner, which could be done to the mutual advantage of the Department of Agriculture and of the Museum."

VISITORS to Paris during the summer ought not to miss the very interesting exhibition that has been opened at the Musée Guimet since April 21. There are exhibited here numerous collections brought back of late years from different parts of the world by French explorers. Among them are objects of ethnological interest from Cambodia, Thibet, Corea, Japan, and Siberia.

Science states that a catalogue of the types and figured specimens of fossil animals in the U.S. National Museum has recently been completed, and includes 3,644 species. This, we believe, is a slip-catalogue, and we do not know whether its publication is contemplated.

THE Royal Geographical Society's Medals have been awarded as follows: the Founder's Medal to Sir William Macgregor, for services in connection with the exploration and mapping of British New Guinea; the Patron's Medal to Mr. St. George Littledale, for his journeys in Central Asia and the Pamirs; the Murchison grant to Yusuf Sharif Khan Bahadur, native Indian surveyor, for work in Persian Baluchistan; the Gill memorial to Mr. A. P. Low, of the Canadian Survey, for explorations in Labrador; the Back grant to Mr. J. B. Tyrrell, also of the Canadian Survey; and the Cuthbert Peek grant to Mr. Alfred Sharpe, for journeys in Central Africa.

THE National Home-Reading Union will hold its Eighth Summer Assembly at Chester, from June 27 to July 6. Natural science will be represented by J. E. Marr and G. F. Scott Elliot, who are to lecture on the geology and botany of the district respectively, while H. Y. Oldham is to give a lecture on geography. Some interesting excursions are planned. Further information may be obtained from Miss Mondy, Surrey House, Victoria Embankment, W.C.

THE Congress of delegates from various natural history societies in the South-eastern district of England was held at Tunbridge Wells, on Saturday, April 25. It was decided to form an association called the "South-eastern Union of Scientific Societies," under the presidency of Rev. T. R. R. Stebbing, with Mr. G. Abbott, of Tunbridge Wells, as Secretary. The object of the union is to aid the co-operation of the societies and to promote their scientific work. It will probably be a link between the smaller societies of the district, which publish no Transactions, and the British Association, since the latter body only permits publishing societies to be affiliated to it. Similar unions in other parts of the United Kingdom, such as the Union of Irish Field Clubs and the Midland Union of Natural History Societies, have already done much good work. Various papers of more or less practical nature were read at the recent congress. We would suggest to the members that more good would probably be done on future occasions by practical and business-like proposals for the organisation of their energies, but of course not much of this could be attempted before the union was fully formed.

AT the annual general meeting of the British Ornithologists' Union on April 22, Mr. P. L. Sclater brought forward a scheme for a new synopsis of the described species of birds, to be arranged in six volumes corresponding to the six zoological divisions of the earth's surface. This has been referred to a committee.

THE Oxford University Junior Scientific Club has brought out a special conversazione-number of its journal, price 1s. The information of chief interest to our readers that we glean from this is that a set of anthropometrical apparatus has recently been presented by Mr. Francis Galton to the Department of Human Anatomy. The eminent donor was himself present at the conversazione, and superintended the use of his instruments, which were on this occasion for the first time exhibited in systematic working order to an Oxford audience.

THE Tyneside Naturalists' Field Club celebrated its fiftieth anniversary on May 20 in a somewhat appropriate fashion. The assembled members traversed the same ground as that of the first meeting fifty years ago, from Prudhoe to Ovingham, and through the woods to Whittle Dene. Of the original membership some ten now survive, among whom we may mention Dr. Embleton, Rev. Canon Greenwell, James Hardy, Richard Howse, Professor D. Oliver. The club is the third oldest society in the north, the Natural History Society of Northumberland, etc., having been founded in 1829, and the Berwickshire Naturalists' Field Club in 1831. The Rev. Canon Tristram is the present President. Mr. George Harkus, the Sheriff of Newcastle, presided over the tea in the evening and made some congratulatory remarks.

THE Geographical Association has sent to various examining bodies a memorial approved by the Geographical Societies and the Teachers' Guild, requesting that the teaching of geography should be based on physical principles, and that the examinations should lay stress upon the scientific aspects of geography.

THERE has just been founded a "Société suisse des traditions populaires," intended to study the folk-lore and customs of the different Cantons. It will probably publish a review. The subscription is 3 francs per annum, and further information may be obtained from Mr. S. A. Stuckelberg, of Zurich.

THE New York Academy of Sciences has formed a new section devoted to psychology, anthropology, and philology, which will hold meetings on the fourth Monday in each month during the academic year. There has also been started in New York an Anthropological Club for informal discussion.

CONGRESSES and meetings are to be held as follows:—German geologists at Stuttgart in August; German naturalists at Frankfort-on-Main, from September 21 to 26; the Swiss Society of Natural Science at Zurich, from August 2 to 5, during which time the Society of Natural History of Zurich will celebrate its 150th anniversary; the American Association for the Advancement of Science in Buffalo, N.Y, from August 24 to 28; and at the same place the Botanical Society of America, on August 21 and 22.

In December, 1894, we gave an account of the work in connection with high-roads being accomplished by the U.S. Geological Survey (vol. v., p. 406). We now learn that a bill is now before the American House of Representatives to create a Special Commission on Highways, consisting of the Chief of Engineers of the Army, the Director of the Geological Survey, and the Chief of Road Inquiry of the Department of Agriculture. It is to undertake the scientific location of highways on the public domain; the employment of the Geological Survey in the discovery of road materials; the free testing of all road materials offered; the construction of model roads, and instruction in road-making at agricultural colleges and experimental stations.

Mr. T. D. A. Cockerell, of the New Mexico College of Agriculture at Las Cruces, finds himself, like so many enthusiastic scientific men in America, forced to leave his post for political reasons, on June 30. He intends, however, to stay in the country and to go on with his work, especially the agitation for educational reform, and he invites his brother naturalists to join him in founding a biological station in New Mexico. Three years' experience have convinced him of the great value of the climate of that part of New Mexico in the earlier stages of phthisis, and he has himself largely profited by its curative effects. Notwithstanding the abundant energy of the American workers, there is still much to be done in this distant quarter of the Southern States, where the exuberance of interesting forms of life, especially among the insects, is remarkable.

Professor D'Arcy Thompson and Mr. G. E. Barrett Hamilton have been sent by the Government to Alaska to study the causes of mortality among seals in the N. Pacific and Behring Sea. The commission appointed for the same purpose by President Cleveland consists of Dr. D. S. Jordan, Lieut.-Commander Moser, Dr. L. Stejneger, Mr. F. A. Lucas, and Mr. C. H. Townsend.

Dr. Bashford Dean is to conduct an expedition of students from Columbia College, N.Y., including one botanist and three zoologists, to explore Puget Sound, south of Vancouver Island. The party will have the use of the U.S. Fish Commission ss. "Albatross."

To the numerous proposed Antarctic expeditions that we have lately mentioned must be added the one which it is proposed should be undertaken by the German nation. A plan and estimates for this have been published in the *Verhandlungen* of the Geographical Society of Berlin.

Léon Diguet, who has recently returned from a scientific exploration in Mexico, is being sent out again by the French Minister of Public Instruction. He proposes to study the Indians of Guadalajara, Sinaloa, and Sonora, as well as the Cahuila Indians of S. California. Dr. M. Raciborski, of Munich, has been sent to the Buitenzorg Botanical Gardens. Professor V. F. Brotherus, of Helsingfors, has gone to Central Asia to work out the bryological mountain flora of Issikul. A party of four, under the direction of Mr. T. H. Mobley, will start from Lacomb, Alberta, to explore Northern Canada from Edmonton to the Arctic Sea. The trip is to occupy two years.

The Fort Pitt Street Railway Company, of Pittsburg, has, says *Science*, given $100,000 for a zoological garden at Highland Park.

A section of seismology has been created at the meteorological observatory at Athens, under the direction of Mr. Papavasiliou. Its labours will be recorded in a monthly *Bulletin*.

CORRESPONDENCE.

THE FUNCTION OF STOMATA.

THE writer of the article entitled "Verworn's General Physiology," in the June number of NATURAL SCIENCE, is surely ignorant of the recent work on the gaseous exchange of foliage leaves, when he terms Verworn's statement, "that plants absorb their gaseous food through the stomata," a curious slip.

Stahl (*Chem. Centralbl.*, 1894) has shown that when the stomata of a leaf exposed to normal assimilative conditions are blocked, no formation of starch takes place; and more recently, Blackman (*Proc. Roy. Soc.*, 1895) has definitely settled the question for carbon dioxide by the employment of an elaborate and delicate apparatus for the estimation of this gas, and has come to the conclusion that, under ordinary circumstances, the sole pathway in and out of the leaf is by means of the stomata. Although the passage of oxygen has not been worked out, yet, as this gas diffuses more quickly through fine openings than carbon dioxide, it is natural to suppose that its chief entrance and exit is also through the stomata. Thus the whole gaseous interchange of the leaf and the atmosphere appears on a more rational basis than that on the old view of the passage through the cuticle, upheld until lately by some botanists, but now untenable.

Trinity College, Cambridge. J. PARKIN.

[We are obliged for Mr. Parkin's correction. Our contributor must have overlooked a note published in NATURAL SCIENCE (vol. vi., p. 228, April, 1895), in which the result of Mr. Blackman's observations was given.—ED. NAT. SCI.]

THE RETORT OF THE SYSTEMATIST.

ONE would have thought that the time was long since past when a journal of the standing of NATURAL SCIENCE would publish, under editorial sanction, such sneers at the systematic naturalist as are contained in the review of Professor Miall's work, in the April number. "The systematist, like the bibliographer, is necessary, and there are faculties that may be trained by the pursuit of either industry." "Of course, Professor Miall, like *every other scientific man*, knows the retort that the systematist will make." It appears to be the reviewer's opinion, as perhaps also Professor Miall's, that the "systematist" is only a sort of necessary evil, and not a "scientific man." It was the fashion a dozen or more years ago for the morphologist, and especially the microscopic morphologist, to express such opinions as does your reviewer, and point, by way of contrast, to the *real* scientific work that he himself did; he even yet appears to have a lingering contempt for the "systematist." But these morphologists are now in danger of falling into the same contempt from the real naturalist—"those who turn their back on the broad field of nature to peer through a microscope at an infinitesimal portion of it." These are not the exact words of Dr. Merriam, but they express his idea as well as that of most real naturalists. The actual fact at the present time is that the "systematist" represents the highest type of the naturalist, and no one can be a good naturalist who is not more or less of a systematist. If natural history means the habits of plants and animals only, or their physiology, then perhaps the systematist is not much of a naturalist. If it means structure and relationships as well, then he is in a high sense a naturalist. Pray let us hear no more of the cry that a systematist is a necessary evil. He who gives utterance to such views only betrays his own narrowness and incompetence. Such men as Cope, Allen, Merriam, Coues, Scudder, Agassiz, Gill, and a score of others in America, and as many other bright lights in England, are systematists. Do let us concede that they are naturalists and scientific men also.

Lawrence, Kansas, U.S.A. S. W. WILLISTON.

May 24, 1896.

[We beg to refer Professor Williston to the Notes on pp. 1–4 of the present number.—ED. NAT. SCI.]

WHAT IS A "DIAGNOSIS"?

THANK you for your note on my paper containing descriptions of new Coccidæ. The only comment it seems worth while to make is in regard to the use of the word Diagnosis. I presume that you will agree that descriptions which accompany names proposed for new species are diagnoses, rather than full descriptions; that is to say, they aim to present the characters peculiar to the object in question only, or, at any rate, those which distinguish it, taken together, from similar forms. Now my idea of a brief diagnosis, such as those I aimed to give in my paper, is something which will distinguish the species from all species previously known, but which does not necessarily present all the distinguishing characters of the species. A full diagnosis, on the other hand, would give many more characters, with a view to distinguishing the species from others which might be discovered in the future. Even then it is scarcely possible that the list of distinguishing characters would be exhausted; because, for example, in describing an insect, one never mentions the internal anatomy at all, although if one took the trouble to examine it, I suppose it would present some specific peculiarities.

Mesilla Park, N.M. THEO. D. A. COCKERELL.

May 13, 1896.

[As regards the Diagnosis, our view is that of Linnæus and the masters of systematic description. The diagnosis of a genus gives, as concisely as possible, the characters by which the genus is distinguished from other genera of the same family. The diagnosis of a species gives, equally concisely, the characters by which the species is distinguished from other species of the same genus. Such distinguishing points are known as "diagnostic characters." The diagnosis of a family should not repeat ordinal characters, that of a genus should not repeat family characters, that of a species should not repeat generic characters.

What Mr. Cockerell calls "a full diagnosis," we prefer to call a "Description." This should be kept distinct from the diagnosis, and, without being verbose, should be as clear and complete as possible. Probably it will describe many characters that are not diagnostic, but which either confirm the ascription of the species, genus, or family to its place in the system, or which may prove diagnostic some day, when future species, genera, or families are discovered. As a general rule the discovery of a new species necessitates the reconstruction of the diagnoses of some, at least, of the species previously known. This is the work that has from time to time to be done by the monographer; nevertheless, it is incumbent on every describer of a new species to indicate the changes that it renders necessary in our conception of other species. The construction of satisfactory and congruent diagnoses is one of the hardest tasks that a naturalist can set himself. For this reason it is generally shirked by the ordinary species-monger, whose work is on the scientific and literary level of an auctioneer's catalogue.

As for Mr. Cockerell's final sentence, it is charming in its innocence. Mr. Cockerell, it appears, never mentions, much less examines, the internal anatomy of the numerous species he publishes in all quarters of the world. The sooner he "takes the trouble" to do this the better; he will find, to take a single instance, that the genitalia of insects afford not the least certain of criteria, as has been amply proved by such eminent workers as Messrs. Salvin and Godman, and as was again insisted on by Messrs. Elwes and Edwards in the revision of the Hesperiidæ that they communicated to the Zoological Society of London on June 2. To the morphologist we say that external characters have a morphological value; and to the systematist we say that characters of internal anatomy have a systematic value. "This was sometime a paradox, but now the time gives it proof." Let Mr. Cockerel recognise this in his new biological station, and we shall have fewer papers from him on "physiological species."—Ed. Nat. Sci.]

Das Tierreich.

Permit me to note, with reference to your critic's remark on p. 308 of vol. viii., that Bory de St. Vincent subscribed his articles Bory simply (his full name was Jean Baptiste George Marie ——). We can, therefore, by following Bory's own example, save even more space than suggested. Theo. Gill.

Some Corrections.

Through an error in the MS. copy of Professor Gill's review of Boulenger's "Catalogue of Perciform Fishes," in vol. viii., the name *Stereolepis* was omitted from the list of genera on p. 340, and the date of "*Plectroplites*, Gill," p. 341, appeared as 1872 instead of 1862.

A correspondent writes that the statement recently made in Natural Science that Congress had appropriated money for a much-needed new building for the U.S. National Museum is unfortunately incorrect. The bill, it is true, has passed the Senate, but it is very doubtful if at this time it will pass the House of Representatives. Meantime, nearly one-half the museum is closed, partly for repairs, but chiefly on account of radical re-arrangements necessitated by the crowded condition of the exhibition series. Some slight relief will be afforded soon by the erection of galleries, for which provision has been made in this year's appropriation. This, however, will not help the reserve, or study series, which is mainly cared for in the exhibition halls owing to the glaring error of constructing the museum building without attic or basement for storage.

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.*

To our Subscribers and Others.—*There are now published* Eight Volumes of Natural Science. *Nos.* 1, 8, 11, 12, 13, 20, 23 *and* 24 *being* out of print, *can only be supplied in the set of first Four Volumes. All other Nos. can still be supplied at* One Shilling *each.*

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It will shortly be necessary to raise *the price of Vols. I.–IV. still further.*

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

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NOTES AND COMMENTS.

The Excusers of the Preliminary Notice.

We have at last found a defender for the preliminary notice, and it gives us great pleasure to publish in our correspondence pages the letter sent us by Mr. F. A. Lucas, of the National Museum, Washington. We derive still greater pleasure from the circumstance that this letter gives us the opportunity of exposing the underlying grounds of our objection. We do not wish to deny that under certain conditions, such, for instance, as those to which Mr. Lucas alludes, the publication of a preliminary notice may fairly be called a necessity, but this does not make such publication any the less an evil. In such cases it is the conditions themselves that are in fault, and the preliminary notice is merely, as it were, an attempt of the body to fight against more deep-seated disease.

In the case of our American friends, the disease appears to be of the following nature: we in England, happily removed from the intrigues of politico-scientific placemen, are accustomed, on receipt of the beautiful volumes which come to us from the United States, to fall into a rapture of admiration without always considering how long a time has elapsed between the sending in of the manuscript by an author and the issue of the work by the Government. Those who wish to know the difficulties that are placed in the way of sincere and hard-working investigators may turn to a prefatory note attached by Professor Hall to his handbook of the Brachiopoda in the 11th *Annual Report of the State Geologist of New York*, as well as to a similar preface on p. 602 of the 13th *Annual Report*. It is, we have heard, often the case that, when the proof has been read and the plates printed, important publications are still kept waiting for a year or more, although the additional expense of printing off and binding would be trivial in comparison with that already incurred. We are still waiting for Dr. Brown Goode's paper on deep-sea fishes, and the second volume of Major Bendire's "Life-histories of North American Birds," which we understand were ready for publication a year ago. What the reasons for this and similar delays may be, it would be difficult to explain; there are, no doubt, plenty of convenient answers to inconvenient questions ready filed for despatch in some Circumlocution Office at Washington—at least, we suppose there is such an office there just as there is at Whitehall. The fear and the experience of such delay is undoubtedly the cause of the extensive production in America of those exceedingly irritating pseudo-publications known as "advance sheets," which the authors are accustomed to obtain from the printers by some method that we are unable to explain, which they distribute to a few favoured friends, and which they rely upon to ensure them the coveted priority. The difficulties in the case are not lessened by the fact that some of these advance sheets are dated, while others are not; the consequence is that the worker of a subsequent generation is constantly puzzled by his dates, and has to waste his time in ransacking second-hand booksellers for these absurd "preliminary notices" and "advance sheets," although the final publications may be standing neatly bound upon his shelves. The distribution of an advance sheet is either publication or it is not: if it is publication, then subsequent publication is nugatory; if it is not publication, it should not be distributed at all.

Another disease of which the preliminary notice is a symptom is this perpetual craving after credit. It is very human, very natural, that a man who has done a piece of good work should dislike seeing the praise wrongfully captured by another; but this, too, is an evil—that people should think so much more of their own self-advancement than of the advancement of science that they should be willing to steal the results of another. Instances of this that have come to our knowledge from America, although we do not mean to say they are confined to that country, force us to believe that there are some people who are men of science first and gentlemen afterwards. It is not likely that either science or their own reputation would be injured if they were to reverse the order; and as for credit, surely there is not so very much credit, after all, attached to the lucky finder or receiver of some new species. True credit belongs to him who works out its structure and affinities with pain and perseverance. Such work is not of a nature to be either accomplished or published in a hurry, and whether the subject of our investigation be blind batrachians or extinct sea-monsters, it is not likely that we shall jump at correct conclusions before accumulating, sifting, and working out a crowd of details. Here let us, to save any suspicion of personality, quote some remarks made by a reviewer in *Nature*:—"The tendency at the present among a certain class of small workers to premature publication and to hasty generalisation, leads to most disastrous results in the accumulation of third-rate literature. A single fact, which often turns out to be no fact at all, is hidden in pages of raw and worthless speculation." Does it not sometimes strike these eager scribes that their work would suffer no harm by being brought nearer to maturity? After all, what they are so anxious to forestall other people with, is often nothing more than an error, the publication of which they subsequently regret. We have known authors bitterly to resent criticism of such work, on the ground that it was "nur vorlaüfig"; we have known them calmly to ignore their own published work, flourishing out names and facts as new a year or two later on. As we said of the advance sheet, so we say of the preliminary notice—it is either publication or it is not, and the sooner it is regarded as not publication the better it will be for the world of science.

These remarks obviously apply chiefly to systematic work, to cases where new names and the description of new species and genera are involved. In the happier department of anatomical work the preliminary notice may sometimes serve a useful purpose. It is the newspaper of science and announces to those interested the nature of new discoveries and the lines upon which investigations are being conducted. Take, for instance, the placenta found by Mr. Hill in a marsupial, and referred to on another page of this issue. It is a discovery of the greatest interest, and we are glad to hear of it long before there is time for the preparation and publication of the elaborate figures and descriptions. The preliminary notice in a case of this kind announces a zoological fact, and is totally different from the preliminary notice of the systematist and theorist, inasmuch as insufficient descriptions of new species and unsupported speculations are not zoological facts.

"Premature Births."

An esteemed correspondent draws our attention to the way in which new species are introduced to the world in the *Journal* of the Marine Biological Association of the United Kingdom. On turning to the number issued in February last, we find that Professor C. C. Nutting publishes imperfect descriptions of three new species of hydroids, of which full descriptions with figures are promised to be given in the *Annals and Magazine of Natural History*. Next comes Mr. Bassett-Smith with a number of new copepods, of which "a description, with figures, will be published shortly elsewhere." In the section headed "Faunistic Notes" we find a description, which is certainly more intelligible, but still published in rather too modest a fashion, of a new species of nudibranchiate mollusc, by Mr. W. Garstang. Further on, in a paper entitled "Algological Notes," by Mr. George Brebner, we are introduced to some four names under the form "Batt. in lit.," although it appears from a note at the end of the paper that the names were no longer *in literis*, but had been already published in the *Journal of Botany*. Whether these names be *nomina nuda*, or whether the few lines that follow each of them be intended as a preliminary description, does not very much matter; in either case the introduction of new names in such a manner is not to be commended. "It can," says our correspondent, "only be from want of thought that such a plan is followed in an otherwise excellent journal."

Another letter we have received says: "Most of us must earnestly desire that you will continue your crusade against the 'preliminary notice.' No naturalist can wish to have to study the same thing twice over, first in an incomplete and puzzling form, and a year afterwards in an explanation long drawn out and devoid of freshness." Our correspondent's meaning is well illustrated by some remarks recently made by Professor G. Lindström in a very valuable paper, "Beschreibung einiger obersilurischer Korallen aus der Insel Gotland" (*Bihang. K. Svensk. Vet.-Akad. Handl.*, Bd. xxi., Afd. 4, No. 7). It appears that many years ago Dr. Lindström introduced certain species of Upper Silurian Corals into zoological literature, partly by their names alone, partly with short preliminary descriptions. The consequence has been (and we do not think that the learned author has any right to complain) that many of his names have received at the hands of various authors a wider meaning than he intended, and that many of them have, in fact, been diverted to forms quite other than he originally meant. To the ordinary person it must certainly appear that there would have been far less confusion introduced into a difficult branch of science had Professor Lindström never published these preliminary descriptions at all.

Description of Species.

In *Memorias* de la Société "Antonio Alzate," vol. ix., p. 32, Professor Herrera asks three questions, to which he desires full replies. (1) What subjects of study do you know that are more important for natural history than the simple description of new species and sub-species? (2) Synonymy becomes daily more confused: do you know the cause? what is the remedy? (3) Do you think it advisable that the authors' names should no longer be attached to the names of species and sub-species, but rather the date of publication of those names? For example, instead of *Tamias striatus typicus*, Merriam, one would write *Tamias striatus typicus* 25,2,86.

Our readers will have their own answers to these questions, but perhaps we may be allowed to indicate what would be our own. (1) Any subject of natural history study seems to us more calculated to advance science than the mere description of species—species, if they are to be described, should be compared one with another and placed in their proper systematic position. It is only when this is done that the study has any claim to be a branch of science. (2) The causes of confusion in synonymy are two: first, the ignorance, real or assumed, of other people's work that is still displayed by the majority of name-givers; secondly, the incompetent descriptions, often without illustrations, that continue to be published by many people who ought to know better, especially in the form of "preliminary notices," so that when the literature is found it cannot be understood. As to our remedy, we have already proposed it. We have said, Let the list of species be drafted by a body having some kind of authority, and let the zoologists of the world agree to accept these names and to make the publication of the list the date before which they will not go (*see* NATURAL SCIENCE, vol. viii., p. 218, April, 1896). (3) There are many people, to whom the term speciesmonger certainly can not be applied, who desire to see the name of the author attached to the name of his species, since it suggests to those unacquainted with systematic literature the place in which the original description may possibly be found. On the other hand, there is no room for doubt that it is this continual repetition of authors' names that leads a certain class of minds to suppose that there is some honour and glory to be gained by attaching new names to innocent animals and plants. This vanity is at the bottom of much hurried and imperfect work, the disgusting race for priority, and of the desire to disinter long-buried names. The suggestion that a date should be attached to the name is not open to the same objection as is affixing authors' names, while it is just as likely to be of service to the ordinary naturalist, since he can at once turn to the name in the *Zoological Record* for that year. Of course, it would be impossible to give so exact a date as Professor Herrera gives in the instance he quotes; at the same time, if the custom were adopted, we should probably be better able to insist on authors and editors giving the correct date of their publications, which is at present an exceedingly difficult matter to determine. The suggestion, therefore, strikes us as an excellent one, and we may point out that a slight extension of it might have the further effect of steadying nomenclature, since two names that were the same so far as their orthography was concerned could be adequately distinguished by means of the date. This is, we believe, the very practical plan that is pursued by the Kennel Club, the only condition being that the same name shall not be used twice within five years. If zoologists are not above taking a hint from the kennel and the course, it is possible that in some such suggestions as these we may find a way out of all our troubles.

THE LARVA OF *Leucosolenia*.

WE have received from the Royal Society the sheets of an interesting communication made by Professor Ray Lankester on behalf of Mr. E. A. Minchin. Mr. Minchin is one of the few Oxford Fellows who, instead of making their fellowship the foundation of a quiet domesticity, have spent their time almost continuously in research. The contribution now before us deals with the very interesting amphiblastula larva, specimens of which in all stages Mr. Minchin obtained, in the case of *Leucosolenia variabilis*, at Roscoff. The minute larvæ leave the mother sponge by the osculum, and at once rise to the surface of the water, where they swim for about twenty-four hours. Thereafter they sink to the bottom, swim sluggishly for a second period of from twelve to twenty-four hours, and then become fixed, and undergo metamorphosis. The newly-hatched larva is a slightly oval body, the larger anterior pole of which consists of a single layer of ciliated cells, each cell being provided with a single long flagellum. The posterior pole has a smaller number of larger and granular cells. Between the two sets is a zone of intermediate cells, which, as Mr. Minchin was able to make out, are transitional stages between the ciliated cells and the granular cells. During the free-swimming larval period the granular area gradually increases by transformation of the cells of the intermediate zone, while the intermediate zone grows by transformation of the adjoining ciliated cells. The centre of the larva is occupied by a mass of pigment, and sections showed that this is part of a remarkable larval organ with pigment, a lens-like body, and central granular cells. It is in fact an eye, or rather a light-perceiving organ of a very simple character. This organ apparently is completely thrown out at the metamorphosis.

The free-swimming larva fixes itself by its anterior pole. The granular cells grow round the ciliated cells, and the metamorphosis is completed in a few hours. The granular cells become a single superficial layer of flattened cells, a layer which Mr. Minchin calls the *dermal* layer, while the interior is occupied by a solid mass of the original ciliated cells, now called the *gastral* layer. These two layers develop independently of each other in their subsequent stages, so that in different larvæ different stages of the dermal and gastral layers may be associated. This seems to us a point of considerable interest, and one upon which an extended set of observations in all sorts of embryos would be useful. For it seems to bear upon the nature of the process of development, and upon the scope of the intrinsic forces which play at least a large part in the elaboration of an individual. The dermal layer gives rise to an inner layer, the cells of which unite into groups and secrete the triradiate spicules, and an outer layer, each cell of which secretes a single monaxon spicule. A split appears in the gastral mass, and around this the gastral cells become arranged in a single layer, except at one point, the future osculum, at which no gastral cells lie and where the covering of dermal cells ruptures.

New Mammals from Victoria.

The discovery of new mammals is so rare an occurrence that we hasten to record *Dasyuroides byrnei*, n.g. et sp., and *Sminthopsis larapinta*, n.sp., two marsupials discovered by the Horn Expedition in Central Australia, and described by Professor Baldwin Spencer in the *Proceedings of the Royal Society of Victoria*, vol. viii., pp. 5–13, as well as further described and figured in the account of the Horn Expedition. *Dasyuroides* is a burrowing, insectivorous marsupial of nocturnal habits, which in the general form of the body closely resembles a large *Phascologale*, or a small *Dasyurus*, while its dentition is also like that of those species of *Phascologale* which approach *Dasyurus*. The skull, on the other hand, agrees with that of *Sminthopsis* in the character of the nasal bones, while the hindfoot in shape and in the absence of a hallux differs from that of both *Phascologale* and *Sminthopsis*. The specimens on which the description is based consist of six males and one female, and the dimensions of an adult male in alcohol are :—head and body, 182 mm.; tail, 130 mm.; ear, 18 mm.; hindfoot, 38 mm. The new *Sminthopsis* is a small mouse-like form, separated from the two known species, *S. murina* and *S. crassicaudata*, by a long, very stout, and highly incrassated tail, and by the greater relative length of the hindfoot.

A Placental Marsupial.

The absence of a true allantoic placenta has for long been regarded as a chief diagnostic character of the marsupials, distinguishing them, as well as monotremes, birds, and reptiles, from higher Mammalia. A recent discovery of J. P. Hill, demonstrator of biology in the University of Sydney, seems to destroy this generalisation. As yet we have seen only a preliminary note (*Proceedings* of the Linnæan Society of New South Wales, vol. x, p. 578), but the description and figure seem to make it plain that in the short-nosed bandicoot, *Perameles obesula*, an allantoic placenta occurs. The allantois is well developed, large, and provided with an abundant blood-supply. It consists of a long and somewhat flattened stalk and a terminal, expanded, and much flattened vesicular portion. The mesoderm of the outer surface of the allantois is fused with the mesoderm of the serous membrane. The capillaries of the vesicular portion, containing the fœtal blood, become closely applied to the surface of the uterine mucosa, and form with it a closely interlocking system, since they dip down into the substance of the mucosa to form short villous processes. The uterine mucosa is very richly supplied with blood, the maternal capillaries forming a net-work on and near the surface of the mucosa, so that the fœtal and maternal blood are thus brought into very close relation. The allantois of *Perameles* is thus functional both as a respiratory organ and as an organ of nutrition. Although this is truly an allantoic placenta, the differences between it and the placenta of higher mammals are sufficiently plain. It is not necessary to suppose that this marsupial placenta augurs a clear zoological affinity between the Peramelidæ and the Eutheria. But, no doubt, Mr. Hill will discuss these problems when the complete account of his investigations appears.

The Plesiosauria.

Mr. C. W. Andrews has been issuing useful additions to our knowledge of the structure of the Plesiosauria, but in no instance have his unique opportunities been better turned to advantage than in the description of the Plesiosaurian skull. His account of this structure appears in the *Quarterly Journal* of the Geological Society for May, and is based on a specimen from the Lias of Lyme Regis, so perfectly preserved as to be comparable to a specimen taken from a recent animal.

The net result of his observations leads him to believe that "among reptiles a certain similarity of palatal structure does not necessarily imply any close relationship, but the very great resemblances existing between the Plesiosaurian and Rhynchocephalian palates, reinforced by the numerous points of likeness in other portions of their skeletons, pointed out by Baur, lead to the conclusion that the Sauropterygia, notwithstanding their single temporal arcade and thecodont dentition, are descended from a primitive Rhynchocephalian reptile." In this opinion Andrews is in complete harmony with Baur, Boulenger, Howes, Lydekker, and other writers.

Australian Pictographs.

We are glad to see that Australian scientific men are beginning to record the artistic efforts of the vanishing 'black-fellow.' The latest contribution to this interesting subject is a communication to the Royal Society of Queensland (*Proc.*, vol. xi., pt. 2), by Mr. R. L. Jack, the well-known Government Geologist. The Royal Society of Queensland evidently does not take its anthropology very seriously, judging from Mr. Jack's mistaken efforts to be humorous—or does he think this is popularising science? We hope that the figures have been in the first place carefully copied from the originals, and in the second place accurately reproduced. We have some doubts on the subject, as we find that the man in fig. 6 is described as having ten locks, but eleven are drawn; and, similarly, those in fig. 10 are drawn with eight locks instead of seven, as stated in the text, and their three hands are drawn with four fingers each, though one is credited with five fingers. This may seem trivial criticism, but, as a matter of fact, it is not so. The most absolute accuracy is requisite in transcribing native drawings and patterns, otherwise they lose almost all their value. A published drawing is of great value to the student at home as a document, but its accuracy should be above suspicion.

Owens College Biological Studies.

We received some time since, from the authorities of the Owens College, Manchester, vol. iii. of *Studies from the Biological Laboratory*. This, like former volumes, consists of reprints from other publications of biological treatises written by those connected with Owens College, and it forms a convenient method of displaying the activity of the biological department of that institution. The present volume opens with the presidential address delivered to the Biological Section of the British Association in 1890. It is a discussion of the general questions connected with development, in the most interesting style of the late Milnes Marshall. The second paper, reprinted from the *Proceedings* of the Zoological Society of London, contains the results obtained by O. H. Latter when, as Berkeley Fellow, he investigated the development of *Anodon* and *Unio*. The volume also contains the careful studies of marine Turbellaria made by F. W. Gamble, and contributed to the *Quarterly Journal of Microscopical Science*, Dr. Hurst's papers on *Archæopteryx*, which appeared in our own pages, and a number of other reprints by various authors.

Cambrian Fossils in Victoria.

In our February number we alluded to the discovery of the Cambrian trilobite, *Olenellus*, on the boundary between South Australia and Queensland in the far north. Cambrian rocks, as evidenced by fossils, were previously known in the Yorke Peninsula, in other localities within 300 miles of Adelaide, in Tasmania, and also from the Kimberley district of West Australia, although the exact locality of this latter appears to be rather doubtful. The occurrence of rocks of this age in Victoria has hitherto been assumed upon purely stratigraphical grounds. No remains, at all events of such a nature as to prove their age, had been found contained in them. But now, in the *Proceedings of the Royal Society of Victoria* (vol. viii. pp. 52–64, April, 1896), Mr. R. Etheridge, jun., describes a new genus and species of trilobite, which has been obtained from a limited outcrop of shale in the Heathcote district, Victoria, where Cambrian rocks had previously been supposed to exist. The fossils were found in 1894, and the time that has elapsed before publication is due to the care that Mr. Etheridge has obviously taken in determining their identity. The specimens, which consist of cephalic shields and pygidia, are all so decorticated, that their study is somewhat difficult. Mr. C. D. Walcott, to whom drawings were sent, identified one as a fragment of *Olenoides quadriceps* (Hall and Whitfield) a Middle Cambrian species, and said "The fossils undoubtedly belong to the Middle Cambrian Fauna, as they are not of the type found in the Upper or Lower Cambrian." Mr. Etheridge, however, after a careful examination, regards the fossils as representing a distinct genus and species, which he names *Dinesus ida*, in allusion to the two supplementary circumscribed lobes of the glabella, and to Mount Ida, near which the fossils were found. The little brachiopod which occurs with the trilobite is doubtfully referred to *Lakhmina*, a genus of the Trimerellidæ, which has been found in the Cambrian series of the Salt Range in India. Whatever may be the precise zoological position of the fossils recorded, there seems little doubt that they prove the existence of a Cambrian fauna in Victoria.

LINCOLNSHIRE GEOLOGY.

AMONG the lists of "new occurrences" and the contributions to parochial "floras," which crowd the pages of our provincial natural history magazines, it is refreshing to come across such a paper as that by Mr. J. H. Cooke in the *Naturalist* for July. Mr. Cooke, who is favourably known for the work that he has carried out during his residence in Malta, has returned to his native country to become the honorary secretary of the Geological Section of the Lincolnshire Naturalists' Union; and the paper that has attracted our attention is some wholesome advice and valuable suggestions given by him to the members of that Section, indicating how they may "utilise their energies to the best advantage by gathering material for the working out of some of the problems in the geology of the county." Among the problems to which attention is drawn is the demarcation of the line between the Kimmeridge and Oxford Clays, and also of that between the Kellaways Rock and the Cornbrash. "The Spilsby sandstone and the determination of its derived fossils, as well as the tracing out of sections showing the nodule bed which invariably occurs at its base, leave much to be desired. Good work, too, might be done around Gainsborough in distinguishing between, and mapping out, the estuarine and the eolian sands that occur so plentifully in the alluvium of the Trent Valley; and in the north of the country in studying the lithology and fossil contents of the superficial clays of the Ancholme Valley, for the purpose of determining whether they be true Oxfordian or of Glacial origin." The determination and correlation of horizons by careful collection of fossils, especially in the Liassic and Kimmeridge clays, is another desideratum. The various river deposits of Lincolnshire also are practically virgin ground, and like the gravels of the Bain and the Witham will probably yield remains of extinct Mammalia. Mr. Cooke then turns to the investigation of the various rocks of the country, such as the phosphate- and iron-bearing beds. He recommends their careful investigation by the chemist and the microscopist, confident that this, besides throwing light on the question of their origin, will lead to valuable commercial results. Finally he urges the systematic study of the erratic blocks of Lincolnshire, upon lines similar to those on which it has been carried on in the neighbouring shire of York. This stimulating paper is doubtless a sample of papers that might be written for every county in England, and shows that there is still plenty of work for the amateur geologist within the limits of his own parish. But Mr. Cooke wisely warns his readers against confining their ambition to the mere collection of records. "They should make themselves *en rapport* with the philosophy of their subject, and endeavour to keep themselves in touch with all new discoveries and theories appertaining to it."

Fossil Monocotyledons.

To the most recent issue of the *Annals of Botany* (vol. x., p. 205) A. C. Seward supplies some notes on the geological history of monocotyledons. The evolution of angiosperms and the relative position in the genealogical tree of the two subdivisions, monocotyledons and dicotyledons, afford problems of the highest interest, but to be approached only with extreme caution and a resolve to take into account every available piece of information. One important point, namely, the first appearance in time of the group in question, is the subject of Mr. Seward's remarks. "It is often assumed," he says, "that monocotyledonous plants are older than dicotyledons, and this assumption would seem to be supported by the facts of geological history." We remember a paper by Mr. Henslow, published in the Linnean Society's *Journal*, and somewhat severely criticised in Natural Science (vol. iii., p. 130), in which a reverse order was asserted, to wit, the origin of monocotyledons from dicotyledons, as the result of taking on an aquatic habit. The evidence, however, seemed anything but conclusive; but, on the other hand, Mr. Seward is forced to admit, with regard to palæontological data, "that no undoubted and satisfactory monocotyledonous plant has so far been recorded from strata older than those in which typical dicotyledons first occur." As the author points out, there are numerous difficulties and sources of error in the determination of fossil monocotyledons. We depend very largely for our knowledge on more or less imperfect casts or impressions of structureless stems and leaves, and it is conceivable that if the leaf-stalks of certain ferns and cycads were only partially preserved they might be regarded as monocotyledonous. Parallel venation is a very unsafe guide, and far too extensively followed. Many narrow leaves, phyllodes, or phylloclades of dicotyledons, would probably, if found detached in a fossil state, be referred to the other group.

The author then proceeds to review, critically and individually, the palæozoic and mesozoic 'monocotyledons.' Many are obviously too fragmentary for any satisfactory conclusion. It is often difficult to decide whether we are dealing with casts of animal or plant structure, as in the case of *Aroides*, which has been considered by some as part of an aroid spadix, by others as a portion of the anal sac of a crinoid. The egg-capsule of a fish is the more generally accepted alternative in another case. Other genera are referred to calamites, mosses and conifers, and the conclusion of the whole matter is that the evidence at present available affords no proof of the existence of monocotyledons in Pre-Cretaceous strata.

Cypresses.

Dr. Masters has made another valuable contribution to the literature of conifers. The most recent issue of the Linnean Society's

Journal (vol. xxxi., pp. 312–363) comprises his monograph, or, as he prefers to style it, "general view" of the genus *Cupressus*. Cypresses are distinguished from their near allies the Thujas, which have similar foliage, by the shape of the cone-scales, those of the former having a shield-shaped expansion at the free end, which is absent in the latter. In *Cupressus*, also, each scale bears two or more seeds; in *Thuja* some scales only are fertile.

There are fourteen species, which, however, are so variable that it is hard to find distinctive characters which shall be generally applicable. A further difficulty arises from the polymorphy of the individual, the plant assuming different appearances at different periods of its growth. These stages of growth are usually transitory, but occasionally become more or less persistent, and when the whole or greater part of the plant is concerned, may produce an appearance quite different from the usual one. The "genus" *Retinospora* was founded on such plants, now known to belong to species of Cypress, Juniper, and Thuja. The identity is proved by the existence of intermediate forms on the same tree, by the presence of cones characteristic of the species, and by the fact that the leaf-characters of "*Retinospora*" are also true of the seedling plant, which only gradually assumes the adult foliage.

An interesting physiological difference exists between the various kinds of foliage. Cuttings bearing the primordial leaves strike freely, while those bearing the adult form take root less readily, "as if the vegetative energy were more or less arrested in anticipation of the commencement of the reproductive stage." Occasionally, however, flowers are borne on shoots bearing primordial leaves, as in a form of *Cupressus pisifera*, one of the Retinosporas.

Another feature, one of important horticultural value, is the tendency to "fastigiation," or an upward growth of the branches at an acute angle, such as occurs also in the Irish Yew.

Cypresses are found in a native state from South-eastern Europe, through the Levant and Persia, to the Himalayas, and in China and Japan. In the New World, there are two species in North-west America, several in California and the mountains of Mexico, and Guatemala; while on the eastern side of the Northern Continent *C. thyoides* extends from north to south.

Diatoms.

There is evidently some work to be done on these microscopic algæ. At the Linnean Society's meeting on June 18th, Mr. G. Murray showed a series of lantern-slides, illustrating some very important observations on their reproduction. Professor Cleve has already figured in a Swedish journal a specimen of *Biddulphia aurita*, showing a young individual within the mother-cell. In the same genus Mr. Murray has also observed a still earlier stage, showing the contraction and rounding off of the contents of the mother-cell. In a species of *Coscinodiscus* he saw a valve with a new diatom within it, and one with a pair of new diatoms, also the same species with cell-contents rounded off into eight and sixteen portions, and further free packets of eight and of sixteen young diatoms, held together by a fine membrane, as they had doubtless escaped from a parent-cell. Cases like the earlier recorded one of *Biddulphia*, where one new individual is produced, appear to be merely a rejuvenescence of the mother-cell. Mr. Murray's observations of preliminary divisions of the contents into eight and sixteen are of far greater interest, suggesting a reproduction by free-cell formation, a process hitherto unrecorded in the family. These discoveries show what a rich area of investigation is open to those who have the opportunity of examining the surface flora of the sea a few miles from the coast. The observations in the present instance were made while on a cruise round the northern coast of our island on behalf of the Fishery Board for Scotland.

Studies on Indian Garnets.

In a paper on "the Acicular inclusions in Indian Garnets" (*Records Geol. Surv. India*, vol. xxix, p. 16), Mr. T. H. Holland investigates the hair-like bodies in garnets from southern India, and contests Lacroix's conclusion that they consist of rutile. He regards them as an excellent example of schillerisation, and therefore as of secondary origin. The isotropic character of the garnet in which they lie enables their optical properties to be fully studied. Mr. Holland determines that the crystals are monoclinic, with their principal axes parallel to the edge of the octahedron of the including garnet, their orthopinacoids parallel to the face of the rhombic dodecahedron, and their clinopinacoids parallel to that of the cube. It seems possible that the so-called "faces" of the needles, could they be actually seen and not inferred, would be found to be merely superinduced by the mode of solution of the garnet, the material filling up the negative crystal having become continuously crystalline in each case and giving the optical properties recorded. But the constancy of Mr. Holland's results probably gives him good reason for regarding the long axes of the hairs as true crystallographic axes. The blue quartz, moonstone, and hypersthene, in the same rocks are also schillerised, a fact which strongly supports the author's contention that the asterism of the garnets is similarly due to secondary action.

In another interesting paper, "On the Origin and Growth of Garnets and of their Micropegmatitic Intergrowths in Pyroxenic Rocks" (*op. cit.*, p. 20), Mr. Holland touches wider ground, and leads us to reconsider our position with regard to the structure of some well-known rocks. All over the world there are masses of granular structure, remarkably similar in their general characters, and containing plagioclastic felspar, rhombic and sometimes monoclinic pyroxene, garnet, magnetite, and perhaps quartz. The garnet often streams out in rays from a centre, forming micropegmatitic intergrowths with other minerals, after the manner of the spherulitic groupings in many eurites or fine-grained granites.

In the diorites of Chota Nagpore and the Sonthal Pergunnahs in Bengal, and in a series of masses from the hills of the Madras Presidency, ranging from granites to peridotites, Mr. Holland has studied the development of garnets by interaction among the original constituents. Where the garnet lies against pyroxene, or against the hornblende which is paramorphically derived from pyroxene, a reaction-border is visible in microscopic sections; moreover, the garnet bulges out towards the adjacent pyroxene, filling curved recesses in the latter, as if it had arisen at the expense of its neighbour. The stages seem to be as follows: the pyroxene becomes schillerised; then follows the formation of a zone of hornblende, which passes into a reaction-border, resembling the mingled materials known as "kelyphite"; and finally, according to the author, true garnet appears. The field-relations of the more pyroxenic and the more garnetiferous masses support the view that the latter are metamorphosed varieties of the former, the granular ("granulitic") structure having arisen from dynamic changes. Mr. Holland observes a fact commonly noticeable in our European "pyroxene-granulites"—the colour of the garnet and the pink tint of the pleochroism of the hypersthene are closely similar in the same rock-section; and he urges that this is due to a significant similarity in chemical composition. Anon he grows bolder, and regards the micropegmatitic intergrowths of felspar and garnet as of secondary origin, the felspar itself being "a by-product in the decomposition of the pyroxene."

We fancy that Mr. Holland accepts too unhesitatingly the theory of the secondary origin of the similar intergrowths of quartz and felspar, such as are common in the so-called "granophyres" of Rosenbusch. Nor is the analogy a safe one, for surely micropegmatitic structure must be regarded as primary in a still wider range of igneous rocks, equally with the pegmatitic structure of so many igneous veins. The value of the present paper lies in its attempt to connect the phenomena of a large series of rocks; and the force of its arguments will at any rate compel us to study again, especially in their field relations, the "pyroxene granulites" of more familiar areas.

THE SIGHT OF CHILDREN.

MR. BRUDENELL CARTER has recently presented to "My Lords" of the Committee of the Council for Education a valuable report upon the vision of elementary school children in London. Children to the number of 8,125, in twenty-five schools, were first submitted by their teachers, according to his directions, to the simpler test of vision.

This preliminary test showed that only about forty per cent. were possessed of what is regarded as normal vision. Of the remaining 4,900 odd, between two and three thousand were examined by Mr. Carter or by Mr. Belcher Hickman, who assisted him in the investigation. The examination of the whole number was impossible for many reasons, of which the chief was that their professional occupations made it impossible for the two gentlemen to conduct their investigations except in the afternoons. Moreover, a considerable number of parents objected, and holidays and the termination of school career interfered with the examination of many cases. It is believed, however, that quite a sufficiently large number of cases was studied to lead to valuable conclusions.

One of the most striking results is that there appears to be no special reason for attributing any increase in short sight to the influence of school-work and school accommodation. Many of the worst cases occurred in particularly well-lighted schools, and among children who were so young that the influence of school life could have had little time to operate. Moreover, recent optical work has made it possible to distinguish between simple myopia, which is more than likely to be an inherited structural peculiarity, and the progressive myopia which results from undue straining of the eyes. Cases of the latter kind were very rare, and bore no relation whatever to school life and school accommodation. This report will be a source of considerable comfort to many anxious school managers.

Process-Engraving in Colours.

In our note on the new photography and natural science (vol. viii., p. 375), we threw out a suggestion as to the application of photography in colours to the production of half-tone blocks for printing purposes. A greater advance than we even dreamt of has, however, it appears from the *Photogram*, been made by Mr. James W. McDonough, of Chicago. His discoveries consist, first, of photographing colours, and, secondly, of the application to purposes of printing. The photographic process is a simple adaptation of ordinary photography. A glass screen, ruled with lines from 300 to 600 to the inch, like that employed in the usual manufacture of half-tone blocks, has its lines coloured with aniline dyes, red, green and blue successively, the colour being everywhere of the same thickness. This is placed in the camera, immediately in front of an orthochromatic dry plate, on which a black and white negative is obtained with lines corresponding to the screen. From this negative the positive is made in the ordinary manner on glass or paper. If the transparent positive be placed in front of a screen like that used in the camera, so that the lines exactly register, the photogram will appear in natural colours; or if the paper on which the print is made be ruled exactly like the screen with red, green, and blue lines, which it may be mentioned are so minute and so close together that the paper looks white, then if the negative be placed over the paper so that the lines register, the print, which is made in the usual way, appears as a photogram in natural colours. Now for the application to printing. If an ordinary half-tone block be made from the negative, then impressions from this, printed in ordinary printing ink, on paper similarly ruled with coloured lines, will produce a result similar to that of the photogram in natural colours. If this account does not exaggerate the perfection of the work, it is clear that before long we shall be able to reproduce coloured illustrations in our scientific books of far higher quality than any that have hitherto been attempted, and at a cost but slightly exceeding that of the ordinary half-tone process print. At present, however, it seems to us that both photograms and process prints must be very dull in colour, since by the very conditions of the process, white itself must be two-thirds on the way to black. Moreover, since in printing the photograms it is absolutely necessary for the lines to register to within one-six-hundredth of an inch, we do not see how the difficulties produced by slight contractions and expansions of film and paper can be got over.

American Entomology.

We have received the third and fourth bulletins of the technical entomological series issued by the U.S. Department of Agriculture. The former is a revision by Mr. C. L. Marlatt of the North American sawflies of the sub-family Nematinæ. In his classification of the group Mr. Marlatt follows Fr. Konow, the old genus *Nematus* being split up into several genera. Many new forms are fully described and several figured. These insects are most numerous in the Boreal and Transition zones of North America, decreasing in the South. A similar distribution is to be noted on our side of the Atlantic, for while Sweden possesses 95 species and Scotland 70, Southern Italy has only 12. The fourth bulletin comprises short papers by various authors on injurious insects likely to be introduced into the United States from Mexico and Japan. It appears that the entomologists are watching the frontiers prepared to wage war on invaders.

I.

Joseph Prestwich.[1]

AMONG the more distinguished of the second generation of British geologists — a band comprising such men as Godwin-Austen, Falconer, Morris, Edward Forbes, Egerton, Jukes, Ramsay, and Daniel Sharpe—the subject of our present memoir has long outlived each one of them, and the close of his life, at the advanced age of 84, severs the most prominent link which connected the geologists of the present day with the Old Masters.

Joseph Prestwich was born at Pensbury, Clapham, on March 12, 1812, and was descended from an old Lancashire family. One of his ancestors, Sir Joseph Prestwich, Bart., was an active Fellow of the Society of Antiquaries, and a manuscript written by him about the year 1798, dealing with the subject of earthquakes, was published by Joseph Prestwich in the *Geological Magazine* for 1870. At one time Prestwich entertained the idea of claiming the baronetcy, which his father had declined to take up, but owing to the loss of documents this intention was abandoned.

Receiving his early education partly in London, partly in Paris at a school attached to the College Bourbon, and partly under the famous Dr. Valpy at Reading, Joseph Prestwich completed his studies at University College, London. There he learnt chemistry under Dr. Turner, and natural philosophy under Dr. Lardner; and he gained some acquaintance with mineralogy and geology from a few lectures included in his course by the Professor of Chemistry. That he had a leaning towards experimental science was evident, for he subsequently formed a laboratory, which he maintained until about the year 1860. His own tastes would have prompted him to adopt a profession, but circumstances caused him to enter his father's business of wine merchant, and in this he was closely occupied for about forty years until 1872, when he retired from his office in Mark Lane.

The brief introduction to geological science which Dr. Turner had given, was destined to bear the most excellent fruit. Prestwich was thus led to examine the collections of fossils in the British

[1] For some particulars relating to Sir J. Prestwich we are indebted to an article printed in the *Biograph* for December, 1881, and reprinted with additions and revisions in the *Geological Magazine* for June, 1893.

Museum; and the works of Conybeare and Phillips, of De la Beche, and Lyell, became his text-books.

Entering the field of geology, as he tells us, for relaxation from the cares of commercial life, he had in his early years only such time as could be snatched from business at intervals, and chiefly on Saturdays and Sundays. Fortunately his duties led him into various parts of the country, and every opportunity was taken of making acquaintance with the physical features and structure of the districts he visited. It is, however, wonderful to find how much he achieved, how early he had mastered the principles of geology, and how sound were his interpretations of facts.

His holidays during the years 1831 to 1833 were for the most part spent in the region of Coalbrook Dale, and the results of his researches were communicated to the Geological Society of London in 1834 and 1836. This work was published in full in the *Transactions* of the Society, and looking at it now it may be regarded as a model of what a memoir should be on such a subject as the coal-field and its associated strata. The Silurian and Carboniferous rocks, the New Red Sandstone, the igneous rocks and the drifts were all duly described, and what is more remarkable, considering the youth of the author, the superficial extent of the various rocks was shown on a map of the scale of one inch to a mile, in a manner differing in no very important particulars from the subsequently published map of the Geological Survey. The structure of the area and its faults were carefully depicted, while the organic remains which Prestwich had obtained were described with the aid of his friend John Morris. So highly indeed would we speak of this work, that had the author done nothing subsequently, we believe it would have entitled him to a permanent place on the roll of those geologists who have rendered distinguished service.

In 1835 another paper was read by Prestwich before the Geological Society, on the ichthyolites of Gamrie in Banffshire, and this was his first published work. In 1837 he supplemented it with observations on the drift deposits, including those of Blackpots, and he noted the existence of a raised beach.

These early studies give a good idea of the bent of his mind, his attention being given to stratigraphical geology and to the physical conditions under which strata were accumulated. In later years he turned again to the Coal-measures in other regions, especially in Somerset, and to their possible underground range in the south-eastern counties, while the subjects of drifts and raised beaches gained eventually more and more of his attention.

Prestwich was elected a Fellow of the Geological Society in 1833, when Greenough was president; and he first became a Member of Council in 1846, when Murchison was president and Sedgwick, Buckland, Fitton, Lyell, De la Beche, and others were his associates.

He had now for some years been particularly occupied in what may be considered his chief work—the elucidation of the Eocene strata of the London and Hampshire basins.

Commencing in the London area he zealously traversed the country wherever the Lower Tertiary strata were to be found, and hardly an outlier of any importance escaped his observation. Mr. Whitaker, who more than any other man has followed in the footsteps of Prestwich over this large region, referred in 1872 to the literature of the subject, and remarked that the period 1841 to 1860 "might well be called the 'Prestwichian period,' from the author who first clearly made out the *detailed* structure of the London basin."[1]

After certain preliminary studies, the interest and difficulties of the subject, as Prestwich himself relates, speedily induced him to take it up with more earnestness and determination, and eventually led him to extend his enquiries over an area which at first he never contemplated. With true enthusiasm he remarked "The Tertiary geology of the neighbourhood of London may be wanting in beauty of stratigraphical exhibition and in perfect preservation of organic types, but in many of the higher questions of pure geology—in clear evidence of remarkable physical changes—in curious and diversified palæontological data, however defaced the inscriptions, which is after all but a secondary point, few departments of geology offer, I think, greater attractions." These statements were made in 1849 when De la Beche handed to him the Wollaston Medal, which had been awarded by the Council of the Geological Society. He had then completed but a portion of those labours which established his reputation as the leading authority on our Tertiary strata. Having already extended his researches from the London to the Hampshire basin, he subsequently followed the strata into Belgium and France, correlating the divisions he had made in this country with those established abroad by Dumont and D'Archiac.

His great aim was, by studying in detail the lithological characters of the strata and their fossils, to mark out the main subdivisions in the Eocene system, and to picture the ancient physical conditions which attended their formation. By following the strata from point to point he was enabled to record the mineral changes which many of the subdivisions undergo, and to note the changes in fauna that accompany these variations in sedimentary condition. He also showed how differences in the flora in certain formations pointed to distinct land-areas. Thus were fossils employed, as they should be in geological investigations, in interpreting the physical conditions of the strata after the stratigraphical features had been determined, and in aiding the subsequent correlation with distant deposits.

In his earlier papers on Eocene formations he dealt with the age and relations of the London Clay and Bagshot Beds. He proved the connection of the London Clay and Bognor Beds, and showed that they

[1] *Mem. Geol. Survey*, vol. iv., p. 395.

were older than the clays and sands of Bracklesham and the clays of Barton. He subdivided the Bagshot Beds, and correlated with them certain strata in Hampshire and the Isle of Wight. Subsequent researches by Mr. Starkie Gardner, Mr. Monckton, and Mr. Herries, have thrown doubt on the correlation of the Upper Bagshot Sands of Surrey with those of Hampshire (the Headon Hill Sands); and in a later work[1] Prestwich agreed that the Upper Bagshot Sands of the London area might be partly or wholly of Bracklesham age. Ready at all times to accept corrections when assured of their accuracy, he was also not unwilling to admit changes in classification when the alteration was for the general convenience. Thus he adopted the term Oligocene for strata previously grouped as Upper Eocene. He did not, however, agree with Mr. Whitaker in his proposal to form a separate division, termed the Oldhaven Beds, from strata in part grouped by Prestwich with the basement-bed of the London Clay, and in part with the Woolwich and Reading Series.

Continuing his researches Prestwich described in full detail the strata between the London Clay and Chalk, giving the names "Thanet Sands" and "Woolwich and Reading Series" to strata previously grouped together as the "Plastic Clay Formation." Referring to the important series of Eocene memoirs, which he had completed in 1854, Edward Forbes remarked, "These remarkable essays embody the results of many years' careful observation, and are unexcelled for completeness, minuteness of detail, and excellence of generalisation."[2]

A popular account of the Eocene strata and of the superficial deposits that occur in the neighbourhood of London was given by Prestwich in 1854 and 1856, in the course of three lectures on the geology of Clapham, and these were published a year later under the title of "The Ground Beneath Us." Clearly and pleasantly written, this little work was well calculated to arouse the interest of the reader, and at the time of its publication it was one of the best introductions to geology which it was possible to place in the hands of a beginner.

While Prestwich gave his attention in the main to pure science, he did not neglect the important applications of knowledge. By his publication in 1851 of "A Geological Inquiry respecting the Water-bearing Strata of the country around London," he came to be recognised as the leading geological authority on the subject; and in 1867 he was appointed a Member of the Royal Commission on Metropolitan Water Supply.

He was elected a Fellow of the Royal Society in 1853, and Vice-President in 1870; in that year also he became President of the Geological Society. In his second address to that Society in 1872, he gave an excellent and oft-quoted account of the growth of London as dependent on the means of obtaining a supply of water. In the same address he referred to the many aspects of geological science, and remarked that, "While treating of these abstract and philo-

[1] "Geology," vol. ii., p. 364.

[2] Address to Geol. Soc., 1854.

sophical questions, geology deals also with the requirements of civilised man, showing him the best mode of providing for many of his wants, and guiding him in the search of much that is necessary for his welfare. The questions of water-supply, of building materials, of metalliferous veins, of iron- and coal-supply, and of surface-soils, all come under this head, and constitute a scarcely less-important, although a more special, branch of our science than the palæontological questions connected with the life of past periods, or than the great theoretical problems relating to physical and cosmical phenomena."

He reverted to the subject of water-supply soon after he came to reside in Oxford, publishing a pamphlet on the geological conditions affecting water-supply to houses and towns, with especial reference to that city. He dealt in 1874 with the subject of the proposed tunnel between England and France, and his essay, published by the Institution of Civil Engineers, gained for him the Telford Medal.

At an earlier period he superintended the enquiries concerning the Bristol and Somerset coal-field for the Royal Coal Commission, and prepared reports (published in 1871) on that area, and on the probability of finding coal under the newer formations of the south of England. With regard to the latter subject he took a favourable view, and observed that we might look for coal-basins "along a line passing from Radstock, through the vale of Pewsey, and thence along the North Downs to Folkestone." The results of the Dover boring have, so far, justified this conclusion, which was based on the acute geological reasonings of Godwin-Austen. At various periods, moreover, he described important well-sections at Yarmouth, Harwich, Kentish Town, and Meux's Brewery in London.

The completion of his labours among the Eocene strata allowed Prestwich to devote more time to the newer deposits, which had on various occasions engaged his attention.

He had examined the Norwich Crag as early as 1834, in company with S. Woodward, and he then found a tooth of *Elephas meridionalis* in the Thorpe pit. Accompanied by Godwin-Austen, Morris, and Alfred Tylor, he had, in 1849, made a short excursion into the crag district, and he then suggested that the fossiliferous shell-bed which overlies the Red Crag, at Chillesford, might represent the Norwich Crag. He returned, in 1858, to the subject of the crag in his description of the remnants of that deposit which occur at Lenham and other places on the Chalk areas of the North Downs. Although the species of fossils were but doubtfully identified by Searles Wood, and some authorities came to regard them as probably Eocene, yet Prestwich contended for their Pliocene age, and his views have been fully confirmed by the subsequent observations of Mr. Clement Reid.

In 1868, he communicated to the Geological Society the first part of his elaborate work "On the Structure of the Crag-beds of Suffolk and Norfolk." The three parts were published in 1871.

They contained the results of his long labours, and as he remarks, "The greater part of my observations date, in fact, so far back as from 1845 to 1855."

In some respects this was unfortunate, since the author had been too much occupied to work out the results of his observations while they were quite fresh in his mind; moreover, he did not fully realise how much had been done by previous observers. In omitting to notice in detail work that had been previously published, he observed, "I may be further justified in this course by the circumstance that my own researches are in great part anterior to most of the papers in question"—a plea that fails to satisfy the worker who is keen on priority of publication. One noteworthy result of this was the introduction into Norfolk of the term "Westleton Beds," for strata previously described at certain localities by Wood and Harmer under the name of Bure Valley Beds. It has now been clearly shown that the Bure Valley Beds (of the Bure Valley) are of earlier age than the Westleton Beds (of Westleton), the former being linked with the Norwich Crag (Pliocene), and the latter being rightly regarded by Prestwich as Pleistocene. What may be the particular horizon in the Pleistocene group of the Westleton Beds is still a matter of dispute. No fossils have yet been found in the Westleton Beds at Westleton, and it is, therefore, a matter of great uncertainty as to how far correlation is justified with the other unfossiliferous pebbly gravels of the eastern and southern counties of England. Prestwich has, however, published a series of papers on these scattered deposits, and the facts which he has made known must always prove of value, while his theoretical conclusions, which have added largely to the interest taken in the subject of gravels, cannot fail to have beneficial results.

The importance of an attentive study of the Glacial Drift and other superficial deposits was pointed out by Joshua Trimmer, and he was followed by S. V. Wood, Junr., who, pursuing the subject in great detail, personally surveyed on the one-inch ordnance maps large areas of the eastern counties, and stimulated others like Mr. F. W. Harmer, in Norfolk, and the Rev. J. L. Rome, in Lincolnshire, to co-operate with him. Prestwich, meanwhile, had made particular observations here and there, and chiefly between the years 1855 and 1861, in Holderness, at Mundesley, Reculvers, Hackney, Salisbury, and Brighton. He devoted his attention more especially to fossiliferous deposits of valley drift and to raised beaches. He described a few sections of Glacial Drift, but did not yet enter into any general discussions with regard to the classification of our Pleistocene deposits.

His most important researches among the latter deposits were unquestionably those relating to the valley or river gravels, and to the occurrence in them of flint implements and certain fossil Mammalia.

The discoveries, made known in 1847 by Boucher de Perthes, of flint weapons together with teeth of the mammoth in the gravels of the Somme Valley had attracted the attention of Dr. Falconer, and he induced Prestwich, in 1859, to investigate these most interesting deposits. After careful study, in which he was joined by Sir John Evans, he satisfied himself that the flint implements were the work of man, that they occurred undisturbed in beds of sand and gravel, together with remains of mammoth, *Rhinoceros tichorhinus*, *Hyæna spelæa*, and other Pleistocene Mammalia.

These researches were in part stimulated by the discovery, in 1858, of flint implements with bones of extinct animals in Brixham Cave; and they served to confirm the previous and long-neglected discovery of flint implements in Kent's Hole, Torquay, made by the Rev. John MacEnery. Sir John Evans, moreover, directed attention to the forgotten discovery of flint implements at Hoxne, in Suffolk, a fact originally published in 1800. No time was, therefore, lost in visiting this and other English localities, and the results were brought before the Royal Society in 1859 and 1862. At the conclusion of his second paper, Prestwich remarks: "That we must greatly extend our present chronology with respect to the first existence of man appears inevitable; but that we should count by hundreds of thousands of years is, I am convinced, in the present state of the inquiry, unsafe and premature." In his latest observations on the subject, he has expressed his belief "that Palæolithic Man came down to within 10,000 to 12,000 years of our own time," while he may have had, "supposing him to be of early Glacial age, no greater antiquity than, perhaps, about from 38,000 to 47,000 years" (Collected Papers, p. 46).

For his original researches on the valley deposits yielding implements and weapons of palæolithic man, Prestwich was awarded a Royal Medal by the Royal Society, in 1865. The full report on the exploration of the Brixham Cave was prepared by Prestwich and communicated to the same Society in 1872, the animal remains being described by Busk, and the flint implements by Sir John Evans.

About the time of his retirement from business in 1872, Mr. Prestwich married the niece of his old friend Dr. Falconer, and settled in a house (Darent Hulme) which he built at Shoreham, near Sevenoaks. He was not, however, to retire from active geological work. After the death of John Phillips in 1874 he was offered the professorship of Geology at Oxford, and this he accepted, now spending a portion of his time in that city. The duties of a geological professor at Oxford are not perhaps very onerous, but Prestwich filled the office with dignity and advantage to the University. Phillips, who excelled in eloquence, had at times no more than three students, as geology received no encouragement from the University authorities. Few geologists of note have, therefore, hailed from Oxford as compared with Cambridge, and we call to mind only Edgeworth David (now Professor of Geology in the University of Sydney) and

F. A. Bather (of the Geological Department, British Museum), who, trained in geology under Prestwich, have since gained distinction. His field-excursions, however, were always highly appreciated by many who found no time to pursue the science in after-life.

Various papers proceeded now from his pen: he dealt with the much discussed origin of the parallel roads of Glen Roy, and he wrote on the agency of water in volcanic eruptions, believing that the water was but a secondary cause, and that the phenomena were dependent on the effect of secular refrigeration. He dealt also with the problem of the thickness of the earth's crust, and published an elaborate paper on underground temperatures.

He also made a special study of the Chesil Beach, coming to the conclusion that it was a wreck of an old and extensive raised beach, of which a remnant still exists on Portland. His view concerning the comparatively recent date of the Weymouth anticline has not, however, proved to be sound.

During his term of professorship, Prestwich wrote his well-known work entitled "Geology, Chemical, Physical, and Stratigraphical," in two volumes, published in 1886 and 1888, a work admirably illustrated. In the first volume he remarked that among geologists two schools have arisen, "one of which adopts uniformity of action in all time, while the other considers that the physical forces were more active and energetic in past geological periods than at present." Advocating this latter teaching, he felt he should be "supplying a want by placing before the student the views of a school which, until of late, has hardly had its exponent in English text-books." He indeed protested on many occasions against the doctrine of uniformity of action, both in kind and in degree. Such, indeed, was the teaching of Ramsay in his Presidential Address to the British Association at Swansea in 1880. That geologist referred to the great changes, of which we have evidence in comparatively late geological times, in the upheaval of mountain chains, and in the vicissitudes of the Glacial period; and, in regard to volcanoes, he believed that "at no period of geological history is there any sign of their having played a more important part than they do in the epoch in which we live." Ramsay based his argument on the record of the rocks, and, leaving out of consideration cosmical hypotheses, he concluded that, from the epoch of our oldest known rocks down to the present day, "all the physical events in the history of the earth have varied neither in kind nor in intensity from those of which we now have experience." This conclusion may be taken to mean that any kinds of physical change that have happened in the past since the earliest rocks were laid down may happen again, and we believe that this is the real view of the Uniformitarian. Mr. Teall, again, in 1893, forcibly urged the claims of the Uniformitarian school, pointing out "that denudation and deposition were taking place in pre-Cambrian times, under chemical and physical conditions very similar to, if not identical with, those of the present day." All geologists seek to interpret the past by the light of the present, but while Uniformitarians (as they are called) demand time unlimited, their opponents, sometimes spoken of as Catastrophists, would rather infer a greater potency in the agents of upheaval or denudation than grant an unlimited amount of time.

As Prestwich puts it, "Not that time is in itself a difficulty, but a time-rate, assumed on very insufficient grounds, is used as a master-key, whether or not it fits, to unravel all difficulties. What if it were suggested that the brick-built Pyramid of Hawâra had been laid brick by brick by a single workman? Given time, this would not be beyond the bounds of possibility; but Nature, like the Pharaohs, had greater forces at her command to do the work better and more expeditiously than is admitted by Uniformitarians." (Collected Papers, 1895, p. 2). He maintained that modern estimates of denudation and deposition, and of rates of upheaval and depression, were no test of what happened in the past: that, in fact, the potency of agents had diminished. Referring to the Glacial period, in his inaugural lecture on "The Past and Future of Geology," delivered at Oxford, in 1875, he thus expresses himself: "This last great change in the long geological record is one of so exceptional a nature, that, as I have formerly elsewhere observed (*Phil. Trans.*, 1864, p. 305), it deeply impresses me with the belief of great purpose and all-wise design, in staying that progressive refrigeration and contraction on which the movements of the crust of the earth depend, and which has thus had imparted to it that rigidity and stability which now render it so fit and suitable for the habitation of civilised man; for, without that immobility, the slow and constantly recurring changes would, apart from the rarer and greater catastrophes, have rendered our rivers unnavigable, our harbours inaccessible, our edifices insecure, our springs ever-varying, and our climates ever-changing; and while some districts would have been gradually uplifted, other whole countries must have been gradually submerged; and against this inevitable destiny no human foresight could have prevailed."

His great text book on geology to which we have alluded, will remain as a monument of his zeal and untiring labour. On its completion he resigned his professorship, and retired to his quiet home among the Chalk hills of Kent. There, however, he maintained his interest in his favourite science, and continued to labour to the very end of his days. Soon after leaving Oxford, in 1888, he was called upon, as our leading geologist, to preside over the meeting of the International Geological Congress, which then held its fourth session in London.

The study of the drifts of the south and south-east of England now absorbed most of his time, and he devoted more attention o the grouping of the later superficial deposits and to the great physical changes to which they bear witness. His ideas on all these topics have not met with the unanimous approval of geologists, nor was such a happy result to be expected on a complex subject where there is great room for diversity of opinion. His views on the primitive character of the flint implements of the Chalk plateau of Kent have, however, opened up a new and interesting enquiry, and one more likely perhaps to gain support than his evidences of a submergence of Western Europe at the close of the Glacial period, and their bearing on questions relating to the tradition of a flood.

It is, however, yet early to judge of these controverted questions. They require further detailed study and impartial consideration, and whatever conclusions be eventually accepted, there can be no doubt that the patient and enthusiastic labours of Prestwich on these most difficult problems will have largely contributed to their solution.

Throughout his long life, Prestwich felt deeply indebted to geology, and as he once put it, not merely because it was a source of healthful recreation, but "for its kindly and valued associations, and above all, for the high communing into which it constantly brings us in the contemplation of some of the most beautiful and wonderful works of the creation."

In the early part of the present year Her Majesty conferred the honour of knighthood upon him, but Sir Joseph Prestwich was too feeble in health to accept it in person. He died on June 23, and was buried in the churchyard of Shoreham, near Sevenoaks, not far from his pleasant home of Darent Hulme.

H. B. WOODWARD.

II.

On English Amber and Amber generally.[1]

I.

AMBER was known and prized as far back as the stone and bronze ages, and the men of those times, if they could not find it at home, brought it back from abroad. The amber trade is, therefore, one of the oldest of trades, and its history would form a very interesting chapter of the history of commerce.

What, however, is the meaning of "amber," and what qualities does it possess? I do not remember that this has been discussed as yet at any meeting of the British Association, and for that reason, here, in the amber country of England, I may be allowed to say something about English amber and amber generally, its character and occurrence, its mode of formation by the mother plants, and the vegetation of the amber period.

Amber is not the scientific name of a distinct fossil, but only a collective name of several different fossil resins and gums occurring in various parts of the world. Ambers are found dispersed over nearly the whole of Middle Europe, and occur also in Siberia and Saghalien, in Spain, Italy, and Roumania; further, in Burmah, Japan, North America, Greenland, Mexico, etc. Most of them differ amongst themselves as regards their origin and formation, their chemical and physical qualities, and also with respect to the organic remains found in their interior. On that account it is indispensable to introduce special names to distinguish the various kinds of amber, such as *Simetite* for the amber from Sicily, *Roumanite* for the amber from Roumania, *Burmite* for the amber from Burmah, and so on.

Amber is especially common in the Baltic district, that is, in the Baltic Sea and in all the countries surrounding it. But even this Baltic amber comprises several heterogeneous resins and gums, which have been thoroughly investigated and described. Only the following kinds need be mentioned here:—

1. **Gedanite**, a yellow transparent amber without appearances of polarisation or fluorescence. It looks as if it were covered with white powder, part of which can be wiped away, and this external feature is very characteristic of gedanite. The hardness is only

[1] An address delivered in Section K of the British Association for the Advancement of Science, Ipswich meeting, 1895.

1·5 to 2. Knocking and cutting easily splits it asunder, and therefore it is not of much value for working. Its fracture is conchoidal and glassy. By heating it to between 140°–180° C. it becomes inflated, and by heating more it begins to melt. The plant which produced gedanite is not known, but sometimes the amber encloses small fragments of a pine-like wood, possibly belonging to the trees which produced the resin. Small leaves also of other plants, which can be scarcely determined, and several kinds of insects are found in the interior of this fossil resin.

2. **Glessite** probably is a gum-resin of a vegetable hitherto unknown. It is of brown colour, almost opaque and also without polarisation or fluorescence. The degree of hardness is 2. The fracture is conchoidal and greasy. No remains of plants or animals are found in the interior.

3. **Succinite** is usually transparent or translucent, sometimes opaque, and it shows all gradations from clear to milky or quite opaque appearance. The yellow colour is the most common, but it is found in many other colours, such as green, red, white, or black. There is probably no tone of colour which might not be represented by specimens of succinite. The crust is dark-coloured and firmly adherent. The hardness is 2 to 3, greater, therefore, than that of all other kinds of Baltic amber. It is true it is somewhat brittle, but it can be worked very well; its fracture is conchoidal and greasy. Its specific gravity is 1·050 to 1·096, and; owing to its lightness, pieces are often driven ashore by waves of the sea. When burnt, succinite gives off an agreeable aromatic odour, though it irritates the mucous membrane of the mouth and nose. When heated, it melts at 250° or 300° C., without being inflated before; its melting-point is, therefore, higher than that of gedanite, which is very similar to succinite in other respects. The chief products obtained by its distillation are 3 to 8 per cent. succinic acid, a peculiar empyreumatic oil, carbonic acid, water, and hydrogen. The great amount of succinic acid is very characteristic of this kind of amber. The elementary analysis of succinite, according to O. Helm, is the following:—78·63 per cent. carbon, 10·48 per cent. hydrogen, 10·47 per cent. oxygen, and 0·42 sulphur. An investigation of its solubility gives the following results: 20 to 25 per cent. is soluble in alcohol, 20·6 per cent. in chloroform, 18 to 23 per cent. in ether.

In general, succinite is the most common and the best known of the Baltic ambers, and of all ambers of the world, wherefore it might be termed Baltic Amber *par excellence*. Together with gedanite and glessite, also with loose rounded bits of carbonised woods, and various remains of crustaceans, echinids, etc., it is found in a deposit of sand containing glauconite, and called Blue Earth, belonging to the Lower Oligocene formation of the Samland in Prussia. This is not the primitive position of these resins; they have been floated there by the waves in the beginning of the Tertiary period. However, succinite is much more frequent in the diluvial deposits of Middle Europe, especially in North Germany, Poland, Holland, Denmark, and South Sweden; and washed out of these deposits, it is carried away and dropped down to the bottom of the sea or is carried ashore. Thus it is to be found on the south coast of Finland, on the islands of Ösel, Öland and Bornholm, as well as on the Dutch coast (Rottum, Schiermonnikoog, Scheveningen, etc.) and on the south-east coast of England. The physical and chemical qualities, and also the vegetable and animal enclosures, prove that the amber from the shores of the German Sea is, almost without exception, true succinite.

English amber in general has been well known for a long time, and lately the monographer of Norfolk geology, Mr. Clement Reid, has drawn the attention of scientific men to this fossil resin. I have more recently also become acquainted with it, and have had the opportunity of learning something more about it at Ipswich. The most southern locality I know for its occurrence is Walton-on-the-Naze, in Essex, and I have seen some small pieces from Walton in the mineralogical collection of the Natural History Branch of the British Museum. I have also seen a large number of specimens in the county of Suffolk, particularly from Felixstowe Beach, through the kindness of Miss Tiny Gower, Mrs. Charlotte L. Ransome, Mrs. Sims, and Mr. Henry Miller, of Ipswich. Mrs. Sims has about forty pieces, the largest of which weighs more than one kilogram. They show various gradations of colour, from light yellow to dark reddish brown, and a few look just like glessite, but their microscopical structure is different. Further, I am told that Mr. C. T. Townsend has had for the last thirty-five years a piece of amber found on the West Rocks, near Ipswich, which weighed more than 100 grams. I have also heard of the occurrence of amber at Orford Ness and Aldeburgh, in Suffolk. Mr. Robert I. Candon, at Southwold, states that for several years he has bought from local fishermen lumps of amber which have either been found on the shore or brought up in the fishing-nets.

In Norfolk, also, succinite is found. First, Mr. Clement Reid has described, in the *Transactions* of the Norfolk and Norwich Naturalists' Society (vol. iii., p. 602), a transparent and wine-coloured amber, from Yarmouth Beach, containing three flies. Mrs. Burwood, of Yarmouth, possesses many specimens, a good many of which were brought in by the fishermen and purchased from them. A note on this collection is published by Mr. Alfred S. Foord in the same *Transactions* (vol. v., p. 92). According to this account, most pieces are of a rich wine-yellow colour; however, there are several of a lemon-yellow, and a few quite opaque, looking like ivory. The locality of one of these latter is accurately known, for it was picked up on the beach at Winterton, about nine miles north of Yarmouth. It is true I have not seen all the specimens from Orford Ness, Aldeburgh, Southwold, Yarmouth, and Winterton, but I incline to think that they belong also to the succinite class of ambers. I have also seen some pieces of real succinite from Happisburgh and Mundesley, in the collection of Mr. W. George Sandford, at Cromer.

The principal place where English succinite has been found is Cromer itself, though it certainly does not occur so often as one might expect from the pieces exhibited in the shops of the town; but Mrs. A. Fox, of Jetty Street, assures me that all specimens exhibited in her own window are collected along that coast, and I have seen there many small and large ones of various and beautiful tones. One or two pieces have the same brown, clouded, and glessite-like appearance as those of Mrs. Sims, of Ipswich, and it would be well to direct attention more to this variety, or even species, of amber for the future. Besides that, I have seen many pieces of succinite from Cromer and from Sherringham in the possession of Mr. Sandford and other gentlemen of Cromer. It is also represented in the British Museum (Natural History), and in some local collections of the country. By the kindness of Mr. Clement Reid, in London, and Mr. George Sandford, in Cromer, I obtained some yellow clouded specimens, which are exhibited now in the Natural History Museum of Danzig. On the other hand, much of the succinite in other shops of Cromer is imported from abroad in order to satisfy the demand of seaside visitors.

In all probability it is met with still further north, and indeed I am told by Mr. Reid that a good deal is found in Yorkshire. I do not know the localities and I never saw a specimen from there, for which reason I am not quite sure if this northern amber belongs to the succinite group.

It might also be mentioned that Mr. William Whitaker has described a piece of amber from the coast of Kent ("Geology of London," vol. i., p. 528, London, 1889), and he was kind enough to send me the piece picked up by him at Deal when a boy. From the examination of this specimen it appears that it is not real amber, but copal. The same author makes mention of the Highgate resin in the London Clay at Highgate, and at a few other London localities, particularly at Richmond (*l.c.*, pp. 258 and 528). It was discovered during the excavations for the Highgate Archway, where it occurred "in irregular pieces of a pale yellowish aud dirty brown colour, resembling the resin copal in colour, lustre, transparency, and hardness. It is also equally difficult to dissolve it in alcohol." Of course, this fossil is anything but succinite; it may rather be called a sort of retinite, as there are very many in the Tertiary formation of various countries. Amber is reported to occur near Dublin and in other parts of Ireland; however, the specimens I know from there are all copal.

On the other hand, in the mineralogical collection of the British Museum (Natural History) I met with a brownish-coloured translucent piece of amber, which was bought from Mr. B. M. Wright, in August, 1863. According to Mr. A. C. Seward's statement, this fossil is said to occur rarely in the Cambridge Greensand, which belongs to the Cenomanian, and for this reason I am much indebted to the British Museum for having given me a small piece for examination. This has shown that the Cambridge amber is softer and more brittle than succinite, and that its chemical qualities are different. For the results of an analysis by Mr. O. Helm, at Danzig, show that 0.3 grms. of it produce, by dry distillation, only 0.006 grams of hydrated succinic acid, corresponding to 0.005 grams anhydrous succinic acid, which means 1.66 per cent. Thus the Cambridge Greensand amber differs from succinite not only in its geological age but also in its physical and chemical characters. To this fact I wish to draw the attention of English geologists and botanists, who would be able to obtain larger quantities of this amber, and who should specially notice any enclosures of vegetable and animal remains in it.

Succinite proper, then, has been found, in England, hitherto only on the east coast from Essex to Yorkshire. Probably that is the most western locality of succinite in general, though I certainly remember in the Zoological Department of the State Museum at Stockholm a pretty large piece of succinite, covered with bryozoa and tubicolous annelids, and perforated by *Pholas cuneiformis*, Say, which species only occurs on the south-east coast of the United States and in the West Indies. It was labelled "Atlantic," but what locality may be meant by that, and in what way it may have got there, remains uncertain.

Pieces of succinite, as well as all other organic and inorganic things which are placed for some time in the sea, may be covered with small living marine plants and animals, such as Algæ, Bryozoa, and Crustacea. But as these are not quite the same in the German Ocean as in the Baltic, English succinite bears an external flora and fauna partially different from the Prussian. Previously, Mr. Foord in his above-named paper occasionally mentioned a small unpolished specimen of the opaque sort "encrusted with a polyzoan," that is to say, with a bryozoon. On the other hand, I know that the shells of a kind of *Balanus* often cover the fossil resin, and Dr. Weltner, of the Zoological Museum at Berlin, has determined it to be *B. porcatus*, da Costa. For instance, Mrs. A. Fox, of Cromer, possesses a light-yellow clouded piece of succinite (plate i., fig. 1), 75 grams in weight, which is covered with the shells of several animals, the largest of which has a diameter of 3 to 3.3 cm., while other specimens have fallen off. According to Dr. Weltner this species lives on the coasts of Japan, North East America, Greenland, Ireland, Scotland, South England, Norderney, Heligoland, and in the whole of the German Ocean, also in the Greater Belt, in the Belt of Fehmarn, and at the Stoller Ground, near Kiel. It may be mentioned that amber from the shores of West and East Prussia is also often incrusted with smaller shells, which belong to another species, *Balanus improvisus*, Darw. Moreover, one and the same English specimen bears on one side the fragments of the tubes of annelids, determined by Dr. Collin, of Berlin, as *Pomatoceros triqueter* (L.). However, there is a similarly coloured second piece belonging to Mrs. A. Fox (plate i., fig. 2), which shows more and better developed tubes. It weighs 65 grams, and is covered with a group of well-preserved tubes and fragments of *Pomatoceros*. According to the same zoologist this worm lives on the coasts of Iceland and Scandinavia from Varanger Fjord to Öresund; also in the German Ocean, on the coasts of N. France, England, Scotland, and N. E. America. I remember a third specimen (plate ii.) of 135 grams, which should be mentioned here. It has a fine yellow cloudy colour, and is covered at one side with a group of about thirty shells of *Balanus porcatus*, da Costa, of various size, which partly contain the dead animals. This piece is in the possession of Messrs. Stantien & Becker, at Königsberg, who bought it from Mr. Perlbach at Danzig, and this gentleman had obtained it from the east coast of England. It should be noticed that both species, *Balanus porcatus* and *Pomatoceros triqueter*, are not found in the Baltic proper.

It is difficult to give an estimate of the quantity of amber found in England, as the pieces are almost all of small size and usually are picked up by visitors who take them away. According to the estimate of Mr. Henry Miller, of Ipswich, only a few pounds annually are found in the neighbourhood of Felixstowe, and Mr. Reid says that three or four pounds are gathered near Cromer. Therefore about four or five kilograms might be collected annually along this coast, but I am told that in old times the yield was much greater.

In spite of this small quantity of amber, quite a little home-industry has originated in England, and I am in a position to give some information on this point. In the first place, Mr. Henry Miller told me of an old woman, Jane Larrett, at Trimley, near Felixstowe, to whom the fishermen and their children used to bring all the amber picked up on the beach. She cut it into ornaments with a file, scraped it with the edge of a piece of broken glass to get rid of the scratches, and polished with soft leather and powdered whitening made from chalk. In such a manner she fashioned small articles such as hearts, crosses, and beads, threaded them so as to be worn as bracelets and necklets, and sold them to the visitors to Felixstowe in the summer. Moreover, she was able to clarify the cloudy pieces by boiling them in oil, just as is done even now in Prussia. That woman taught Mr. Miller to cut and polish amber when he was a boy, but she has been dead for many years, and there is now no one who carries on the business in Trimley. However, in other places there are some people who carry on a little home-industry; for example, Mr. Croydon, at Felixstowe, makes brooches, pins and other things, and Mr. Robert J. Candon, of Southwold, works amber found on the shore there into various articles of jewellery. One would expect the greatest industry of that kind to be at Cromer, where numerous objects are made, namely, beads, necklaces, crosses, hearts, mouthpieces for pipes, and so on. But such articles are also imported from Germany, just as is rough amber, and I remember very well having seen in the windows there a good many specimens from Danzig and Königsberg. Of course it is cheaper to import the articles from German manufacturers, where they are worked *en gros*, than to engage a workman at home to make single objects. Still, English succinite is worked on a small scale in England. Moreover, this branch of industry is by no means limited to Prussia. Though the greatest manufactories exist there, particularly at Danzig, Königsberg and Stolp, succinite is worked in various parts of Europe; as, for example, in Russia (Polangen, Ostrolenka), Sweden (Malmö), Denmark (Copenhagen), and elsewhere.

Regarding the widely-spread occurrence of succinite, it is very probable that the marine Tertiary deposit which contained this fossil, was, in old times, not limited to the Samland, but had a much greater extension. Of course a good deal may have been carried down by the advancing of the ice during the ice age, and then by the waves, but that alone would not account for its appearance in Finland and England, in Sweden, Poland and Central Germany, here and there even in large quantities. Again, some geological observations seem to indicate that the district of the amber forests once extended over a wide area from east to west. For in several localities of West Prussia and Pomerania greensands exist similar to the Blue Earth of the Samland, though succinite has not been found in them hitherto; but the large greensand deposit of Eberswalde, near Berlin, does contain succinite. Further, in Mecklenburg, Schleswig-Holstein, Denmark, and Sweden, geologists assume that the succinite found there is derived from destroyed Tertiary deposits of those countries. Moreover, the succinite of England was not carried there from Samland, but was probably washed out of a diluvial or Tertiary bed, which is not preserved now or which is covered by the North Sea. A few specimens, as I have seen at Cromer, exhibit glacial scratches, and probably they were derived from a diluvial deposit not far from the English coast. Even those pieces could not have been brought by the glacial current from the Samland, but from another locality which was situated much nearer.

In the Newer Pliocene forest-bed of Cromer one specimen has been dug up, but it has not been possible to find another. It belongs to the succinite group, and Clement Reid thinks it may have been washed out of an older, perhaps underlying, deposit. Generally the geological structure of Norfolk, with which he is so intimately acquainted, leads him to assume an original continuity of the amber-bearing bed from the Prussian coast (Samland) to within a short distance of the English coast. For the eastward dip of the strata in Norfolk, and the thickness of the London Clay at Yarmouth, ought to bring Upper Eocene and Oligocene beds near to that shore.

It is well known that worked amber is found in prehistoric graves in England, and it was generally supposed that those ornaments had been imported from abroad. Even Clement Reid states that the manufacture would only be understood in a district where the raw material was comparatively plentiful; I am not, however, in a position to assent to this. First it must be noticed that there are also some amber objects which are attributed to the stone age, and it is not proved that in this period a connection between the English and the Prussian coast already existed. Therefore these neolithic ornaments—if they should be foreign—could only have been brought from the Danish coast or from the German shore of the North Sea, where amber occurs a little more often; but, in general, why should Englishmen have sent for the fossil from abroad when they could get it at home? Add to this, that the working of amber is quite easy, and that we know of numerous articles of other countries which are fashioned very delicately by primitive instruments of bone and stone. Certainly the manufacture of amber is not more difficult than that of jet, whereof we know many beads and other articles made in the stone age in England. Besides, the characteristic manner of perforation of the jet ornaments is like that of the Prussian amber objects of that period, which proves anew that the same uses and methods, as well as customs, may originate in different countries, without any reference to one another. Moreover, we have learned that in England, even in these days, there exists an original amber manufacture, unchanged by foreign influence, and just in the same way the fossil could have been worked a few thousand years before.

Of course, amber is not abundant on the shore, and usually it is mixed with sea-weeds, for which reason many specimens may be overlooked, but the prehistoric articles also are rare, and "the present annual yield is more than sufficient to account for all the ancient amber ornaments yet found in England" (Reid, *l.c.*). Having regard to all these circumstances, it is simpler, on the whole, to trace the ornaments to English amber (succinite) rather than to foreign importation. Still, it may be that this and the other amber articles of the bronze and of the iron age have been brought from abroad.

H. Conwentz.

(*To be continued.*)

III.

Two Views on Museums.

AS we go to press the Museums Association begins its meeting at Glasgow, under the presidency of Mr. James Paton. Besides visiting the Corporation Galleries, the Kelvingrove Museum, and the Hunterian and other museums in Glasgow, members will have an opportunity of seeing the new museum at Perth, an account of which has been published in our pages (vol. viii., pp. 41–45). There is a strong local committee and abundance of hospitality, so that the meeting seems likely to be an enjoyable as well as a profitable one.

No doubt some of the numerous debatable questions that have been raised by Sir Henry Howorth in our pages during the past year will come up for discussion at this meeting, and we are glad to furnish as a contribution to the discussion the following note by so well-known a representative of American Museums as Mr. F. A. Lucas, of the National Museum, Washington. As an alternative to the opinions of Mr. Lucas, we venture to recommend to the assembled curators a small pamphlet that has just been sent to us by Professor Alphonse L. Herrera, of the National Museum in Mexico, to whose other attempts at reform we again draw attention in our Notes and Comments.

I.—The Skeleton in the Museum.

In the June number of Natural Science Sir Henry Howorth objects to the exhibition in museums of what Ruskin, to use his own choice diction, terms "Bones, guts, or any other charnel-house stuff." It would hardly seem necessary to protest against this snap judgment, which reminds one of the dictum of George Francis Train, "One man right, forty millions wrong," but I cannot refrain from saying that, if Sir Henry sees no good in a room full of skeletons, there is something wrong with the skeletons—or himself. Personally, I hold to the belief that all knowledge save that which tends directly to the procurement of bread and butter is a misfortune, but, being in a minority, and in a country where the majority is *supposed* to rule, I endeavour to adapt myself to circumstances. Such being the case, I try to make the exhibition series of the Department of Comparative Anatomy furnish the illustrations, and the labels the text of a work on anatomy, and, although at present but a few chapters are outlined, I hope that at least one visitor in a thousand may leave the "Dead House" with something besides the subject for a nightmare.

It is true that anyone may learn from a text-book that the hand of a monkey and the flipper of a whale are constructed on the same plan, and that their external differences are due to the fact that one wears gloves and the other mittens. But there is nothing like the objects themselves to teach this and similar truths, especially to people who never open a book on anatomy, and to teach these truths is one of the objects of the anatomical collection. Moreover, it is one of the provinces of anatomy to show adaptation to certain ends, and if Sir Henry will come to Washington next year he may, if he wishes, see series devoted to modifications of the limbs for walking, flying, swimming, and the like, and he will find here and there skeletons bearing labels calling attention to their mechanical adaptations. But doubtless all this, and more, is to be seen at South Kensington, whose methods are my models and whose resources my envy and—almost—my despair, so I will simply touch on one other point.

If you *must* pull your skeletons out of the cupboards, where they should be decently concealed—says Sir Henry—then you should mix them with stuffed specimens, doubtless in order to hide their nakedness so far as possible, or else put them in the society of respectable fossils. That recent and fossil forms should be shown together is beyond dispute, but the manner in which skeletons are to be exhibited depends largely on the purpose for which they are displayed, upon whether one wishes to use them by themselves or as adjuncts to other specimens. For example, the case in the Index Collection at the Natural History Museum, South Kensington, illustrating the morphology of the Batrachia, seems to me magnificent, although it may contain too many bones to please Sir Henry, and yet I presume that Sir William Flower would not consider that skeletons of batrachians should not appear elsewhere in the museum. I certainly hope that he may agree with me in thinking that a large museum should contain a series of the skeletons of the higher groups of vertebrates, let us say families, from Myxine to Man. Also if one wishes to emphasise some point in the structure of an animal, to illustrate some detail of classification, or to show how little a creature's inside may have to do with his external appearance, place the skeleton where it will do the most good. But if you wish to trace the relations between various groups, to show their structural similarities or differences, to make apparent to the visitor or student the lines on which vertebrates are laid down, the room full of skeletons is a necessity. More than this, they must not be mixed up with stuffed specimens where the *comparative* purpose for which they are shown would be utterly lost, but they must be shown side by side in order that one may be compared with another, and they must be so arranged and labelled that even the casual visitor may pick up an idea, or have one thrust upon him as he strolls through.

There is much more that might be said on this point, but once started on the question of museum installation it is difficult to tell where to stop, and so I will stop at once.

Washington, D.C. FREDERIC A. LUCAS.

II.—THE MUSEUM OF THE FUTURE.

Professor Herrera's pamphlet, reprinted from the *Memorias de la Sociedad "Alzate" de Mexico*, vol. ix., pp. 221–252, is entitled "Les Musées de l'Avenir." Of these museums we are told "there is no gallery of insects, no gallery of birds, or of mammals, or of fishes, or of reptiles; no collection of Coleoptera, no collection of Chiroptera, or of pheasants, or of pigeons. Museums of the future do not classify by classes, families, tribes, genera, species, sub-species, varieties, sub-varieties, races, and sub-races; *they put in order facts, and classify ideas.* . . . There are rooms for heredity, for ontogenesis, cænogenesis, variation, mimicry, the struggle for life, nutrition, and so on. . . . These rooms are arranged in a philosophical order, and in that order they must be visited by the public; to this end there will be barriers suitably disposed. . . . In the museums of the future the zoological specimen is the lacquey of an idea, whereas in our present museums ideas are the slaves of specimens. Thus, a specimen is not exhibited because it is rare, or because it ought to be exhibited: we show the most profound contempt for specimens that are rare, curious, or pretty. . . . The museum of the future aims at being, not a magazine of dead lumber eaten by worms, but an open book in which men can read the philosophy of nature." The first room of Professor Herrera's museum reminds us of some gruesome diagrams that used to be visible at South Kensington, showing, by coloured squares, cubes, and so forth, the amount of the various inorganic substances contained in the human body, the chief difference being that the method is here extended to the flesh of other animals. The idea of this room is to show the unity that pervades nature, whether in chemical composition, in organic matter, in organic force, in vital phenomena, in the plan of organisation, in origin, end, or in the conditions and causes of evolution. The next room displays the comparative physiology and anatomy of animals; the natural system of classification is treated with contempt; the ideas of biology are better illustrated by the association of animals living under similar conditions or using similar devices, by the comparison of analogous rather than of homologous organs, thus showing the numerous modifications and specialisations that have been adapted to a single or to similar ends. Room no. 3 is to show the various methods of reproduction, and all organs and functions associated therewith. In the next room distribution is dealt with, not, however, according to any scheme hitherto proposed.

but considered as "the correlation between the distributional areas of organisms and all the general biological conditions"; thus, we have animals from warm regions, animals from cold regions, alpine species, species from great depths, species from deserts, species from caverns, species from islands, species from forests, and so forth. Then follow exhibits showing the correlations between the present fauna of certain countries and their extinct faunas. Other cases exemplify migration, means of dispersion, and laws of geographical distribution. The next gallery is given up to evolution, and here Professor Herrera is frankly Darwinian, making no mention of neo-Lamarckism, bathmism, and other philosophical schools. Consequently, his exhibits are intended to show such facts of nature as the rapid multiplication of individuals, the struggle for existence, adaptations, sexual selection, and results of selection. In the arrangement of his specimens, in order to bring out the various ideas, Professor Herrera places them in series and places them in contrast, using either method as seems most suitable to each occasion.

The paper is undoubtedly suggestive, and it is not intended to be anything more; no doubt Professor Herrera would agree that each curator must find his ideas and work them out for himself, in accordance with the circumstances of the museum in which he is placed. Neither does he mean to deny that some such arrangement of the museum according to ideas has found its scattered instances; indeed, he does allude to some of those beautiful cases that adorn the entrance-hall of the Natural History Museum in London, exemplifying such biological ideas as variation, protective mimicry, and albinism. But it is still true that the idea which governs our museums is the arrangement in accordance with some human system of classification—"Why!" says our author, "the decimal classification that is being adopted for libraries is preferable to the natural (?) classification. It is this that will be universally applied in the museums of the future." And thus he concludes: "All I know is that if, fifty years ago, museums had adopted the philosophical and not the systematic order, then man, seeing side by side the animals of the deserts, would have discovered protective mimicry fifty years ago. Seeing together on one side the victims, on the other side the executioners, and further off the champions, he would have discovered the struggle for life, unity, selection, catabolism. . . . But from time immemorial, man has tried to imprison the things of nature in a fixed system, a fixed classification, which is not the whole of science, and which cannot be the nest of all philosophy. Nature, in her vastness, protests against the classifiers; maddened, indignant, desperate, she revolts against routine. A Darwin and a Huxley as yet have lived in vain; for we, here below, we classify, classify, classify. . . . I know that when they have visited the museums of the future, the learned, the children, the pretty girls will remain very serious, seriously meditating upon all this profound philosophy of nature, upon all her wings, upon all her nests."

IV.

Sporozoa.[1]

THE volume by Dr. von Wasielewski, recently published, is an extremely good and complete account of the Sporozoa, with especial reference to those which are permanent cell-parasites and, like *Hæmamœba Laverani*, the parasite of malarial fever, are associated with disease.

A very curious and striking fact is that, although the Germans, Kölliker, Hammerschmidt, and Lieberkuhn, forty years ago were the chief workers who had added to our knowledge of the genus *Gregarina*, established by the French entomologist Dufour, yet, with the exception of the pioneer work of Eimer, the newer knowledge of the Sporozoa is almost entirely due to French, Italian, and English observers. So that we have here, in Dr. von Wasielewski's book, a very unusual circumstance, namely, a German zoological treatise which is mainly occupied in making known and accessible to German readers the original work of French zoologists and micrographers.

In the history of research on the Sporozoa—the name given by Leuckart to Gregarinæ and the allied forms—we find, following after the fundamentally important memoir of Theodor Eimer on the Coccidia of mice and rabbits and their spore-formation, the "Leçons sur les Sporozoaires" of Balbiani, published in 1884; the numerous short papers of Aimée Schneider in his *Tablettes Zoologiques*, from 1881 to 1892; the admirable systematic treatise of Labbé "Parasites Endoglobulaires," published about two years ago in the *Archives de Zoologie expérimentale*; the researches of Thelohan on the Myxosporidia, published last year in the *Bulletin Scientifique de la France et de la Belgique*, and of Gurley on the same subject in the *Bulletin* of the U.S. Fish Commission; the memoir of Leger on the true Gregarinæ, in the *Tablettes Zoologiques*, 1892; and the original treatises of Danilewsky, Laveran, and Grassi, on the Hæmatozoa. All this and other material is freely drawn upon and reproduced in systematic form in the present volume; well executed and abundant figures are copied from original sources, and the whole subject is carefully treated, both with reference to description of particular groups and species, and as to classification and systematic nomenclature.

An idea of the range of the work may best be formed by the following outline of the classification and enumeration of genera:

[1] SPOROZOENKUNDE: ein Leitfaden fur Aerzte, Tierärzte und Zoologen. Von Dr. von Wasielewski. Pp. viii., 162, with 111 figures in the text. Jena: Gustav Fischer, 1896. Price 4 marks.

Class or Phylum. **SPOROZOA.**

Order I. GREGARINÆ.

Sub-order A. **Gymnosporea.**

Family 1. *Gymnosporidæ.* Genus.—*Porospora.*

Sub-order B. **Angiospora.**

Family 2. *Clepsidrinidæ.* Genera.—*Clepsidrina, Didymophyes, Eirmocystis, Hyalospora, Euspora, Gamocystis, Cnemidospora, Stenocephalus, Sphærocystis.*

Family 3. *Anthocephalidæ.* Genus.—*Anthocephalus.*

Family 4. *Dactylophoridæ.* Genera.—*Echinocephalus, Dactylophora, Pterocephalus, Trichorhynchus, Rhopalonia.*

Family 5. *Actinocephalidæ.* Genera.—*Actinocephalus, Geneiorhynchus, Dufouria, Bothriopsis, Coleophora, Phialis, Discocephalus, Pyxinia, Xiphorhynchus, Schneideria, Monocystis, Pileocephalus, Amphorella, Stephanophora, Asterophora, Doliocystis.*

Family 6. *Acanthosporidæ.* Genera.—*Corycella, Syncystis, Acanthospora, Ancyrophora, Pogonites.*

Family 7. *Stylorhynchidæ.* Genera.—*Stylorhynchus, Oocephalus, Cystocephalus, Sphærocephalus, Lophorhynchus.*

Family 8. *Menosporidæ.* Genera.—*Menospora, Hoplorhynchus.*

Family 9. *Gonosporidæ.* Genus.—*Gonospora.*

Family 10. *Urosporidæ.* Genera.—*Urospora, Ceratospora.*

Order II. HÆMOSPORIDIA.

Family. *Drepanididæ.* Genera.—*Drepanidium, Karyolysus, Danilewskya.*

Order III. COCCIDIA.

Family 1. *Monosporidæ.* Genera.—*Eimeria, Pfeifferia.*

Family 2. *Oligosporidæ.* Genera.—*Cyclospora, Diplospora, Isospora, Coccidium.*

Family 3. *Polysporidæ.* Genera.—*Barroussia, Adelea, Klossia.*

Order IV. ACYSTOSPORIDIA.

Family 1. *Acystidæ.* Genus.—*Karyophagus.*

Family 2. *Hæmamœbidæ.* Genera.—*Halteridium, Proteosoma, Hæmamœba, Dactylosoma, Cytamœba.*

Appendix. *Apiosoma, Babesia.*

Order V. MYXOSPORIDIA.

Family 1. *Myxididæ.* Genera.—*Sphærospora, Myxidium, Sphæromyxa, Myxosoma, Ceratomyxa, Septotheca.*

Family 2. *Chloromyxidæ.* Genus.—*Chloromyxum.*

Family 3. *Myxobolidæ.* Genera.—*Myxobolus, Henneguya.*

Family 4. *Glugeidæ.* Genera.—*Glugea, Pleistophora, Thelohania.*

Order (?) VI. SARCOSPORIDIA.

Genus.—*Sarcocystis.*

Order (?) VII. AMŒBOSPORIDIA.

Genus.—*Ophriocystis.*

Order (?) VIII. SEROSPORIDIA.

Genus.—*Serosporidium.*

The author, Dr. Wasielewski, is not responsible as an original authority for the classification put forward in each group. I have no hesitation in saying that the whole scheme, both of families and genera, adopted for the order Gregarinæ is misleading and unnatural.

It is chiefly based on Aimée Schneider's system. The form and number of the spores is about as natural a basis of classification of the Sporozoa as was the Linnean staminal system of phanerogamous plants. It is neither more nor less than absurd to place *Monocystis* with the Actinocephalidæ. The classification which I proposed in the "Encyclopædia Britannica" (Zoological Articles—Protozoa) at any rate takes account of important structural features in the full-grown active form of the organism. I do not think that at present any further division of the Gregarinæ than that into the order Haplocyta, with the single genus *Monocystis*, and the order Septata, with the two genera *Gregarina* and *Hoplorhynchus*, is useful, and it seems to me that further generic distinctions should be sought in characters of a less trivial nature than the form of the spores.

I observe that none of the recent writers have re-studied my *Monocystis aphroditæ*, a monocystic form with a long proboscis of peculiar character resembling the epimerite of some Septata. This species is not uncommon in the alimentary canal of the larger sea-mouse (*Aphrodite aculeata*), and is worth re-examination. Probably it should be the type of a new genus.

In regard to the Coccidiidea (which ought not to be called, as they are by Wasielewski, by the generic title Coccidia), the spore-containing cysts are so much more dominant in the life-history than the unencysted "Euglenoid," that there is sufficient excuse for classifying them in reference to their sporulation. But here, too, I note the omission of an interesting form described and figured by me in the article "Protozoa" above cited, viz., *Klossia chitonis*—which is extremely abundant in species of chiton on the English coast. It would come under Schneider's genus *Barroussia*.

It is also important to correct an omission by Dr. von Wasielewski of a sporozoon discovered in my laboratory at Oxford, and described and figured by Miss Pollard in *Quart. Journ. Microsc. Sci.*, vol. xxxiv., January, 1893. This interesting form is parasitic in the epithelial cells lining the intestine of *Amphioxus lanceolatus*. It is sickle-shaped, resembling a *Drepanidium*, and causes a distortion and atrophy of the nucleus of the cell in which it is parasitic. Its spore-formation has not been observed, and no generic or specific name was assigned to it by Miss Pollard.

The separation of the order Hæmosporidia from the order Acystosporidia appears to me to be unnatural. The Acystosporidia are only a step further advanced in degenerative cell-parasitism than the Hæmosporidia, and should not on that account be made into a distinct order. It may, however, be noted that Grassi thinks the Acystosporidia are not Sporozoa at all, but to be placed near *Amœba* and the Mycetozoa.

The *Drepanidium ranarum*, described and figured by me in 1871, and so designated by me in 1882 (*Quart. Journ. Microsc. Sci.*, vol. xxii., p. 53), has become the prototype of a number of blood-parasites.

Three species of *Drepanidium* are distinguished: two occurring in the red-corpuscles of frogs, and one in those of birds. *Karyolysus* and *Danilewskya* are very similar forms, the species of which occur in the blood of lizards, tortoises, and frogs. The (as it seems to me) really closely-related Acystosporidia occur chiefly in the red-corpuscles of birds, but also in salamanders, tritons, and frogs. The most important of these is the "organism of malaria," to which Professor Grassi has given the name *Hæmamœba Laverani*—after Laveran, who found it in 1880 in the blood-corpuscles of men suffering from malaria. The sporulation of the parasite was described by Marchiafava and Celli in 1888. Golgi showed that the access of fever had a definite relation to the development of the parasite. Black pigment granules, formed by the destruction of the hæmaglobin of the blood-corpuscle in which it is parasitic, are characteristic of the *Hæmamœba* of malaria. The crescent-shaped pigmented bodies seen in the red-corpuscles of malarial patients are a phase of the growth of this parasite. An account of the recent work of Marchiafava, Bignami, and Mannaberg, with drawings of various parasites of malarial fever, was given by Dr. J. W. Gregory in NATURAL SCIENCE for September, 1894 (vol. v., pp. 195–201). *Glugea bombycis* is the name now assigned by Thelohan to the "pebrine corpuscles" of the silk-worm, studied by Pasteur, and this organism is ranked among the Myxosporidia. The suggested but doubtful relationship to Sporozoa of the corpuscles observed in cancer-cells is not touched on in the present treatise.

Extremely numerous as are the parasitic Protozoa included under the group "Sporozoa," it is well to remember that there are a number which are referable to the Flagellata, and are not treated of by Wasielewski in his book. This is to be regretted, since there is very close affinity between some of the parasitic Flagellata and the blood-parasites referable to the Sporozoa. The late Timothy Lewis and others have described remarkable elongate Flagellata (*Herpetomonas lewisii*, Sav. Kent.) from the blood of rats and other animals, and, just lately, it has been suggested as probable that the Tsetze fly of South Africa owes its deadly character to the fact that it is the means of carrying a parasite, which appears to be one of the Flagellata, from one animal to another. It is to me by no means clear that these hæmatozoic Flagellata are widely separable from hæmatozoic Sporozoa, whilst some of the parasitic Monadina of Cienkowski, referred by some writers to Mycetozoa, stand very close. The three groups, Flagellata, Sporozoa, and Mycetozoa, are in many respects closely allied. Perhaps the essential cell-parasitism of the Sporozoa is the chief point in which they differ from parasitic Flagellata and from Mycetozoa. The field of work offered by parasitic Protozoa is still one which will yield most important results to the skilled microscopist with zoological training. Such works as that of Dr. von Wasielewski furnish real help to the would-be investigator.

E. RAY LANKESTER.

V.

Lyell and Lamarckism: a Rejoinder.

IF the author of "Lyell and Lamarckism: a Reply to Professor W. K. Brooks" (NATURAL SCIENCE, May, 1896), means, by the words "an explanation," on p. 331, a complete and ultimate explanation, I fully agree with him that, in this sense of the words, natural selection is no explanation of the attributes of living things, and that, "we should still want to know the true causes of them," although the fact that we "want to know" is no evidence that we ever shall know the true cause, *vera causa*, of anything.

Explanations, although imperfect, may still be valuable, even if we are never to find out "that which produceth a thing and maketh it what it is."

If it should ever be proved, as it may for all I know, that the matter which composes the known universe has been sifted out from other forms of matter by its property of weight, gravitation would remain as good an explanation of our "universe" as it is now, although we should still "want to know" how our particular sort of matter got its weight.

Darwin's work, like all good work in science, is an attempt to find out a little of the *order*, as distinguished from the *true cause*, of nature. It is a highly successful effort to study the history of living things, by means of all available evidence; and, as I understand it, the value of natural selection is quite independent of whatever we may discover, or fail to discover, concerning the true cause of that diversity among individuals which has, by an unfortunate use of words, come to be called variation.

The author of the article on "Lyell and Lamarckism" says: "According to the Lamarckian view, all adaptations, at any rate all adjustments concerning whose action and efficacy there is no dispute, have arisen in the same way as the enlargement of a muscle by exercise" (p. 330); that is, "they must be ascribed to a fundamental property of protoplasm" (p. 328); "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" (p. 330).

I am not sure I understand what the writer means by *structural adjustments for rendering adjustments possible*, but I suppose the structural adjustments of the human eye will be admitted as examples of "adjustments concerning whose action and efficacy there is no dispute"; and the writer is quite right in his assertion that "Brooks . . . supposes that these structural adjustments have to be explained," if they can. He might have added that I *do not suppose* the assertion "that they are *merely* the fundamental properties of protoplasm," will be generally regarded as an important contribution to the explanation.

As I understand him, the writer believes the attributes of all living things are to be deduced from the properties of living matter; an opinion which I am quite prepared to accept as soon as it is proved; for I most assuredly do not believe anything inconsistent with this creed, except that "the assertion which outstrips evidence is not only a blunder but a crime."

If it is ever proved that the attributes of all the living things which exist and of all those which have existed in the past are deducible from the properties of living matter, I do not see how we can stop here, or refuse to admit that innumerable forms, filling up all the gaps between all the known species, are also deducible from the same properties. We must also admit that this living matter contains the promise and potency of all the monstrosities which have been reared by the breeder or the horticulturist, and of innumerable abortions, the Anthropophagi and men whose heads do grow beneath their shoulders, as well as hosts of possible organisms which have, so far, laid dormant in the womb of time, and of which most may never see the light.

The first question concerning the origin of species we have to ask is, why this potency has resulted in a system of nature which is comparable to a tree, with diverging branches, and empty spaces, widening as time goes on, between them—instead of a spherical shell of individuals growing outwards in all directions from a common centre.

According to Darwin this is the outcome of a process of extermination, which must lead to this result whether there is or is not an agency which draws out definite combinations from that wonderful Pandora's box, the potency of living matter.

A species consists of a number of similar, but not identical, individuals, grouped about a mean according to the statistical "law of error," and the characteristics of each individual are what the students of statistics call an "event."

According to Darwin the influences which determine each "event" have nothing to do with the character of the type, as this is fixed by the standard of extermination. To the question whether specific types are inherent in living matter or external and objective to it, he answers that they are both; that they are inherent insomuch as all their data, or "events," are properties of the physical basis of life; but that they are external insomuch as the agreement of the "events" with the "law of frequency of error" is the effect of the environment.

When embryologists talk about the doctrine of evolution in embryology as antagonistic to the doctrine of epigenesis; when biologists seek for the origin of species in laws of variation which are not the outcome of selection; when they talk about a "principle of organic stability," which does not owe its origin to the same mechanism—it seems to me that they fail to grasp the significance of Darwin's work, and that they are wandering from the only path in which we can have any well-grounded hope for progress; the path which takes its departure in that conception of specific types which leads us to seek for the origin of the "events" that exhibit the type in the structure of living organisms, and to seek in the order of nature external to the organism for the origin of that "law of error" which picks out a type from among these events.

The specific types of the zoologist and the botanist have peculiar interest since they persist from generation to generation, according to what is known as the law of specific stability; while they also undergo slow changes according to the principle of the mutability of species. In popular language specific stability may be said to be due to inheritance, and specific mutability to variation; but in this connection these words have only a loose meaning, and it has long seemed clear to me that much of the current misconception of Darwin is due to the fact that, in his desire to make clear the analogy between natural and artificial selection, he borrowed these words from the breeders without due deliberation.

In so far as they give the impression that the stability of species and the mutability of species are antagonistic to each other, that they are due to two distinct and opposing influences, or that the individual which is preserved is a "variation" in any sense which is not equally applicable to the one which is exterminated, these words are unfortunate; for, notwithstanding Darwin's words, his context shows clearly that he looks at both the stability and the mutability of species as due to the same influence—the extermination by natural selection of certain individuals, and the preservation of others and their progeny.

While a recent writer in NATURAL SCIENCE (Nov., 1895) holds that sexual reproduction is the cause of types, all students of the subject are perfectly familiar with the fact that data drawn from any source, living or dead, may conform to a type, and the excellence of natural selection is not that it explains the existence of types, but that it explains a distinctive peculiarity of the particular sort of types which concern the zoologist and the botanist. These types not only persist from generation to generation, but they also exhibit fitness. It is this fitness, and not mere conformity to the statistical "law of error," which calls for explanation, and gives to biology the rank of an independent science, distinct from the physics and chemistry of the living body. It is in this that we find the great excellence of Darwin's explanation of the origin of species by the extermination of the unfit and the survival of the relatively fit; for he shows that the fitness is determined by the external world and not by any inherent property of fitness, or of unfitness, in those which are preserved, or weeded out, since a difference in the external world might have reversed the result.

The motive of my own letter on "Lamarck and Lyell," which has called forth this "Reply," was not love of controversy, but a natural desire to protest against the statement, which has appeared in a book, that I am one of the prominent advocates of Lamarckism.

Since I "have quite failed to understand the Lamarckian view," the author of the "Reply" suspects strongly that I have not tried, though I hope he will credit my assertion that my failure is not due to lack of effort, but to the incompetency of this effort to bring about the desired result.

My studies seem to show that Lamarckians believe (1) that effort, use and disuse, and the direct action of the conditions of life, are adequate to explain all the phenomena of fitness, and that natural selection is superfluous; (2) that natural selection is useful as a means for preserving what the Lamarckian "factors" supply, but that it originates nothing; (3) that these "factors" account for the "incipient stages" which are seized upon and culminated by natural selection—that they press the button, as it were, leaving natural selection to do the rest; and (4) that species are exactly like inorganic types, and that the opinion that they are distinguished by fitness is erroneous.

If failure to discover which of these is the "Lamarckian view" is failure to understand this view, I frankly admit that I have "quite failed," although I regret this the less since all these hypotheses seem to me equally unsatisfactory. I do not know how many hold the opinion that the conception of fitness, as distinctive of species, is erroneous, but as I hope the common sense of most will ultimately hold a fretful few in awe, I shall not dwell upon this point of view at present, except to call attention to the familiar fact that the phenomena of geographical distribution are inexplicable unless species are more or less fitted for that state of life to which they are born.

As regards the hypotheses which I have numbered 1, 2, and 3, it is clear that unless the "Lamarckian factors" can be proved competent to explain the incipient stages of useful structures, they cannot be competent to do what 1 and 2 attribute to them. I therefore ask, in my letter on Lamarck and Lyell, for evidence that the influence of the so-called Lamarckian factors is beneficial, and I asserted that I learned, from the study of Lyell's "Principles of Geology," to ask for this evidence, and to refuse, in its absence, to admit that these "factors" explain even these incipient stages.

I had supposed that, by their "factors," Lamarckians meant use and disuse, effort, and the direct action of the conditions of life, but as I have "quite failed to understand" their views, this may be a mistake. At any rate, instead of giving evidence that the influence of these conditions is beneficial, the author of the "Reply" tells us all adaptations must be ascribed to the fundamental properties of protoplasm, although this statement, while it may be true, has, in the present state of our knowledge, no more claim to be called an explanation than the assertion that the origin of steam engines is to be ascribed to the fundamental properties of matter; an assertion which may also be quite true for all I know to the contrary, although it will be soon enough to accept it as a belief when some one deduces a steam engine from these properties.

This writer objects to my statement that I learned from Lyell that the Lamarckian factors could not be accepted unless they could be shown to be inherently beneficial, since he is not able to learn anything of the sort from this author; although I suppose my statement will be justified if I can show that others, including Lyell himself, have made the same deduction from his teaching. His biographer in the Encyclopædia Britannica, after speaking of his mastery of the work of Darwin and Wallace, says: "Then it was that Lyell, who had rejected Lamarck's theory because it rested on a purely imaginary law of *innate progressive development*, at once accepted natural selection."

Darwin's letters show, however, that this acceptance did not come "at once," but that Lyell had much difficulty in perceiving the fundamental difference between Darwin's views and those of Lamarck, and that he for some time thought his criticism of Lamarck applied to Darwin also. After Lyell had read the proof sheet of the "Origin of Species," Darwin wrote to him as follows, Oct. 25, 1859, in answer to a letter which, unfortunately, is not printed in either Lyell's or Darwin's "Letters": "Our difference on 'principle of improvement' and 'power of adaptation' is too profound for discussion by letter. If I am wrong, I am quite blind to my error. If I am right, our difference will be got over only by your re-reading carefully and reflecting on my four first chapters. I supplicate you to read them again carefully."

Darwin is no doubt right, and anything further is a waste of words; for those who are not persuaded after reading and reflecting on these four chapters, remind one of the five brethren of a certain rich man mentioned in history.

W. K. Brooks.

SOME NEW BOOKS.

Judd's Lyell.

The Student's Lyell: A Manual of Elementary Geology. Edited by John W. Judd. 8vo. Pp. xxiv, 635, with a geological map[1] and 736 illustrations in the text. London: John Murray, 1896. Price 9s.

It will be a sad day for the learners of geology when the lucid and suggestive writings of the great geological philosopher are pronounced to be altogether too behind the times to have an educational value. In so rapidly advancing a science such a probability is not very remote, and we are proportionately grateful to those who, like the late Martin Duncan, and the present editor, Professor Judd, do their best to bring the well-known "Student's Elements" up to date. It is a thankless task to revise the writings of a previous author, especially when they have the fame and the individuality possessed by the writings of Sir Charles Lyell; but among British geologists there are few whose grip of the science in its physical aspects would fit them for the work so well as the learned Dean of the Royal College of Science.

The original plan and methods of the book are followed, including the arrangement that naturally commended itself to the prophet of uniformitarianism, of beginning with the newer rocks, less altered than the older ones and deposited under conditions less different from those of our own day. Much, however, has been added to the text and much has been altered; this is especially observable in the portions dealing with stratigraphy and petrography. To accommodate the additions, the more detailed matter is printed in smaller type, some of it being in double columns. This has the advantage of marking for the beginner those portions that he will be wise to omit on a first perusal, and to study when reading through the book a second time, on which occasion it might be as well for him to reverse the order of the historical systems and to take the oldest first. On the whole, this additional matter seems to us worthy of the honourable place that it occupies, and if we think that some sections are a little too detailed while others are not dealt with fully enough—well, we also know that this is a matter on which no two geologists would be agreed. For the mere sake of illustrating our meaning, we would suggest that half-a-page is not quite enough to devote to the whole Palæozoic basin of Bohemia, the rocks of which were laid down in a different sea under far other conditions than those of Britain, and, thanks to Barrande, form the type for all the Palæozoic rocks of south-eastern Europe. Again, if it be necessary to give, as on p. 336, a table of correlation of the Mesozoic rocks in different areas, we fail to see why the large series of such rocks in North America should be represented by only "Freshwater Strata of Western Territories,"

[1] We give this on the faith of the title-page: there is no map in the copy sent to us; further, owing to a misprint in the signature, sheet D D has been wrongly folded.

"Greensands of New Jersey," and "Newark Formation"; the account given in the text, though by no means exhaustive, is far more detailed than this. However, it is right and in accordance with Lyell's methods that the British student should learn his lesson from the sections exposed in his native land, and the facts of British geology are clearly and accurately set before him.

But when we consider the palæontology, which, to judge from the abundance of figures of fossils, is intended to form no unimportant feature of the book, we find that Professor Judd shares the ultra-conservative opinions of nearly all British geologists, especially those in official positions. Let us examine some of the said figures. A few are new and good, as those of the Triassic reptiles, *Lariosaurus*, *Hyperodapedon*, and *Tritylodon*, but most are old friends that have nothing but antiquity to recommend them. The erroneous restoration of "*Aechmodus*" (= *Dapedius*) by Agassiz is reproduced on p. 278, although more accurate ones have already reached most text-books. It should have been stated that the restoration of "*Megalosaurus bucklandi*" on p. 282 was a work of pure imagination, based on Marsh's *Ceratosaurus* from North America. Pages 380 to 382 are crowded with caricatures of fish from the Old Red Sandstone, though we thought they had been exploded long ago; of these, Hugh Miller's drawing of *Pterichthys* is the most dreadful, and is made worse by the legend, which describes as the mouth a depression that may be the orbital opening or a slime canal; it would have been easy to borrow Traquair's excellent and accurate figures of this interesting creature. The engravings of invertebrate animals and of plants are those with which we have been familiar for the last fifty years, and it is cruel to keep them from their well-earned retirement. So famous a publishing house as Mr. John Murray's could surely spend a few pounds on modern clichés, even if it could not afford to pay an artist. The drawings of *Stringocephalus*, for instance (fig. 540), give a very false idea of the well-known deltidial structures to which such importance is now attached. *Granatocrinus ellipticus* of our Mountain Limestone is represented by an incorrect drawing labelled "*Pentremites*": it is really time that our students should be taught that *Pentremites* does not occur in Britain at all. So, too, the figure said to be *Cypridea*, on p. 272, might have yielded to one of those long since published by Rupert Jones. But if impecuniosity may be put forward as an excuse for the absence of decent illustrations, it cannot explain away some of the remarkable statements in the text. *Nipa* is not confined to "the Molucca and Philippine Islands, and Bengal," but is found in Ceylon, Borneo, and New Guinea as well. It is said to be "allied to the cocoanut tribe on the one side, and on the other to the *Pandanus* or screw-pine," a sentence that we hope Professor Judd will explain to his own pupils if not to others. *Ptychodus*, we are told, "is allied to the living Port-Jackson shark, *Cestraceon* [*sic*] *Phillippi* [*sic*]"; though it is now generally admitted to be related not to *Cestracion*, but to the skates. *Archegosaurus minor* is described on p. 366 as from "the Coal-measures, Saarbrück"; but the coal-deposits of Rhenish Prussia were long ago proved to be Lower Permian. The following remarkable sentence was not, we believe, written by Lyell, and we cannot imagine where Mr. Judd found anything so erroneous:—"The Echinodermata of the Silurian include great numbers of Crinoids, all belonging to the Palæocrinoidea or Tesselata [*sic*], in which the plates composing the calyx are fused together." And a little further on it is still said that "several peculiar species of *Cyathocrinus* are found in the Wenlock Limestone," although Bather showed two or three years ago that this was one of the rarest genera in that formation, being represented by very few specimens of only two species. On p. 405, *Plectrodus mirabilis*, from the Upper Ludlow bone-bed, is described as "the jaw and teeth of a predaceous" fish; but it is many years since this was proved to be simply the denticulated edge of a cephalaspidian shield. The *Cyathaspis* recently described by G. Lindström is wrongly ascribed to the "Gothland Limestone," which Mr. Judd, on another page, rightly makes the limestone equivalent of our Ludlow beds; the fossil was really found in shale correlated by Lindström with the Wenlock Shale. *Trimerella* and *Siphonotreta* are far from being confined to the Ordovician of Russia and North America: the former comes from the Upper Silurian and, among other places, from Gotland; the latter is found in the Llandeilo and Wenlock beds of our own island.

Perhaps the foregoing examples are enough both for our readers and for the author. Now, Professor Judd does not, we understand, profess to be a palæontologist; but palæontologists do exist in this country, and, as they are not rich as a rule, one of them might have been induced by a small fee to check the palæontological portions of this book so as to make them worthy accompaniments of the general geology. We refuse to believe that "the convenience of the student" is consulted by retaining an obsolete classification of animals, a rejected nomenclature, illustrations that were necessarily made in the absence of our modern knowledge, and a mass of errors that would cause even an elementary student to be ploughed in his first examination. Let us hope that it will be long before Lyell vanishes from our class-rooms, and that Professor Judd may be able to bring out yet another edition on less conservative lines.

THE EVOLUTION OF THE HOMINIDÆ.

ETHNOLOGY. In two parts: I. Fundamental Ethnical Problems. II. The Primary Ethnical Groups. By A. H. Keane. Cambridge Geographical Series; General Editor: F. H. H. Guillemard. Pp. xxx., 442, with illustrations. Cambridge University Press, 1896. Price 10s. 6d.

CAMBRIDGE University has the most laudable ambitions, the most excellent intentions. Its scientific members are producing a series of Manuals, a Natural History, and now a Geographical Series. This last is under the editorship of so travelled a naturalist as Dr. F. H. H. Guillemard, and it is, we gather, intended to introduce to English readers the modern science of Geography, which hitherto we have had to learn from peripatetic lecturers. The aim is worthy.

The first volume of this new series deals with the science of Ethnology, not with Ethnography, which is mere "literature" and "purely descriptive," and not with Anthropology, which is more "technical and special," while Ethnology is "more all-embracing." The author at all events grasps the lofty ideals of the series, and does not forbear to magnify his office. Evolution is his watchword, his "golden skeleton key." "*L'heure des grandes synthèses*," he quotes, "*a déjà sonné*. Such a synthesis is here for the first time attempted in the English language." There is much truth in all this; a book on these lines was wanted, and we applaud the attempt.

But when we pass from promise to performance, we are disappointed, perhaps just because the author "doth protest too much." The subject is wide and complicated: the synthesis no easy task. Mr. Keane's knowledge of linguistics and obviously wide reading would have qualified him for it, if only they had been associated with a scientific mind and an appreciation of the needs of learners. The misfortune of the book is that it has been written by a library student, who has not had either the advantage of teaching the subject, or, apparently, any practical experience in anthropological investigations, and who, therefore, could not appraise the value of much of the evidence he so diligently garnered, or check the statements that he copied. We have no wish to be hypercritical, nor do we wish to cast all the blame upon the author; a man can no longer be proficient in all branches of knowledge. But, as we have often maintained, a book for beginners should not contain obvious errors, and we cannot withhold censure from the University Press and from the Editor for passing an unusually large number in the present work. If Mr. Guillemard did not feel quite certain on some points, he could easily have asked experts to help him. The presence of pigment "under the second (Malpighian) skin"; the increase of pigment due to "excess of vegetable food, yielding more carbon than can be completely assimilated" (p. 171); the effect of "a volcanic environment like that of Java" in causing early man "to shed the wool and retain the sleek hair" (p. 263); "spiders and other insects" (p. 52): these ideas would surely not pass muster in the Cambridge biological schools. The geology is equally quaint: "Trenton, Niagara, and other formations, doubtfully of Silurian age"; *Eozoon* "is now known to be a mineral" (p. 52); "the few or no traces of glaciation" in the Chalk, Carboniferous and older periods, are due to "exceeding high temperature" (p. 59): but "Croll, reasoning with the intuitive genius of a Kepler" is a spectre from the past that we thought had been laid at Cambridge for ever. Other examples that we might select are, perhaps, due to carelessness, but that is not less culpable. Thus, zoologists are said to "detach from the Class Mammals the large and widespread group of Apes and Half-Apes" (p. 17); on p. 144 the skull of *Pithecanthropus* is said to show "characters intermediate between gorilla and Neanderthal," while on the next page the Neanderthal calvarium is described as "altogether the most ape-like skull hitherto discovered"; and, inexcusable in a book that is nothing if not evolutionist, A. R. Wallace is hailed as "one of the originators of the doctrine of evolution" (p. 32). This last sentence suggests that the author is as unacquainted with the history of philosophy as he is with the ideas of zoology. The family-trees of the human varieties are very useful in explaining Mr. Keane's views as to relationships; but the number of roots with which he has provided each one, even that of the Hominidæ, suggests to the zoologist that the author maintains the polyphyletic origin of man, though that is far from his intention. There is pedantry in the frequent use of the term Hominidæ, and a specious precision in speaking of *Homo Mongolicus*, *Homo Americanus*, etc.; any biologist would naturally assume that these were names of species, but after some trouble he would find that Mr. Keane was abusing technical terminology by referring to varieties, and not species, in this manner.

We sympathise with Mr. Keane in his attempts to extend the antiquity of man. Still, we may suggest to him that, when discussing Dr. Noetling's discovery of chipped flints in Burma, he should not have overlooked Mr. R. D. Oldham's criticism (NATURAL SCIENCE, vol. vii., p. 201, September, 1895).

Mr. Keane has made linguistics a great feature of the book, and deals lucidly with the relation of stock languages to stock races, and with the evolution of the various morphological orders of speech. We cannot profess to criticise him here, though we note that he runs counter to certain recognised authorities. The future will show whether he has really proved some of his positions; in the meantime, we may give him credit for attempting to make the most of his special knowledge in this department. We venture to think, however, that a considerable portion of Part I. might have been omitted, as bearing more upon "special anthropology" and archæology, and the space thus saved might have been devoted to the main object of the book as suggested by its title. But the marrow of the book, "la grande synthèse," is the construction of a phylogenetic tree of the human race, complete to its minutest twigs. The attempt, even were it less successful, would be of value, and the fact that it is in many places open to criticism chiefly shows how much opinions still differ on important points. In this part, chapter xii., on "*Homo Mongolicus*," is the most interesting, as giving us a discussion of the Finno-Tatar, Chuckchi, Japanese, and Malay racial problems, with the author's original views.

In the preface, Mr. Keane apologises for dogmatism; but there are two ways of being dogmatic, one is to take decided views and go straight to the point on their assumptions, the other is to lose the point in abundance of controversy and criticisms of those who think differently. It is the latter method that is here adopted, and it does not put the reader into a good temper. Surely it was unnecessary to labour the point of evolution as against the "*deus ex machinâ* view"; or to pass from an attack on *Dryopithecus* to criticism of unorthodox theologians, de Quatrefages, and the "Dauertypus." The student wants his synthesis, right or wrong; he is only puzzled by this abundance of learning, and by the arguments against all the other synthetists. Nevertheless, the book fills a gap, and its second edition, with the obvious errors set right, will doubtless come nearer the ideal of the author and of the University.

Cephalopods of the North Atlantic.

Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier, Prince souverain de Monaco, Fascicule IX. Contribution à l'étude des Céphalopodes de l'Atlantique Nord. Par Louis Joubin. Pp. 63, 6 plates. Monaco, 1895.

The present memoir treats of eighteen species of cephalopods, three of which are indeterminable and five new. All were captured between 5° and 45° W. long. and 37° and 49° N. lat., principally in the Bay of Biscay and in the neighbourhood of the Azores; in fact, the seas surrounding these islands have furnished so large a percentage of the collection that Dr. Joubin has devoted the first section of his work to a statistical discussion of their cephalopod fauna, from which it appears that fifteen species have now been recorded, two of which here appear for the first time. Most of them are widely distributed forms, so that their occurrence in this particular locality does not call for special comment.

Passing to the systematic portion of the work, we note that fragments of an example of the rare *Alloposus mollis* were found upon the surface, where the animal appeared to have been attacked by a number of cetaceans, whose movements directed attention to the spot. It was perfectly fresh, and plate 6 shows its natural colours after a sketch by the Baron de Guerne. The softness of its tissues was such that it would probably have passed in fragments through an ordinary trawl. Some fragments of this specimen and of another suitably preserved enabled the author to make some observations on its histology. He found a thick gelatinous coat, in structure like the umbrella of a medusa, traversed by fibres regularly arranged and in a direction normal to the surface of the body. Very remarkable is the record of a male *Rossia macrosoma*, which presented no trace of hectocotylisation, although it was full-grown and well preserved; its sex was ascertained by dissection. In the matter of hectocotylisation, moreover, it is strange to find a specimen of *Octopus macropus* recorded without note or comment as having the third *left* arm thus modified. There is possibly a little confusion here, for we find both third and fourth arms put down as dorsal, but if the facts be as stated the specimen should be referred to the genus *Scæurgus*.

The species which Dr. Joubin has called *Trachelotenthis Guernei* certainly cannot be referred to that genus, for it has the connection between the funnel and mantle characteristic of *Ommastrephes*. The author is also mistaken in thinking that a cartilaginous plate is shown in pl. 28, fig. 7, of the "Challenger" *Report*; the white lines merely indicate the superior muscles of the siphon. Several pages are devoted to a description (reproduced from a previous communication in *Bull. Soc. Zool. France*) of the curious organs discovered in *Chiroteuthis Grimaldii*, believed by the author to be thermoscopic eyes. This theory can hardly be regarded as demonstrated, but Dr. Joubin's arguments are ingenious and plausible, and it is difficult to find an alternative hypothesis that so well fits the observed facts.

Dr. Joubin's writings have made us acquainted with many interesting forms of Cephalopoda, and have also thrown much new light on those already known, and the appearance of this beautifully illustrated and sumptuously printed memoir will still further enhance his reputation. W. E. H.

British Wasps and Bees.

The Hymenoptera Aculeata of the British Islands. A descriptive account of the Families, Genera, and Species indigenous to Great Britain and Ireland. By Edward Saunders, F.L.S. 8vo. Pp. viii., 391, 3 plates. London: L. Reeve and Co., 1896. Price 16s.

The systematic study of the aculeate Hymenoptera has not attracted so many English entomologists as the importance and interest of the group would lead us to expect. Mr. Edward Saunders has probably gained a large proportion of the existing devotees by means of his "Synopses," published some years since by the Entomological Society. It is to be hoped that the book now under notice will be even more successful than the previous work, on which it is based. We note in the preface that the author expresses a hope that "the coloured figures in the larger edition of this work will remove, at any rate to a certain extent, the apparent difficulties of the subject"; this hope we echo most heartily, but if the larger edition (which we have not seen) is richly illustrated with a view to enticing future students, then we fear it may fail in its object. Hundreds of boys collect and think that they are interested in butterflies and moths; not one in a hundred makes an intelligent study of them, nor does the collecting instinct survive the attainment of manhood. Why is this? We unhesitatingly assert that it is due to coloured plates in works on Lepidoptera. By their means captures can for the most part be identified with a minimum of observation and a complete absence of scientific study; thus the mind is not trained, and what little interest there is soon flags—the collection is abandoned to its fate in common with stamps, marbles, *et hoc genus omne*. These strictures do not apply to the work before us, and they are only made to point out what experience has shown to be the result of too copious illustration, viz., defeat of its own object. We venture to think that of those who have put their hand to the hymenopteran plough extremely few have looked back, and this result is largely due to such books as this of Mr. Saunders. Three plates only are given here: the first is an excellent "structural plate," which will be most useful to all students; the other two are entirely devoted to mouth-parts. We rather regret that a place could not be found for a reproduction of the genital armatures which are figured in the Synopses, if only for the convenience of having all within one cover. In general arrangement but few alterations have been introduced into that adopted in the Synopses, though minor changes are numerous. Four sections are now recognised instead of two; Kohl's arrangement of the Sphegidæ is adopted; several families, *e.g.*, Crabronidæ, are no longer admitted, while others are created, *e.g.*, Eumenidæ to include *Odynerus* and *Eumenes*, Colletidæ to include *Colletes* and *Prosopis*; the Acutilingues are divided into two families—Andrenidæ and Apidæ, the former including *Nomada* (Perez notwithstanding), *Panurgas*, *Dufourea*, and *Rophites*, in addition to the six genera so included in the Synopses. Specific names have undergone considerable change, particularly in the genera *Andrena*, *Bombus*, and *Cerceris*; altogether there are some thirty such alterations, which generally consist in adopting names previously quoted as synonyms, though in a few cases old species are split up, and in fewer still they are "lumped." About a dozen new species are admitted as British, and of these seven belong to *Sphecodes*. The notes on habits are admirable, and it is agreeable to find that all dimensions are now uniformly stated in mm., and that the authorities for localities are given. Inaccuracies are extremely few—two occur in the account of the Vespidæ: (1) p. 151, "six species [of *Vespa*] occur in this country"—seven are given in the table immediately below; (2) The large female cells are not *always* in the lowest tier of the nest, but may be added anywhere, as Dr. Ch. Janet has shown. The introduction contains much valuable information on Anatomy, Collecting, etc. A few of the sentences are, however, somewhat obscure and awkwardly expressed: *e.g.*, p. 5, "there seems to be doubts"; "the nervous system . . . consists of a system of ganglia united *along the centre* of the insect by two longitudinal cords"; "the circulatory system consists of a dorsal vessel, which lies along the back of the abdomen, from which the blood is circulated"; p. 6, "the respiratory system is *carried on* through the agency of spiracles"; p. 7, "head large, but varying little" should surely be "varying but little." The adjective "classificational" (p. 10) strikes us as cumbrous, and we rather take exception to the use of the plural "tarsi" to express a single tarsus of many joints.

Apart from these very slight blemishes we have nothing but praise for the book, and wish it the success that it thoroughly deserves. O. H. L.

The Butterfly Hunter in France.

L'Amateur de Papillons. By H. Coupin. Pp. vii., 329, with 124 cuts. Paris: Baillière, 1895. Price 4 francs.

This handy little work contains a series of useful hints upon the practical methods of catching or rearing insects for the cabinet, among which hints is scattered some information upon the anatomy and the life-history of insects in general, and Lepidoptera in particular. There is of course the inevitable chapter upon mimicry, protective resemblance, and so forth; but as this has made the fortune, intellectually speaking, of the entomologist, and has raised him from former obscurity, we can hardly blame the author, especially as it does not interfere with the real object of the handbook. The only definite fault indeed that we can find with Mr. Coupin's book is that it is written in French; as there are so many English books of a similar scope we cannot predict for it a large sale in this country; but we should be quite glad to be mistaken.

Plants of the Lowlands.

The Flora of Dumfriesshire. By G. F. Scott-Elliot, M.A., F.L.S. With map. 8vo. Pp. xl., 219. Dumfries: Maxwell, 1896.

Finding his county to be "an extremely unnatural one," Mr. Elliot has not confined his work within political boundaries, but has included in the flora the whole drainage area of the Nith and Annan, with the upper portion of Eskdale. The last-mentioned, between Langholm and Canobie Bridge, is described as "the most beautiful wooded valley that the writer has seen in any part of the world." The flora includes seed-plants and vascular cryptogams, numbering (as we learn incidentally from the paragraph on insect visitors) nearly 900 species. Its chief feature is found in the notes on habitat and exposure as well as lists of the insect visitors, which are appended to many of the species. These notes represent a large amount of valuable work, but are still, as the author admits, far from complete. The book in its present state will, however, be of much help to future workers, to whom we must look for a more complete elucidation of the factors of environment, a systematic study of which has hitherto been sadly neglected. It is only by careful study in this direction that we can hope to solve the problems of plant distribution and evolution. We would suggest, however, that the list of visitors would be more useful if the individuals were classified under a few heads, as *e.g.*, moths, bees, flies, etc. A string of specific names conveys but little information to the ordinary botanist. In the collection of facts like these Mr. Elliot has received much assistance, which he duly acknowledges. In the introductory chapter we find, also, a section on the Hymenoptera of Mid-Solway by R. Service, and one on the geology of the district by B. N. Peach and T. Horne. The points most open to criticism relate to general arrangement and nomenclature. Such are the insertion of a period between the name of the species and its author, the occasional omission of the latter, and the misuse of the capital for specific names. We find *Trollius Europæus*, *Platystemon Californicum*, *Meconopsis Cambrica* but *Papaver rhœas*, *Aconitum napellus*, *Cheiranthus cheiri*; and *Solanum Dulcamara* but *Atropa belladonna*. "Escapes" might, with advantage, be in different type from indigenous species. If the author will pay attention to these and similar points (popular names, for instance) in future editions, the value of the work will be enhanced. A chapter might also be added, giving a general classified account of the flora as a whole, showing the proportion of rarer British plants, and bringing out relations which must exist with other parts of the British Isles.

Sunday-school Botany.

How Plants Live and Work. By Eleanor Hughes-Gibb. 8vo. Pp. xii., 115, with 30 figures in the text. London: Griffin, 1896. Price 2s. 6d.

This little book is further described on the title-page as A simple

Introduction to real life in the Plant-world, based on lessons originally given to country children. In her preface the author tells us that the study of plant-life has been one of the keenest and most unfailing pleasures of her life; it was with a view to awakening the same interest in "the dear green world around them" that the notes, from which the book has grown, were made for a course of lessons to village children. Others who have the opportunity for, and are willing to take up, similar work could hardly have a more satisfactory primer than the subject of our review. The child's attention is first secured, and then, in language simple, yet scientifically accurate, the first lessons in plant-life are set before it, its growth and development, its nourishment, and its movements. Then, in the second part, the little students learn something of plant-structure and some details of the work of assimilation. Errors are rare; we may mention, however, that "perisperm," in Lesson II., should be "endosperm," the term in general use for the stored nourishment of an albuminous seed.

Crystals in the School-room.

Crystallography for Beginners; with an Appendix on the use of the Blowpipe and the Determination of Common Minerals. By C. J. Woodward. Pp. vi., 164, with 75 woodcuts and 4 plates. London: Simpkin, Marshall, 1896. Price 4s. 6d.

During recent years a remarkable and significant tendency has been evinced by the more progressive science teachers, to assign a rather subordinate position to the absorption of mere facts, and to make the acquisition of logical habits of thought and of accurate expression the main ends of an elementary education in science. This salutary tendency, which is, perhaps, merely the reaction against classical and traditional methods, is nowhere more apparent than in the teaching of physics and chemistry, and it is at least curious that the great adaptability to modern methods possessed by the related science of crystallography has not been more generally recognised. So much elementary geometry and trigonometry might be taught, and so valuable a faculty for visualising problems in tridimensional space might be acquired with ease and pleasure by experimentally illustrating these subjects with crystallographic examples.

Mr. Woodward seems to have had some such facts as these in view whilst compiling his little work. He first directs the attention of his students to obvious geometrical relations noticeable on crystals which they have themselves prepared, and catechises them on the immediate consequences of their observations; the students are then told to measure angles upon their crystals with the aid of a rough contact goniometer of their own construction, and to examine in an elementary sort of way the optical properties of the crystals by means of a home-made polariscope. Although the idea involved in work and thought of this kind is not carried to nearly such an extent as we should think advisable and possible with very young students, yet the combination of actual hand-work with deductive reasoning demanded from the student must go far towards giving him that self-confidence and easy manipulation of facts and things which every science-student must possess, and without which he is a failure.

The book is clearly written, although in parts a little expansion would have materially conduced to simplicity. A few errors are noticeable, such, for instance, as the statement, on p. 55, "that the symbols of all planes in a zone have two of their indices always in a constant ratio"; that this is erroneous is obvious, from the fact that any two faces, such as (2 3 4) and (5 6 7) can form a zone, and if two sets of any three whole numbers be taken, it is not true that the ratios of two numbers of each set are in general the same.

Instructions are given and "nets" provided for the making of crystal-models illustrative of the chief forms and of the crystals which the student meets with during the lessons; these will do good service. We are less sanguine regarding the utility of the appendix on the blowpipe determination of minerals.

Arrangements have been made for issuing a small set of specimens and apparatus for use with the book; these consist of appropriate crystals of common substances to illustrate each crystalline system, and of simple materials for illustrating crystallographic optics and thermal conductivity. The set will doubtless be of use to students who have to study without assistance, or who are unable to obtain the requisite common minerals. W. J. Pope.

Selborne for Children.

The Natural History of Selborne. By Gilbert White, with an Introduction by Edward S. Morse. Abridged. 8vo. Pp. xvi., 251. Boston: Ginn & Co., 1896.

Good wine needs no bush, and Gilbert White no commendation. We may, however, notice the handy little edition of the "Natural History of Selborne," which Messrs. Ginn and Co. have just published in their series entitled "Classics for Children." A gentleman at the British Museum has lately had the enterprise to produce a volume entitled, we believe, "The Brownings for Babes." We suppose that it will not be long before we have "Boëthius for Boys" and "Newman for the Nursery." In the present series, among the familiar Andersen, Grimm, and Goldsmith, are to be observed such unexpected authors as Lord Chesterfield, Epictetus, Samuel Johnson, and Marcus Aurelius. For our American nephews and nieces we will not venture to speak, but if our own English children are to be considered, this series demands a precocity which we fear they do not possess. Gilbert White, however, is an author whose introduction into the school-room, or, we should prefer to say, the play-room, can produce none but good effects. Complaints have of late years been numerous that the observant naturalist of the old school is dying out, and is being replaced by the section-cutter and the planter of phylogenetic shrubberies. Collectors are turning their attention from butterflies, birds' eggs, and fossils, to posters and postage stamps, being, we suppose, frightened by the extensive learning now required of those who would pursue the paths of science. We must endeavour to recapture this wasted energy, and without making the claims of science less, to make the love of nature more. As a helper in so worthy an attempt, we welcome this clearly-printed and not over-annotated edition of Gilbert White's famous letters. The country parson is left to speak for himself, with the omission of "certain passages objectionable on account of the plainness of the language, many Latin words, phrases, and quotations, and a few paragraphs of no special worth or interest to the reader of the present day." The explanation of such Latin words and scientific terms as inevitably remain is left to the teacher or parent. Incorporated with the letters are some passages usually printed separately under the heading of "Observations on Nature." Thus the author is made his own commentator.

THE COMFORTABLE WORD.

THOUGHTS ON EVOLUTION. By P. G. F. 8vo. Pp. 88. London: Swan Sonnenschein & Co., Ltd., 1896. Price 1s.

THIS little pamphlet is a defence of the ethical aspect of evolution, in opposition to the thesis of Huxley's "Evolution and Ethics." The criticism of the Romanes lecture that we published exactly two years ago contains the gist of P. G. F.'s arguments, though it does not contain all the assumptions and statements that P. G. F. finds necessary. We, for instance, should not say that "since the advent of man a great change seems to have come over the animal creation. That prolific activity of the cosmic spirit which distinguished the first period, resulting in the production of such an amazing variety of animal forms, appears to have relented after that event." Or again, "some force or vital principle appears to have left the animal and passed into the human nature, which conferred on the latter the capacity of developing into the higher form of life, and the loss of which deprived the animal nature of the same capability." The author does not attempt to prove these propositions, and we can find no warrant for them. Such passages, which are not few, suggest that the writer's acquaintance with the facts of nature is derived from controversial literature similar to his own essay.

THE SEQUENCE OF EVOLUTION.

THE WHENCE AND THE WHITHER OF MAN: a brief History of his Origin and Development through Conformity to Environment. By John M. Tyler. 8vo. Pp. 312. New York: Charles Scribner's Sons, 1896. Price $1.75.

THIS little volume, by the Professor of Biology in Amherst College, contains the course of Morse Lectures delivered at Union Theological Seminary in the spring of 1895. The ten chapters, representing as many lectures, are of an elementary and popular character; and they will prove both entertaining and instructive to the general reader who desires to know the present position of the doctrine of evolution. The professor's main idea is, that the broad outlines in the development of the world of life can be determined by tracing the "sequence of dominant functions" or "of physiological dynasties" presented by organisms as they are followed through time. This sequence "can be traced with far more ease and safety, not to say certainty, than one of anatomical details. The latter characterise small groups, genera, families, or classes; while the dominant function characterises all animals of a given grade, even those which through degeneration have reverted to this grade. Even if I cannot trace the exact path which leads to the mountain-top, I may almost with certainty affirm that it leads from meadow and pasture through forest to bare rock, and thence over snow and ice to the summit; for each of these forms a zone encircling the mountain. Very similarly I find that, whatever genealogical tree I adopt, one sequence in the dominance of functions characterises them all; digestion is dominant before locomotion, and locomotion before thought. . . . The history of the development of anatomical details, however important and desirable, is not the only history which can be written, nor is it essential. It would be interesting to know the size of brain, girth of chest, average stature, and the features of the ancient Greeks and Romans. But this is not the most important part of their history, nor is it essential. The great question is, what did they contribute to human progress." The idea is carefully worked out, and the biological facts in illustration of the thesis are well selected.

The Lower Vertebrates.

The Royal Natural History. Edited by R. Lydekker. Parts 26–30. London: F. Warne & Co., 1896.

We have already referred in terms of high commendation to the admirable up-to-date "Natural History" which Messrs. Warne and Co. have placed within reach of the general public. We have now received the completion of the section devoted to vertebrate animals, and can merely endorse those expressions. The editor himself has contributed the chapters on reptiles, amphibians, fishes, and "semi-vertebrates," which are contained in the parts before us; and the coloured plates are all new, expressly designed and drawn by Mr. P. J. Smit. We should be disposed to criticise the vivid colouring of some of these illustrations, but on the whole they are very effective, while those of the wall-lizards and salmon are especially pleasing.

The chief feature in the account of the lower vertebrates is the classification of the fishes, in which Mr. Lydekker has followed the palæontologists. The "Ganoidei," as an order or sub-class, have thus disappeared, and the arrangement is approximately that of the British Museum Catalogue of Fossil Fishes, of which we reviewed a volume last June. The order of treatment of the various groups is alone different, and this we can hardly admit to be an improvement. As a concise general account of fishes, that of the "Royal Natural History" has pleased us more than any we have previously seen, and students of these animals will welcome so cheap and handy a compendium.

A Course of Practical Zoology.

Elementarcurs der Zootomie. By Drs. B. Hatschek and C. J. Cori. 8vo. Pp. viii., 104. Pls. xviii., and 4 figs. in text. Jena: Gustav Fischer, 1896. Price 6 mark 50 pf.

This course is arranged in fifteen sections, each adapted for a practical lesson of two hours' duration, and the authors vouch for the possibility of covering the ground in the time, having already worked according to the scheme for the past ten years. The course is so designed that all the observations may be made macroscopically—a fact which is to be deplored, inasmuch as it precludes the study of unicellular animals, without which no course of zoology, however elementary, can be considered complete. Moreover, the excuse given by the authors for not including a cœlenterate may be regarded by many as insufficient to warrant the omission. With these exceptions, the animals considered are mostly those which are usually dissected in zoological laboratories—viz., the freshwater mussel, snail, crayfish, cockroach, earthworm, leech, and frog. *Apus* is a welcome addition, and in furnishing an account of the anatomical structure of the salamander the authors have made an important contribution to laboratory literature, the only succinct account hitherto of the anatomy of this animal being that of Rusconi, published some forty years ago.

A book of this kind (in fact, one might say every book) must be judged according to the special object for which it is produced, and since the present work is, as expressly stated in the preface, only intended as a laboratory guide for students who are also attending a course of lectures, it is difficult, without knowing something about those lectures, to discuss its merits and demerits. Thus, the description of each animal is introduced by a formidable-looking table showing its systematic position. Now, were the book a guide complete in itself, one would not hesitate to condemn the practice as a violation of a most important educational principle. It is only after the student has gained a fair knowledge of the anatomy of animals that he should be shown what anatomical features may be selected for systematic purposes, and how a classificatory table can be constructed therefrom. To begin with, such a review is not only calculated to discourage the beginner by overwhelming him with a multitude of strange names, but is likely to give him a false idea of the fixity of a classificatory scheme. Since, however, it is quite conceivable, nay, probable, judging from the reputation of the authors, that the mind of the student has already been suitably prepared for these "Uebersichten" in the lecture course, we say nothing. The book is illustrated by eighteen folding plates, carefully drawn and free from all confusing detail. The figures, which with very few exceptions are original, are printed in black, and the names of the parts written, with but slight abbreviation, in brown ink. Both text and figures are remarkably free from errors, although it might be pointed out that in the *Anodonta* the lower of the two anterior retractor muscles is more usually known as the "protractor pedis," that the duplicity of the nerve cord of the crayfish in Taf. xii., fig. 2, might with advantage be more clearly indicated, and that an unfortunate slip has occurred in the numbering of the segments of the earthworm in Taf. xvii., fig. 7. On the whole, the book should commend itself to teachers of elementary practical zoology. W. G. R.

A Zoology for Practical People.

Text-book of Zoology. By J. E. V. Boas; translated by J. W. Kirkaldy and E. C. Pollard. Pp. xviii., 558, with 427 figures. London: Sampson, Low, 1896. Price 21s.

This text-book has already appeared in two Danish and two German editions. The second German edition was reviewed in Natural Science, vol. v., no. 30, p. 142, August, 1894. The translators have adhered faithfully to the plan of the original work, though there are certain differences between the English and German texts, as the book before us has been thoroughly revised by the author.

It is divided into two parts. The first or general part deals briefly with histology, fundamental form, affinities of animals. Then, in a series of short essays, such questions as "Parasitism," "Duration of Life," "Protective Adaptation," and "Geographical and Geological Distributions" are dealt with. The second or special part is systematic. Here, as all through the work, it is evident that Dr. Boas wishes his students to be naturalists, rather than mere laboratory or lecture-room scholars. In the German edition the description of the groups are followed by lists of familiar German species. These have been admirably replaced in the translation by similar lists of common British species. The illustrations are clear and suggestive, and, on the whole, good, though somewhat unequal. Certain desirable additions and improvements have been made on the figures in the German edition. The form of the book, printing, and indices leave nothing to be desired.

The addition of references to special works or original papers would, we think, greatly enhance the value of this book, as a guide in the subject of zoology both for the student and the general reader.

English students have to thank the translators for making accessible to them a text-book which is at once comprehensive yet simple, and, as we have said before of the German edition, better than any English text-book or translation of similar scope. The translators, in their preface, observe that Dr. Boas gives prominence to facts rather than to theories. Must we not have the proverbial straw, not to mention the actual clay, before we can make bricks?

The Names of the Foraminifera.

An Index to the Genera and Species of the Foraminifera. By Charles Davies Sherborn. Part 2 (Non. to Z). From Smithsonian Miscellaneous Collections, vol. xxxvii. (no. 1031). 8vo. Pp. i.–iv., 241–488. Washington: Smithsonian Institution, 1896.

Part one of this laborious compilation was reviewed in Natural Science for May, 1894. The appearance of the second, and concluding part, allows us to repeat what we then said. The book is invaluable to the student of the Foraminifera, and we learn from the preface the true purpose of the author in spending so many years on its production. Mr. Sherborn points out that many authors take up the description of the Foraminifera without the adequate knowledge necessary, and without the facilities desirable for a proper study of the literature. By the publication of this Index to the works of all authors between 1565 and 1888, he has made it imperative for all those who write to examine carefully that which has been done before their time. There can now, therefore, be no excuse for any author to publish as new, old and well-known forms. We sincerely hope the ideal set forth will be realised; many authors, now-a-days, are only too keen to make "types," and whether they are valid or not is quite a secondary matter to them.

This part of the Index opens with the conclusion of *Nonionina*, and includes, of course, the difficult genera, *Nummulites*, *Orbitoides*, etc. The preface is admirably short, and calls attention, among other matters, to the method of quotation employed, viz., that of adding the name of the original authors to every reference. For instance, Mr. Sherborn says that great trouble is often caused by quotations like "*Cristellaria cultrata*, Brady, Report 'Challenger,' etc.," when really "*Cristellaria cultrata* (Montfort), Brady, etc.," is meant; a trouble we have often ourselves experienced.

That no labour has been spared in rendering this work complete is shown by the five pages of additamenta and corrigenda, and we offer our congratulations to Mr. Sherborn on the publication of a work which has been on his hands eleven years, and thank the Smithsonian Institution for giving it to zoologists.

Serials and Announcements.

We have received nos. 8 and 9 of vol. ii. of *La Naturaleza* (Mexico, 1894, 1895). P. Maury describes *Sebastiania Ramirezii*, a new species of Euphorbiaceæ, and on it some further notes are given by J. Ramirez. A. Dugès communicates an account of *Hemichirotes tridactylus*, as well as some descriptions of new species of *Trombidium* and *Sphæroma* by Messrs. Trouessart and A. Dollfus. A new species of *Pterostemon*, one of the Rosaceæ, is described by J. Ramirez. E. Ordóñez describes a fragment of granitic rock found in the volcano Ceboruco, and A. Dugès figures a fossil footprint from the Upper Pliocene or Pleistocene of San Juan de los Lagos, which he ascribes to a large species of *Felis*, different apparently from the ordinary *Felis concolor* of Mexico.

J. N. Rovirosa describes various vascular cryptogams and other plants, collected by him in Mexico and Chiapas. *Mocinna heterophylla*, of La Llave, one of the Papayaceæ, is re-described and figured by J. Ramirez. In both parts the Flora Mexicana of Mociño y Sesse is continued. This is a work that has remained in manuscript for about a century, and is now being published for the first time. Its botanical value is naturally not great; but it is possible that it may throw light on some questions in the history of botany, since some specimens on which it was based were, we believe, sent to De Candolle.

The Society "Antonio Alzate" of Mexico sends us vol. ix. of their *Memorias*. Besides A. L. Herrera's paper, "Hérésies taxinomistes," to which we have already alluded (vol. viii., p. 5, Jan., 1896), there are several letters on this paper from various authors, as well as quotations on the subject of nomenclature. Mr. C. T. Hudson writes:—"Of course, vanity is at the bottom of it all. My remedy is a simple one, I *neither* buy nor read these books. I am content with studying the live plants and animals about me, and their names are *the last thing* I want to know. . . . It is a good idea to make placemen or stamp-collectors of these pestilent species-makers; I wouldn't hang the poor wretches." Professor Herrera has another lively paper, a study in comparative philosophy, entitled "The Animal and the Savage," greatly to the advantage of the former. With D. Vergara Lope he has a paper on the atmosphere of great heights, and the latter author writes also on mountain sickness.

There also comes to us the *Actes de la Société Scientifique du Chili*, 5e annee, livr. 1, 2, 3, and 4, Santiago, 1895-96. We are not surprised to find the ubiquitous Mr. Cockerell describing even here new species of Coccidæ. F. Lataste has some natural history notes on Cicadas, and tells us how to catch them by clapping the hands to the time of the insects' song. C. Emery continues his description of Chilian ants, many of which are new. A. Giard describes abnormal nervation in the wing of a specimen of *Pterodela*. A. F. Nogues describes the lignite beds of the south of Chili, and concludes that the so-called Arauco group is equivalent to the Laramie and Chico-Tejon beds of North America. He also has an article strongly urging the construction of a detailed geological map of Chili: those at present in existence are old and incomplete, and Chili compares ill in this respect with other civilised countries. It appears, however, that sufficient money is not usually forthcoming from the Government to pay for scientific works of this kind. F. Gautier tells how the Indians of Bolivia eat a white clay, though not to such an extent as to cause such evil consequences as are seen among some African tribes. C. Pérez Canto describes two new cetaceans from Chili, under the names *Phocœna albiventris* and *P. philippii*. Many other papers of much interest are included in this volume.

The *Scottish Geographical Magazine* for July contains an interesting *resumé* of the papers which Drs. P. and F. Sarasin have contributed to the *Zeitschrift* and the *Verhandlungen der Gesellschaft fur Erdkunde zu Berlin*, during the last three years, on their explorations in Celebes, an island which hitherto has been but little explored. They have obtained a large amount of information regarding the physical features of the island, and its geology, its fauna and flora, and the habits and customs of its natives. In giving an account of the eleventh Swiss Geographical Congress, V. Dingelstedt says that R. Pictet has been studying the effect of the sun's heat in forming sand-spouts in Egypt. He suggests that the heat might be employed in raising the water of the Nile for the irrigation of Egypt. This might be effected by covering a large area with blackened plates of sheet-iron, under which water would be conducted. This water, as shown by his observations, would be raised to a temperature of 150° F., some 80° higher than that of the Nile. A boiler thus constructed over 2½ acres would develop 2,000 horse-power, by which the water of the Nile might be raised to the necessary height and poured in abundance over the desert land.

We find that the remarkable paragraph entitled "Four-legged Birds," to which we recently drew attention as going the round of the English popular Press, was lifted verbatim from an article, adorned by a striking illustration, that appeared in *Popular Science News* for February, 1896. This, which is published in New York, is an illustrated monthly, in which many curious articles of a like character may be found.

An up-to-date address-book of botanists has been a desideratum for some time. One is now published by J. Dörfler, Barichgasse, 36, Vienna, III., at the price of 10 M. Despite the numerous errors, which the botanists themselves can easily correct in time for a second edition if they will take the trouble, the directory is a great improvement on any that have previously appeared.

We have much pleasure in drawing the attention of those of our readers who are interested in ornithology or anthropology to a book that is being prepared by our esteemed contributor, the Rev. H. A. Macpherson. It is entitled "A History of Fowling: being an account of the many curious devices by which wild birds are or have been captured in different parts of the world." It is believed to be an almost exhaustive treatise, and contains much new information from most regions, as well as being a digest of what has been published, especially as regards old and rare Italian works and other recondite sources. The MS. is ready, but has not yet been sent to the printers, since the author desires to ensure himself against losing much on the actual printing and engraving. The volume will be a quarto of about 450 pages, and the price is one guinea to subscribers in advance. If sufficient support be obtained by the author, he will hope to figure specimens of such ethnological interest as traps from Borneo, Morocco, Japan, India, and other parts of the world. Mr. Macpherson's other books have shown that he is well fitted to deal with a subject of such general as well as special interest, and we hope that many will send their subscriptions to him at 11 Victoria Place, Carlisle.

Literature Received.

New Mammals from Mexico, E. A. Mearns: U.S. Dept. Agric. Handbook of British Birds, H. K. Swann: John Wheldon. Der Lichtsinn Augenlose Tiere, W. A. Nagel: Jena, Fischer. What it costs to be vaccinated, J. Collinson: Humanitarian League. A Geographical History of Mammals, R. Lydekker: C. J. Clay. Official Guide to Norwich Castle Museum, T. Southwell: Jarrold and Sons.

Anableps, S. Garman: *Amer. Nat.* Leucosolenia variabilis, E. A. Minchin: Royal Society. Earliest Record of Arctic Plants, Holm: Biol. Soc., Washington. Label List British 5-banded Shells, J. T. Carrington. 45th Annual Report: Birkbeck Bank. 1st Report on Flora, Evan Nelson: Wyoming Exp. Station. President's Address: *Lin. Soc. N.S.W.* Tertiary Polyzoa of Victoria, P. H. MacGillivray: *Trans. Roy. Soc. Vic.* Lead and Zinc Deposits, A. G. Leonard: Iowa Geol. Survey. *Transactions Manchester Micros. Soc.*, 1895. Intermediate Fluke, W. Fielder, 3rd Notice.

Nature, June 18, 25, July 2, 9. Literary Digest, June 6, 13, 20, 27, July 4. Revue Scientifique, June 13, 20, 27, July 4, 11. Irish Naturalist, July. Naturen, June. Nature Notes, July. American Journ. Science, July. Naturæ Novitates, June. Amer. Naturalist, July. Science, June 19, 26, July 3. Scott. Geogr. Magazine, July. The Naturalist, July. Westminster Review, July. Botanical Gazette, June. Popular Science News, July. Knowledge, July. Photogram, July. Psychological Review, July. Science Progress, July. Ornithologist, July. Bulletin, 4, 5, 6, Int. Inst. Bibliographie, Brussels.

OBITUARY.

HENRY JAMES SLACK.

Born October 23, 1818. Died June 16, 1896.

WE regret to record the death of this well-known microscopist. Mr. Slack was educated at Dr. Evan's School, Hampstead, was a barrister-at-law, and was proprietor and editor of the *Atlas* and the *Intellectual Observer*. He erected an observatory at his residence, Forest Row, Sussex, but paid more attention possibly to the microscope, his little book, "The Marvels of Pond Life," of which a third edition appeared in 1878, showing close interest and observation. He was a warm advocate of the Sunday opening of museums; and his attachment to the cause of Liberalism and progress, and his sympathy with Kossuth, Mazzini, and others, is told in a short sketch by Mr. G. J. Holyoake, in the *Daily News*, June 27, to which sketch we are indebted for the above facts.

There are also announced the deaths of: W. von Henke, Professor of Anatomy at Tübingen University, on May 17, aged 62; F. Ludy, the coleopterist, on March 1; Dr. Hosius, Professor of Mineralogy at Münster, aged 70; and the ethnographer, Von Irgens-Bergh, on May 21, at Copenhagen, aged 76. Botanists have to deplore the loss of: R. P. Delavay, well-known for his researches on the flora of China, who died at Yunnan in that country, on December 31, 1895, at the age of 62; Dr. G. Liebscher, Professor of Agriculture and a noted investigator of plant-physiology, who died at Göttingen, on May 9, at the early age of 43; and Dr. J. Lerch, a student of the Swiss flora, who died at Couvet, Switzerland, on March 13.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced:—H. J. Mackinder, to be Reader in Geography to the University of Oxford for a further period of five years; Dr. Lickfett, to be Director of the Hygienic Bacteriological Institute at Dantzig; Dr. Paul Eisler, to be Extraordinary Professor of Anatomy at Halle; Dr. M. Westermeier, Professor of Botany in Freising, to hold the same position at Freiburg University; N. B. Zinger, to be Curator at the Botanical Garden at St. Vladimir's University, Kiev; Dr. Went, Director of the Experiment-Station in Java, to be Professor of Botany in Utrecht University; Professor F. Kohl, to the Chair of Botany in Marburg University; Dr. F. Kienitz-Gerloff, of Weilburg-on-Lahn, to receive the title of Professor; Dr. Thilenius, to be Privat-Docent in Anatomy at Strassburg University; Dr. G. Fatta, to be Assistant in Palermo Botanical Institute; J. H. Maiden, to be Government Botanist and Director of the Botanic Gardens at Sydney, in succession to Charles Moore, who retires after nearly fifty years' service; Dr. Arthur Allin, to be Professor of Psychology and Pedagogy in Ohio University, Athens; Dr. Charles H. Judd, to be Instructor in Psychology at Wesleyan University; Miss G. A. Smith, to be Assistant in Botany, and Miss L. D. Wallace, in Zoology, at Smith College, U.S.A.; A. A. Heller, to succeed F. P. Sheldon as Instructor in Plant Taxonomy and as Curator of the Herbarium at the University of Minnesota. L. Dippel, Professor of Botany in Darmstadt, has retired.

L. J. PICTON, of Merton College, has been elected by Oxford University to the Biological Scholarship at Naples for the year 1896–97.

A BILL has been introduced into the House of Lords to transfer the right of patronage to the chairs of natural history and of botany in Edinburgh University, now exercised by the Crown, to the curators of patronage in the university.

THE Charing Cross Hospital Medical School has been enabled, by re-arrangement of existing scholarships and the proceeds of a special fund, to found memorials to Dr. Livingstone and Professor Huxley—both of them old students of the school. The memorial to Livingstone takes the form of an entrance scholarship of 100 guineas per annum; that to Huxley, first, of an entrance scholarship of £55, open to the sons of medical men; second, a second year's prize in anatomy and physiology; and, third, a lectureship dealing with recent advances in science and their bearing on medicine and surgery.

THE German Universities are beginning to take some notice of women. At the University of Berlin they are to be allowed to attend lectures after securing permission from the Minister of Public Instruction and from the lecturer. At Munich the great experiment is being tried of allowing a woman to attend courses in geology and palæontology. Göttingen, which apparently does not approve of the mixing of the sexes, is arranging special courses for women in botany, physics, and chemistry.

ON July 1 a new section of the U.S. Department of Agriculture was established under the title of the Biological Survey. It is intended to furnish agriculturists, horticulturists, and stock-breeders with charts showing the various areas in the United States that are suitable for the cultivation or rearing of different species of plants and animals.

WE are informed by Miss Hall, curator of the Whitechapel Public Museum, that, in order to extend its educational value, the Commissioners are willing to open the museum at any time after 9 a.m. to teachers who may desire to bring their classes for practical demonstration. Two days' notice previous to the visit should be sent to the curator.

THE Geological Rooms in the museum at Peel Park, Salford, which have been re-arranged by Mr. H. F. Bolton, as we described in our February number, vol. viii., p. 140, were opened on July 1, upon which occasion an explanatory address was given by Mr. Bolton.

THE ninth general Report of the Museum and Free Library of Bootle shows that the use of both institutions by the public continues to extend. Mr. H. Chadwick, the newly-appointed assistant-curator, has been arranging the mammals with a view to instruction as well as pictorial effect. He has also prepared drawings illustrating the anatomical characters of the various classes of Invertebrata. During the winter nine free addresses, illustrated by the lantern, were delivered in connection with the natural history objects in the museum. The attendance was satisfactory, and consisted chiefly of young people.

THE palæontological collections of the Musée d'Histoire Naturelle in the Jardin des Plantes are undergoing re-arrangement in a large new gallery recently erected for their reception and still unfinished. This gallery is lofty and very well lighted, and is in every way worthy of the important collections to be exhibited in it. In the central portion will be placed the larger objects, such as the magnificent skeletons of *Hipparion* and *Mastodon* from Pikermi, the skull of *Steneosaurus heberti*, and many other famous specimens. Round the walls are arranged a series of cases for the reception of smaller objects. These cases are entirely constructed of iron and glass, and are of such a height that the whole of their contents can be easily seen, a distinct improvement on the lofty cases used at the Natural History Museum, London, although, on the other hand, less convenient for the study of smaller fossils than the table-cases employed in the last-mentioned institution.

THE Committee of the Albany Museum, Grahamstown, Cape of Good Hope, sends us the *Report* for 1895, written by Dr. Schönland. It complains that the buildings are by no means well adapted either for the proper exhibition of the specimens or for their safe protection, while no use can be made of the collections for educational purposes. Dr. Schönland has been experimenting with formalin as a substitute for spirits of wine; he prefers it because it preserves the specimens better, is cheaper, and, in the weak solutions required, non-inflammable; he only fears that it may not keep in the hot climate. So far as the acquisition of specimens is concerned, the museum is progressing favourably, and the number of persons from all parts of South Africa seeking for information on the various subjects embraced by the collections is steadily increasing. Dr. Schönland's labours are so appreciated by his Committee that they have raised his title from that of Curator to Director of the Museum.

Apropos of formalin, Mr. Haly, the Director of the Colombo Museum, Ceylon, states that it is as injurious to bright colours as alcohol, and therefore does not supersede the gum and glycerine and carbolised oil methods at present employed. This building also seems to require extension, as well as another water-hose. Lists of many species of shells, Hymenoptera, moths, and Diptera contained in the museum are given; but Mr. Haly seems to be a little bit taken aback by the revolutionary changes that are being made in scientific nomenclature by such works as Boulenger's "Catalogue of Fish" and "The Fauna of British India," while mention of "Das Tierreich" suggests to him that any further compilation of lists on his part is quite useless. We do not think that Mr. Haly need be afraid that "Das Tierreich" will be completed for many years to come; at all events, if it be completed as rapidly as he seems to expect, its value will not be great.

MR. FREDERICK CHAPMAN has been elected an Associate of the Linnean Society, as a recognition of his work on the Foraminifera. We are glad that Mr. Chapman has been so honoured, for we are inclined to value the A.L.S. highly, as, unlike the fellowship of other societies, it cannot be bought.

PROFESSORS W. G. RÖNTGEN and K. V. Kupffer have been elected Corresponding Members of the Royal Prussian Academy of Sciences.

THE delegates to the International Conference on the Bibliography of Science, with other invited guests, were received by the President of the Royal Society at Burlington House, in the evening of Monday, July 13, and began their serious discussions the next morning. On Tuesday evening they dined together at the Hotel Metrôpole, the following day were received at the Mansion House, and on Thursday attended a garden party given by Mr. and Mrs. Ludwig Mond, where the beautiful entertainment was hardly spoilt by the unfavourable weather. Since the meetings of the Conference were strictly private, we are precluded from reporting the discussion, but we understand that it has been decided to establish a Central Bureau, having its headquarters in London, and separate National Bureaux for each state concerned. The National Bureaux will undertake the work of cataloguing the literature, each for its own country, and of transmitting this preliminary catalogue to the Central Bureau, which will prepare it for publication in final slip- and book-form. As regards the further questions of organisation, language, and system of classification, these are, for the present, referred to an organising committee, to be appointed by the Royal Society, which will enquire into the various questions, possibly experimenting in some manner, and which, when it has arrived at certain conclusions, will convene another conference, the date of which is not to be later than January, 1898. It is, we believe, decided that the titles of all papers shall be quoted in the original language, but that certain languages, as yet undecided, shall also be translated into some more familiar tongue.

A CIRCULAR of invitation to the Seventh International Congress of Geologists has been issued by the Russian Organising Committee. The Congress will take place at St. Petersburg, towards the end of August, 1897, under the honorary presidency of the Grand Duke Constantine, and the acting presidency of Dr. A. Karpinsky, Director of the Geological Committee of Russia. The General Secretary is Professor Th. Tschernyschew. The session will last about a week, and the proceedings of the Congress will not be distributed among sections, as at Zurich, but will be devoted to the discussion of various broad principles. Some communications, however, will be made with reference to the important geological studies and explorations now being carried on in Russia. For those geologists who wish to read little papers on subjects interesting to themselves, it is proposed to have special meetings of various scientific societies, at which such minor matters can be discussed. Numerous excursions are announced:—to the Ural Mountains, to the Volga, to Esthonia, to Finland, etc. After the Congress a long excursion will be made, first to Moscow, where it will divide into three parts, one going to the basin of the Donetz, the second to Nijni-Novgorod, and the third to Kiev; meeting again, the members will proceed to Tiflis, Bakou, Batoum, Kertch, and various parts of the Crimea, ending at Sebastopol. Among other places that may be visited as variants from this excursion are the Caucasus and Mount Ararat. Those geologists who intend to go on any of these excursions should send notice before October to the Secretary, when they will receive a detailed plan of the excursions, with an approximate estimate of the expense. The latter item will be greatly lessened by the gracious act of His Majesty the Czar in granting to all geologists who shall, in due time, have intimated their intention of attending the Congress, tickets giving free passage, first-class, over all Russian railways, both before and after the meeting of the Congress.

ANOTHER so-called International Congress! This time it is on sea-fishery and oyster-culture, and is to be held from September 3 to 7 at Sables-d'Olonne (Vendée), under the presidency of Admiral Duperré and Professor Perrier. Subscriptions and communications may be addressed to Mr. A. Odin, 67 Rue du Port, Sables-d'Olonne.

THE Herpetological Society, whose foundation we announced in our February issue, published the first number of a journal under the name of *The Vivarium*, which is now quite out of print. Both society and publication, however, received so little financial support that they are in abeyance for the present.

PRIZES for essays on the following subjects are offered by the Royal Danish Academy of Sciences:—Morphological and physiological researches on the asci of the Ascomycetes; the Danish species of Nematoids and Anguillulinæ; and the life-history of those Sphæriaceæ which are destructive to cereal crops.

PROFESSORS H. T. PECK, Daniel Brinton, and H. C. Adams have been appointed a committee to adjudge the two prizes of 5,000 and 2,000 francs founded by Joseph Loubat, of Paris, to be given every five years to the authors of the best works on the history, geography, archæology, ethnology, philology, or numismatics of N. America. The next competition is in 1898.

AT a recent meeting of the Biological Society of Washington, Mr. Charles D. Walcott, Director of the U.S. Geological Survey, stated that he had completed an extensive memoir on the fossil Medusæ of the Lower and Middle Cambrian of North America and the Jurassic of Europe. It will be illustrated by numerous plates showing details of structure of many of the forms, which were preserved under very favourable conditions, and presenting also the results of experiments with living species.

A NEW zoological garden has been opened at Königsberg, in Prussia, under the directorship of Dr. J. Müller, formerly of the garden in Berlin.

A SITE of 261 acres in Bronx Park, south of Pelham Avenue, has been suggested for the new zoological park, New York, but action is postponed for the present, since Mayor Strong is opposed to granting the land. Mr. W. T. Hornaday is now in Europe inspecting the various zoological gardens.

PROFESSOR DARCY THOMPSON, who, as we announced, has gone to the Behring Sea to study the seal fishery question, is accompanied by Mr. Andrew Hackett and Professor Macoun, of the Geological Survey of Canada. The party has gone to the Prybilov Islands in the U.S. Fish Commission steamer "Albatross."

THE largest meteorite in the world, weighing forty tons, which was found by Lieut. Peary in Greenland, is to be brought back by him for the Philadelphia Academy of Sciences on his present trip. Large scientific parties are going with him. One party will make a geological study of the region near the Devil's Thumb at the south end of Melville Bay, and will collect the fauna and flora. Another will land at the Great Umanak Fiord, where it will make pendulum observations, natural history collections, and study the glacial phenomena. Peary himself will proceed north as far as Cape Sabino, and will also try to explore Jones' Sound. An artist accompanies him to take casts of the Cape York natives, who, it is to be hoped, will prove amenable. The ss. "Hope," conveying the expedition, left Cape Breton Island on July 16.

A PARTY of four, under the direction of Mr. T. H. Mobley, will start from Lacomb, Alberta, to explore Northern Canada from Edmonton to the Arctic Sea. The trip is to occupy two years.

THE Conway Expedition to Spitzbergen has already conducted some successful, though difficult, explorations, and Dr. Gregory has obtained some valuable geological results. The ice in this neighbourhood is very heavy this year, and it is thought that the "Windward" may be frozen up in Barents Sea before she can reach Franz Josef Land with her supplies for the Harmsworth-Jackson Expedition. This will affect most of the other expeditions now around the North Pole, except Andrée's balloon expedition. An interesting account of the balloon and its arrangement, by G. Tomel, is given in *Popular Science News* for July, 1896.

PROFESSOR AGASSIZ and party have returned to America from their expedition to the barrier reef of Australia. The ss. "Croydon" was chartered in Brisbane from the A.U.S.N. Co., and the reef worked from south to north. We learned from the party as they passed through London that the results were not so good as had been expected. Owing to the unfavourable weather the vessel had to lie to for considerable periods at Cooktown, Pitcairn, and elsewhere, so that only about a week of working days was found. Deep dredging became out of the question, but some captures were made with surface nets, and several photographs were taken. Professor Agassiz expressed himself as enchanted with the indescribable beauty of the corals, which surpassed that of any reefs he had previously seen.

MR. C. HEDLEY has joined the coral-reef boring expedition to Funifuti as zoologist.

MR. E. A. FITZGERALD, the climber of the New Zealand Alps, leaves England in September for Chili, where he will explore the summit of Aconcagua, 23,200 feet. Among those accompanying him is Mr. Philip Gosse, and it is stated that the scientific side of the expedition will be as perfect as it can be made, nearly £4,000 being spent in completing the preparations.

DR. M. RACIBORSKI, of Munich, has been sent to the Buitenzorg Botanical Gardens.

PROFESSOR V. F. BROTHERUS, of Helsingfors, has gone to Central Asia to work out the bryological mountain flora of Issikul.

THE Japanese Parliament has voted a sum of 5,383 yen (about £675) for the scientific exploration of Formosa by members of Tokyo University.

A STATE Entomological Experiment Station, for which the money has been voted by both Chambers, is to be built near Stockholm.

SOME important deposits of brown coal have recently been discovered in South-west Russia, near the Fastov Railway, and a company is being formed in St. Petersburg to work the same; true coal has also been found in many parts of Western Siberia, in the Governments of Yeniseisk and Irkutsk, in the provinces of Yakoutsk, Trans-Baikal, the Amour, in the Maritime Province, and in Kamschatka. The most important deposits are those in the Maritime Province, which is the only one in which mining operations are carried on. Seams of good coal have been found near Spickholzerteide, in South Limburg, Holland, and will be worked by a Dutch-Belgian company. For some time a company known as the Budapest Regional Coalmining Industry Company has been boring for coal at Vorosvar, Hungary. It is now reported that a thick seam of coal has been cut through at a depth of about 273 yards.

MUST not palæontology in the United States be in rather a bad way if it is necessary for Professor G. D. Harris, the editor of the *Bulletins of American Palæontology*, to offer a prize of $50 for a monograph suitable for publication, to be presented before May 1, 1897? Whatever be the reason for this move, the energy of Mr. Harris deserves commendation.

CORRESPONDENCE.

The New Fittings for the South African Museum.

In your abstract of the Report of the Trustees of the South African Museum for 1895 (antea p. 66) you mention that the air-tight iron and glass cases, on my system, for the new building in Cape Town, are to be supplied by Chubb & Sons' Safe Company. I beg to state that this London firm has ordered the said fittings in Dresden, but, unfortunately, from a manufacturer who is not up to date in this respect. Since my last publication (in the year 1892) on this matter, which has been reported also by you (vol. v., p. 14, 1894), I have, with the help of an exceedingly clever member of the firm of Messrs. Herrmann & Ranft, in Dresden, hit upon some very essential improvements, which alter the aspect of these fittings, cases as well as desks, much to their advantage. I regret that I have not yet found leisure to publish anything about this progress (though I hope to be able to do so still in the course of this year, with the necessary figures for illustration), and that, in consequence, the South African Museum will receive fittings after a system given up by myself several years since, and which I, for my part, would not advocate any longer, since "the better is the enemy of the good."

Royal Zoological Museum, Dresden. A. B. Meyer.
July 2nd, 1896.

The Cause of the Mammoth's Extinction.

In Professor Bonney's review of Dr. Gregory's valuable work (Natural Science, vol. ix., pp. 53–57) reference is made to the discovery of large quantities of bones of animals lying exposed on the surface in Eastern Africa, unweathered and ungnawed, and it is suggested that in some way or other these bones illustrate the well-known cachés and deposits of bones which date from Pleistocene times and which have occupied me much, and I am reminded of the analogy by Dr. Bonney.

The fact was familiar enough to me as existing elsewhere. Darwin has a very interesting reference to similar collections of bones in South America. My brother-in-law, who has long had a cattle ranche in New Mexico, tells me that seasons of great drought there are always followed by similar phenomena. The buffalo plague in South Africa left similar mementoes, while not long ago Mr. Wylde at my own table described the terrible sights he had seen on the plains of the Eastern Soudan, where 200,000 skeletons lay exposed on the ground, the result, not of drought, but of Martini rifles. Similar deposits to these are referred to in my Mammoth book, but I have there protested, and I propose to protest again, against there being the smallest analogy between them and the Pleistocene buried bones.

In the first place, the series of these buried bones is really conterminous with the Siberian deposits, where the flesh and soft parts of the animals are preserved. The two conditions of the preservation of these latter are that they have remained frozen since they were deposited, and that they were buried and protected from weathering directly after they died, and have remained covered in ever since. The latter condition applies to all the cases where whole skeletons have been found with their several bones in position, which has happened in many places, as I have shown, from the Pyrenees to the Yellow Sea.

It is true that the bones exposed on the African plains remain ungnawed, largely because they have been stripped of their flesh by raptorial birds which cannot gnaw bones. It is true also that they remain for a year or two with their edges sharp, but this condition is very short-lived, the rain and the sun speedily disintegrate and weather them.

In the case of the Pleistocene bones, we know that they remained not only ungnawed, but with their fleshy covering uneaten until it decayed away, while the bones remain as fresh to-day after thousands of years as they were when the animals died, and without the slightest trace of weathering. This is, in itself, a very great distinction. A greater remains in the fact that the Pleistocene bones are buried deep in gravel or brick earth, and do not lie on the surface, and they must have been buried when the carcases were intact, for the bones are all in place. They are buried not merely on river bottoms, but over immense stretches of undulating country in Eastern Europe and Siberia, are chiefly *found where the ground is highest*, and are covered by vast continuous mantles of gravel, etc., in countries where the rivers carry no gravel, and where, when they flood the country, they leave scarcely a trace of warp. All this I have urged in great detail elsewhere, and it has to be accounted for. What single point of contact does it present with the scattered bones on African plains after a drought, or the myriads of dead seagulls on our coasts after some portentous storm ?

Again, all these cases and similar ones are quite local, dependent on local circumstances, local droughts, local murrains, etc., etc., but in the case of the Pleistocene beasts the problem which has to be explained covers threc continents. We may start from Italy and Southern France, traverse every degree of longitude till we reach Behring Straits, and find the same phenomenon presenting the same conditions; and if we cross Behring Straits to Alaska, we may begin another journey which shall carry us right down to Patagonia. Everywhere, so far as the evidence goes, we have traces of the same stupendous hecatomb of beasts buried under similar continuous mantles of loam and gravel, and for the life of me I cannot see, any more than Darwin could see, how the phenomenon of the Pampas is to be separated in date or in kind from the phenomenon of the Russian plains. Darwin himself confessed that he was baffled in trying to explain the difficulty, and so must every man be baffled who starts with hypotheses and then turns to the facts Deductive methods must be barren in a science like geology. To start with a magnificent postulate about uniformity, and to attempt to squeeze any part into that straight jacket is not science. It may be metaphysics, but metaphysics is not a fruitful tree. Nor may I say is it fruitful to attempt to correlate the local phenomena following a drought in Africa with continental phenomena derived from droughtless regions, which, as I have shown, differ so essentially in every particular from them, as do the conditions under which the bones in the great Pleistocene graveyard were accumulated. Yours most obstinately,

30 Collingham Place, Earl's Court. HENRY H. HOWORTH.

THE NAME OF THE GORILLA.

ON p. 31 of your last number Dr. Arthur Keith comments on the name *Anthropopithecus gorilla* affixed to the gorilla's cage in this Society's Gardens, and asks who is responsible for it. I may state in reply that I am responsible for all the names given to the animals in the Zoological Society's Gardens. Dr. Keith appears to prefer the name *Troglodytes gorilla*, but if he will refer to Flower and Lydekker's "Mammals Living and Extinct" (p. 736) he will find the reason stated why the term *Troglodytes* cannot be used.

I may add that all the names employed in the labels used in the Society's Gardens will be found to correspond with the list of the animals in the Gardens published in 1883, which was prepared mainly with the view of ensuring uniformity in the nomenclature.

Zoological Society of London, P. L. SCLATER.
3 Hanover Square, London, W.
July 7th, 1896.

A PLEA FOR THE PRELIMINARY SINNER.

IT is not without much hesitation that I venture to appear in NATURAL SCIENCE as a defender of the "preliminary notice," and I am quite prepared to undergo the process which on this side of the water is styled being "jumped on with both feet."

Nevertheless, I cannot look upon the preliminary notice as an unmitigated evil, nor consider the writer thereof as utterly lost to all sense of scientific decency. This is very likely because I am, to some extent, myself one of the sinners and wish to be forgiven not only for past sins, but, like Louis XI., for one little sin more, that I hope to commit ere long.

The object of the preliminary paper is to render immediately available facts which would otherwise remain unknown for an indefinite time, to protect the worker from having the cream of his labour skimmed off by someone who has been but a brief time in the field, and to place the credit for work or discoveries where it justly belongs. Consider, for example, Dr. Stejneger's recent paper on the blind amphibian *Typhlomolge*. It will undoubtedly be two or three years before a detailed description of the species, fully illustrated, and properly compared with other forms, can be issued, and, but for the preliminary notice, the credit of the discovery of the interesting little beast, and the recognition of its affinities, would undoubtedly have been claimed by another. And yet, had this happened, such a paper, so far as results are concerned, would have been just as preliminary in its character as that of Dr. Stejneger, besides having the added evil of depriving another of his just dues.

Again, the U.S. National Museum is the possessor of some remains of *Zeuglodon* which will form the basis of an illustrated memoir. Pending the publication of this, it is purposed to publish a preliminary paper giving the characters of the family and genera and probable affinities. This will render the main facts in the case of *Zeuglodon* at once available, while, from the nature of the work, it will be *at least* two years before it will be possible to publish in detail the results of the study of this material together with the figures which will practically place the specimens at the disposal of everyone. Shall we stay our hands—and preliminary notes—and bottle up the information so far as possible, or shall we do the best we can now and do better later on?

There are doubtless some happy individuals, not hampered by the cares of the world, who can prosecute their work without interruption and publish it without delay, but there are also people whose work is subject to numerous interruptions, and who consider it great good fortune to have a paper published within a year of its completion. And to these unfortunates the preliminary notice comes as a means of saving grace—and credit—and it is a little hard to say that there is no good in them—or in their paper.

Not that the mantle of charity should be spread over the shoulders of every preliminary paper; for there are many that should be treated as outcasts and turned out into the cold. But there are papers and papers, and it seems to me eminently proper to allow a man to secure his main facts with a preliminary nail, and then sit down and work in peace.

Washington, D.C. F. A. Lucas.

[We do the "jumping on" Mr. Lucas in our Notes and Comments.—Ed. Nat. Sci.]

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.*

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NATURAL SCIENCE:

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NOTES AND COMMENTS.

"Skål to the Norseman! Skål!"

PEOPLE of all nationalities, and especially the friends of science, will greet with a hearty welcome the safe return of Fridtjof Nansen, and the notable results of the voyage of the "Fram." It was on midsummer day, 1893, half-an-hour after noon, that Nansen, with twelve men, left Christiania "on a polar expedition, with the fixed resolve to do their uttermost." It will be remembered that Nansen's plan differed from that of his predecessors in that he took for his allies the forces of nature themselves. The discovery on the east coast of Greenland of flotsam, supposed to be derived from the American ship "Jeannette," which had sunk near the island of New Siberia, about longitude 155° E., and latitude 77° N., suggested that they had been carried across the polar circle by some unknown current. On this idea Nansen's plan was based; the "Fram" was specially built so as to be lifted up by the ice when nipped instead of being crushed by it, and she entered the ice-sea north of the New Siberian islands with the intention of being carried, if not across the north pole itself, at all events nearer to it than man had hitherto penetrated. The scheme was scouted by many old Arctic voyagers, and there were not a few who thought they had seen the last of "the foolhardy Norseman" on that midsummer day three years ago. But the enterprise is justified by the event, and Nansen returns to us, not merely as the most successful of those that had ventured towards the pole, but crowned with the more fruitful honours of important scientific discovery.

The "Fram" left New Siberia, and, entering the ice, was uplifted by it and carried to 84° N. This was already higher than the most northerly latitude previously attained, namely 83° 24', which was reached by Lieutenant Lockwood of the Greely expedition in 1882. Here, however, it appeared that the vessel would not be carried further north, as it was then imprisoned by ice drifting in a westerly direction. Therefore, on March 14, 1895, Nansen and Johansen, who volunteered to accompany him, left the ship, and journeyed northwards with dogs, sledges, snow-shoes, and two kajaks. They progressed slowly, partly over dangerous ice, partly over open water, till on April 8, 1895, they reached 86° 14′ N., being only 420 kilometres (about 252 miles) from the pole, about longitude 50° E. Icebergs made further advance northwards impossible, so turning towards the east they came, on August 6, to the north coast of Franz Josef Land, which they crossed, and on August 26 again came to open water, in 81° 13′ N. Here they wintered in a hut built of stone, earth, and sealskin, with a bearskin for a door, shooting seals and polar bears, whose flesh they ate and whose fat they burned in a lamp made of sledge bolts. The dogs had to be killed one by one as food for the rest, till at last none were left. On May 19, of this year, the two men set out with the intention of reaching Spitzbergen, and after six weeks' journey, fell in with the Jackson expedition, in whose winter quarters they stayed for a month and a half. At last they returned on board the "Windward," reaching the Vardö at 4.30 p.m., on Thursday, August 13. Nansen reports that all on board the "Fram" were well when he left, and had provisions for 6 years, with 100 tons of coal. He believes that they must by this have reached the east coast of Greenland, and that it will not be long before they are in Bergen.

So far as they can be gathered from the brief telegrams as yet to hand, the chief scientific results of Nansen's expedition are as follows. The existence of a current running across the polar sea from Siberia to Greenland is proved. Petermann Land does not appear to exist; in fact, no great land masses are to be found in this region north of 82° lat. On the other hand, many unnamed islands have been charted. Nansen seems to think that his wintering place was not actually on Franz Josef Land, but that there is an error in von Payer's map. Besides this, there can be little doubt that both by Nansen and by those left on board the "Fram" many observations have been made of scientific importance. So trained an observer as the zoologist of Bergen is not likely to have let slip any opportunities. The cost of this expedition was about £23,000: such vast results have rarely been obtained with so small an expenditure of money, or, as we hope it is safe to add, with so little loss of human life.

[At moment of going to press, we learn that the "Fram" arrived safely at Tromsö, with all well on board.]

The Bibliography of Zoology.

We have received from the Committee of the British Association of Zoological Bibliography and Publication the following communication:—

"It is the general opinion of scientific workers, with which the committee cordially agrees:—(1) That each part of a serial publication should have the date of actual publication, as near as may be, printed on the wrapper, and when possible, on the last sheet sent to press. (2) That authors' separate copies should be issued with the original pagination and plate-numbers clearly indicated on each page and plate, and with a reference to the original place of publication. (3) That authors' separate copies should not be distributed privately before the paper has been published in the regular manner.

"The committee, however, observes that these customs are by no means universal, and constant complaints are made that one or other of them is not put into force. In case the publication or society with which you are connected does not comply with these desiderata, the committee ventures to ask whether it would not be possible for it so to comply in future. Should you, however, have any good reasons against the adoption of these suggestions, the committee would be much obliged if you would kindly inform them of your reasons, in order that they may be guided in their future action.

"The committee further begs to ask for your co-operation in the following matter. There are certain rules of conduct upon which the best workers are agreed, but which it is impossible to enforce, and to which it is difficult to convert the mass of writers. These are: (4) That it is desirable to express the subject of one's paper in its title, while keeping the title as concise as possible. (5) That new species should be properly diagnosed and figured when possible. (6) That new names should not be proposed in irrelevant footnotes, or anonymous paragraphs. (7) That references to previous publications should be made fully and correctly, if possible in accordance with one of the recognised sets of rules for quotation, such as that recently adopted by the French Zoological Society.

"The committee ventures to point out that these and similar matters are wholly within the control of editors (*rédaction*) and publishing committees, and any assistance which you can lend in putting them into effect will be valued, not merely by the committee, but, we feel sure, by zoologists in general."

We have much pleasure in giving further publicity to the request of the committee, but in these matters our own conscience is clear. The printers of NATURAL SCIENCE have always had strict orders to obey the instructions 1, 2, and 3 of the committee, while the editors have always attempted to induce their contributors to follow suggestions 4, 5, 6, and 7. In this attempt they will continue, but they take this opportunity of pointing out to their contributors how greatly editorial labours can be lightened by closer attention to some of these small details.

PITFALLS IN BOTANY.

THE great bugbear of the student of botany just at present is the *stele*. It cannot be avoided, for it confronts him at every examination. He gets the latest text-book and grinds it up, or tries to do so, for the result is often hopeless muddle. It looks plain sailing enough. There are the three primordial layers at the growing-point (at least the figures in his text-book show them): *dermatogen*, developing into *epidermis*; *plerome*, forming the central *stele*; and *periblem*, yielding the *extra-stelar* tissue between the *stele* and the epidermis. The limit of the extra-stelar tissue is the *endodermis*, a layer characterised by the presence of starch in its cells and curious thickenings on its radial walls. He often fails to find this endodermis when he cuts his sections of the stem; but then sections do not always turn out as they should. He goes on bravely, but *schizostely* puzzles him, and when he comes to *Equisetum* he gives it up as hopeless. We would advise him to put a pin through those pages in his text-book, and go to some library where he can get hold of the April and May numbers of *Science Progress* (it is much too expensive for him to think of buying—an opinion which, unfortunately, is shared by many librarians), and read an account of the history of the theory, with criticisms thereon by Mr. A. G. Tansley. Meanwhile, we will put him up to one or two points. Plausible though it seem, there is really no connection between the dermatogen, periblem and plerome business, and the stelar theory of Van Tieghem. Perhaps, though, relying on his text-book, he does not even know it as Van Tieghem's theory. If he goes into the question, he will find that recent observers are not by any means certain about these three initial layers at the growing point, and that the stelar theory must, in the present state of our knowledge, be considered quite apart from them. Briefly, it is something like this. There is a striking similarity in the internal structure of all roots, as Van Tieghem showed nearly five-and-twenty years ago. They contain a central cylinder, in which, before matters become complicated by secondary thickening, we find strands of wood and bast separated by parenchymatous "conjunctive cells," the whole surrounded by a *pericambium*, or *pericycle*, and bounded on the outside by the innermost layer of the cortex, which shows the characters that we associate with an endodermis. The great service of Van Tieghem to the study of plant anatomy was in showing that this arrangement in the root is continued through the hypocotyl into the stem, and that in stems of many seed-plants it is possible and easy to trace a pericycle continuous with that of the root and surrounding the system of vascular bundles separated by conjunctive tissue, with which is included the pith. Continuous also with the endodermis of the root is a similar layer, with similar characteristics, forming the limit of the cortex towards the central cylinder or stele. The root, hypocotyl and stem have one continuous stele—are, in fact, *monostelic*. There are cases, however, where the very best of sections reveal no endodermal layer round the central bundle-system. Now, an endodermis cannot be imagined. As Strasburger has pointed out, it is a layer whose cells have certain histological characters to which we have referred, these characters being associated with certain physiological properties. It is, in fact, a layer that will transmit water, but not air; as such it is eminently of service in enclosing the water-conducting system, and therefore very frequently found surrounding it; but it may, and does, occur elsewhere, and must not be considered as an integral part of the stelar theory. To avoid this Strasburger suggests a new term, *phlœoterma*, for the layer next outside the stele and surrounding it. The phlœoterma may have endodermoid characters, or it maybe indistinguishable from the other cortical layers. On this assumption the great stumbling-block, *Equisetum*, is easily removed. Formerly we were bothered by the vagaries of the endodermis, which sometimes surrounded each bundle, sometimes formed a double ring bounding the bundle-system towards both the cortex and the pith, or sometimes behaved properly and ran round the outside only. Now, if we imagine instead a phlœoterma, which in every case surrounds the whole bundle-system, having, in the two last-mentioned cases, the characters of an endodermis, and, in the first, no character at all by which we can distinguish it, we bring *Equisetum* into a place in the theory as a monostelic plant.

In stems of ferns and selaginellas, in the roots of a few palms, and in the stems of *Gunnera* and species of *Auricula*, among dicotyledons, something different occurs. The single stele of the root, in passing through the hypocotyl, breaks up into several steles. In such cases the stem or root is *polystelic*, each stele containing bundles of wood and bast, separated by conjunctive tissue, surrounded by a pericycle, and bounded at the cortex by the phlœoterma, which generally shows endodermoid characters. As the student who has cut sections of the bracken-fern will remember, the steles are not always cylindrical, but may be oval or drawn out into a band; in fact, they may show considerable variation in shape.

Finally, the term *schizostele*, or *meristele*, is applied to those portions of the stele, or steles, of the stem which run up into the petiole and, as in *Pinus*, continue unbroken through the leaf, or, as is generally the case, branch repeatedly in the flat, expanded blade. The advantage of the stelar theory is that it supplies what we have hitherto wanted, a general standpoint from which to view the internal anatomy of the plant axis and its branches. It directs attention to the vascular system as a whole, and not, as hitherto, to the vascular bundle, which, implying very different things in different cases, does not admit of a comparative treatment.

Plant Evolution.

There are often several ways of looking at the same thing. A flower, for instance. We were wont to define it as a shoot modified for purposes of reproduction. Goethe's Ur-plant showed how the petals, sepals, stamens, and carpels were after all only leaves which, in virtue of their respective functions in connection with the ultimate object of forming fruit containing seeds, assumed shapes differing more or less widely from what we generally associated with the term leaf. That is to say, the popular leaf being the flat expanded green foliage-leaf, we felt constrained to derive the floral leaves from such a one. We could fold one up nicely to make a carpel, but stamens floored us rather, and we rejoiced over the water-lily, which showed us how it had all happened, supplying a complete transition from the flat 'leaf'-like petal to the anther-bearing filament. Double-flowers and monstrosities delighted us, for in them we saw a harking back to the original form. If we imagined anything of evolution it was an ordinary foliage shoot, becoming in course of ages converted into a flower, perfect and complete. And after all we found nothing in our text-books, and heard nothing at our lectures, to contradict our little theory.

The outer series, the sepals and the petals, were concerned mainly with the protection of the 'essential' stamens and carpels, or with visits of insects and other creatures associated with the deposition of pollen on the stigma. The pollen-sacs of the stamen, and the ovules borne by the carpel, were sporangia comparable with those borne on the fertile leaf of a fern, or the sporophylls of an *Equisetum*. But when we came to study 'types,' beginning with the unicellular plant, and working upwards, doubts would sometimes arise. Our series of types we somehow thought represented stages in evolution. The complex seed-plant had gradually evolved from the simple monad. But the latter was in the habit, at certain periods of its life-history, generally when times were hard, of simply becoming a sporangium, its living cell-content contracting to form spores. Obviously, the sporangium existed long before the leaf. Were we right then in deriving, as our training certainly tended to make us derive, the sporophyll (stamen, or carpel, or what not) from the leaf? What was faintly foreshadowed in these doubts may become a reality for the next generation of students. There are some who tell us that the sterile tissue which we find forming bands between the spore-producing cells in the sporangium of *Isoetes*, or segmenting the pollen-sacs of certain seed-plants, recalls the commencement of the evolution of vegetative from reproductive tissue; and that in such sterile tissue, in fact, we see the origin of the vegetative structure—root, stem, and leaf—of the higher plants. We shall then have at any rate a consistent plan of evolution, though one not easily admitting of proof.

Hydrocyanic Acid in Plants.

In the *Annales du Jardin Botanique de Buitenzorg* (vol. xiii., pt. i., 1895) appears a most interesting and important paper by Dr. Treub, entitled "Sur la localisation, le transport et le rôle de l'acide cyanhydrique dans le *Pangium edule*, Reinw."

This paper seems to throw some light on the steps in the formation of proteid by combination of the substances formed by assimilation in the leaves with substances absorbed by the roots. In *Pangium edule* large quantities of hydrocyanic acid (HCN) occur, either free or in an unstable combination. The substance obviously is of great importance in the metabolism of the plant, and its occurrence and behaviour have been studied in detail by Dr. Treub.

In the stem and roots it occurs chiefly in the phloem, while in the leaf it occurs in most of the parenchyma cells, but also in certain specialised cells of the epidermis. To these last Dr. Treub assigns the formation of the acid. By various experiments he showed conclusively that it is transported through the phloem. For its appearance in the leaves he found certain conditions necessary. He could not prove that the presence of carbo-hydrates was required, but in the absence of light and carbon dioxide the acid rapidly disappeared from the leaf. It would appear, then, that the carbon and hydrogen of hydrocyanic acid comes from assimilated carbo-hydrate, while the nitrogen must be obtained from material absorbed by the roots.

In accordance with this supposition, Dr. Treub found that interference with the supply of water tended to prevent the appearance of hydrocyanic acid in the leaf; thus, if the vascular bundles of certain lobes only of a leaf be cut, these lobes continue to grow, but much less of the acid appears in them than in the uninjured lobes. The connection between water-supply and the presence of hydrocyanic acid is also borne out by another very interesting observation; it was found that the lowest leaf on the plant was entirely or almost entirely free from hydrocyanic acid; but, on removal of all the upper leaves of the plant, hydrocyanic acid soon appeared in the lowest leaf, the reason being, as Dr. Treub believes, that this leaf has now the whole water-supply to draw upon, and so is no longer starved for want of nitrogen salts.

From a study of the conditions for the appearance of hydrocyanic acid in the leaves, Dr. Treub concludes that in *Pangium edule*, at least, "hydrocyanic acid is the first recognisable product of nitrogen assimilation." He believes that the carbo-hydrate formed in ordinary assimilation is combined with nitric acid (set free by the vegetable acids from the nitrates absorbed by the soil) to form hydrocyanic acid, and that this, by further anabolic change is converted into proteid.

These new and suggestive observations will no doubt lead to further work from which certain conclusions may come. As yet Dr. Treub cannot be said to have given direct evidence that carbohydrates and nitrogen salts are necessary for the formation of hydrocyanic acid; nor for his important inference that the acid is the first recognisable product of the assimilation of nitrogen. Hydrocyanic acid might equally, so far as we know, be a product of the decomposition of some more complex organic body.

Botanical Drawings.

An interesting series of coloured drawings of plants is on view at South Kensington, in the Botanical Department of the British Museum. The largest amount of space is justly devoted to the beautiful and yet botanically accurate sketches of the brothers Bauer.

The elder, Francis, was born at Feldsberg, in Austria, in 1758. In 1788 he came to England, and was induced by Sir Joseph Banks to remain as draughtsman to the Royal Gardens at Kew, Sir Joseph himself defraying the salary during his own life, and providing in his will for its continuance. Bauer spent the rest of his days at Kew, and died there in 1841, in the eighty-third year of his age. His numerous drawings of the plants of the Gardens are now preserved in the British Museum. A selection was published in 1796, under the title "Delineations of Exotick Plants cultivated in the Royal Gardens at Kew," but three parts only, consisting entirely of heaths, were published. He also prepared an elaborate series illustrating the structure of the grain, the germination and growth of the wheat-plant; these are well described by his biographer in the *Proceedings* of the Linnean Society (i. [1841] p. 102) as "perhaps the most splendid and important monument of Mr. Bauer's extraordinary talents as an artist and skill in microscopic investigation." Within the last few years Mr. Carruthers has, under the auspices of the Royal Agricultural Society, reproduced a selection of these in sheet form, illustrating the life-history of the wheat-plant from seed to seed. Another beautiful and detailed series of drawings of orchids supplied material for Lindley's "Illustrations of Orchidaceous Plants."

Ferdinand Bauer was born at Feldsberg two years after his brother. It is of interest to note that the father held the appointment of painter to Prince Lichtenstein. When only fifteen years old Ferdinand was employed in making miniature drawings of plants from nature. In 1784 he accompanied Dr. Sibthorp to Greece, and the completion of the numerous drawings made on the journey occupied several years after his return; he was, in fact, thus engaged in England at the time of his brother's arrival. In 1801 we find him selected by Sir Joseph Banks to go with Captain Flinders as natural history painter to Australia, Robert Brown being the naturalist. When Captain Flinders went back to Europe, Brown and Bauer remained behind in New South Wales. Before returning home, in 1805, Bauer also spent eight months in Norfolk Island, collecting and making drawings of the plants, and from these materials Endlicher compiled the "Prodromus Floræ Norfolkicæ." In 1813 he began his "Illustrationes Floræ Novæ Hollandiæ," a magnificent undertaking, which, however, met with so little encouragement that only three parts were published, the artist in the meantime retiring in disgust to Hitzing, near Vienna, and the large botanic gardens of Schönbrunn. Except for a visit to England in 1819, and occasional botanical excursions into the Austrian and Styrian Alps, the remainder of his life was spent near the Austrian capital, his chief occupation being the drawing of the more remarkable plants which flowered in the Imperial Gardens. He died in March, 1826. His paintings of Australian plants passed into Robert Brown's hands, and subsequently became the property of the British Museum.

The only artist, who, for the beauty and accuracy of his work can be compared with the Bauers, was George Dionysius Ehret, several of whose drawings are shown. Ehret was born in Saxony, in 1708, but, like Francis Bauer, found a home in England, where he worked at his art, and died in 1770. We have already referred to his life and career in a recent number of NATURAL SCIENCE (vol. viii., p. 367).

Of the other last century artists whose work is represented, Sydenham Teak Edwards was born at Abergavenny (1769 ?), and died at Chelsea in 1819. He was a protégé of William Curtis, the founder of the *Botanical Magazine*, and for many years during the life and after the death of his patron drew the plates for that journal. He also drew for the *Botanical Register* for several years, from its start in 1815. James Sowerby (1757–1822), who was born and died in London, is known chiefly for his connection with the "English Botany," all the original drawings and proofs of plates for which are in the Botanical Department. One of the most conspicuous objects in the Public Gallery of this section of the museum is his collection of models of British fungi. Of John Frederick Miller (fl. 1776–1794), Frederick Polydore Nodder (fl. 1777–1794), and Sydney Parkinson (died 1771), we know but little. From Britten and Boulger (British and Irish botanists) we learn that Nodder was botanic painter to Queen Caroline, and also drew and engraved the plates for Martyn's "Flora Rustica," while Parkinson was another protégé of Sir Joseph Banks, with whom he went to the South Seas in the "Endeavour," in 1768, as draughtsman; he died on the Indian Ocean in January, 1771. The sketch of a white lily on a black ground, by John Christoph Dietzsch (1710–1769), represents an old and striking style of plant-portraiture.

Of nineteenth century artists, specimens of whose work is shown, Walter Hood Fitch was born in Glasgow in 1817, and died at Kew in 1892. His most important botanical work was in connection with the *Botanical Magazine* and Hooker's "*Icones Plantarum*," both of which he illustrated for more than forty years. Of Mrs. Withers, to whom is due the beautiful sketch of a columbine, we know nothing, and the same applies to the Chinese artist who produced the two elegant drawings of chrysanthemums. Worthington Smith is still with us, and much in evidence in the Botanical Gallery, of which his illustrations of British Basidiomycetes form a conspicuous ornament, besides affording valuable help to students of a group of plants which it is impossible to keep in anything approaching to a natural condition.

In our remarks we have had to refer again and again to Sir Joseph Banks, to whom botany, and especially the Botanical Department of the British Museum, owe an unmeasurable debt of gratitude. It is appropriate to find him, represented by the beautiful statue by Chantrey, as sitting between the two cases in which the drawings are shown, his head inclined towards the one containing the work of the two Bauers.

ANTHROPOLOGY.

It is well known that the Negrillos of Central Africa, *i.e.* from the country of the Mombuttus to the West Coast, resemble in many ways the brachycephalic Negritos of South-Eastern Asia. Side by side with these rounder headed pigmies are dolichocephals; one of these, a Babinga (Aka) woman from the Sangha River, is the subject of a paper by Dr. R. Verneau, in *l'Anthropologie* (vii., p. 153). The estimated cranial capacity (1,440 *c.c.*) is by no means small, it being above the average European female. The skull is very dolichocephalic (73·2), very platyrhine (63·5), mesoseme (87·8), and has a considerable sub-nasal prognathism. The pelvis exhibits characters intermediate between those of a true negress and a European. The mesaticephaly which is met with to the west of the pigmy territory, may be due to a crossing between brachycephalous Negrillos and Negros of tall stature; these are the semi-dwarfs ("demi-nains") of Mr. Hamy. If a comparison be made between the measurements given by Dr. Verneau and those published on various pigmy peoples, it will be evident that the former could scarcely belong to a person of pigmy stature, that is, with an average male stature below 4 ft. 9 in., and we must, for the present, be sceptical as to this individual being a true dolichocephalic pigmy.

The subject of infantilism, femininism, and the hermaphrodites of antiquity, has been carefully studied by Mr. Henry Meige in *l'Anthropologie* for 1895. He came to the conclusion that "there exist in nature several bodily conformations in which the morphological characters of the male are associated in the same individual with those of the female. These hybrid forms should be considered as anomalies of development resulting from a congenital alteration of the trophic centres which regulate the evolution of the sexual organs. They can be referred to infantilism, femininism, and virilism." Mr. Meige finds that the representations of hermaphrodites in the ancient world fall into two classes:—1. Those which are simply artistic creations, in which the female form—more rarely the male—is provided with organs that belong to the other sex. 2. Those which represent a natural type, these being forms exhibiting infantilism, or, most frequently, femininism. These the author believes were copied from the life. In the current number of the same journal Dr. O. Ammon has a communication on the same subject, in which he points out that though permanent infantilism may occur, in most instances this is only a transient stage; that is to say, virile development may be exceptionally retarded.

The causes of this sexual retardation may be racial or due to unfavourable economic conditions. Usually these cases of retarded virility occur among very poor families, but he has sometimes seen boys of the middle classes, in comfortable circumstances, not attaining a virile character till the age of seventeen, whilst the mean age of puberty of this class is from thirteen to fourteen years of age. It is clearly necessary that the subsequent history of the patient should be followed to see whether the retardation is temporary or permanent. Similarly he finds femininism may be transient or lasting. Dr. Ammon had previously stated that the Greeks imitated nature, and thus the origin of the classic hermaphrodite can be explained in a simple manner, and without obscenity on the part of the artists. Infantile individuals, from nineteen to twenty-two years of age, should not be regarded as anomalies; most are retarded cases who will develop in course of time. This temporary kind of infantilism is chiefly found in individuals of short stature and smooth body. Permanent infantilism is rare, but occurs among men of all heights. Femininism, as manifested by the development of the breasts, is not rare among boys, but usually it is only temporary, and eventually disappears completely. When the growth does not soon stop, it develops to a pronounced extent, and breasts comparable to those of young girls of fifteen are developed; in this case it remains permanent, but does not influence the other organs, which develop normally.

North American Mammals.

One of the most interesting and important of a number of recently published papers on the North American mammals is from the pen of Dr. Hart Merriam, and deals with the bears (*Proc. Biol. Soc., Washington*, vol. x., p. 65). The author states that after an examination of a very large series of skulls, he is convinced that the generally accepted classification is quite inadequate. Four new species are described, three of which are bears of huge size, inhabiting various parts of Alaska and the adjacent islands, while the fourth is the black bear of Florida. In the classification proposed, five distinct types are distinguished; of these subdivisions the first includes only the polar bear, which is regarded as a distinct genus, *Thalaretos*, the second comprises the black bears, forming a subgenus *Euarctos*, while the remaining three, including the grizzlies and three of the new species, are placed under *Ursus*. The new forms are described in some detail, and the paper is illustrated by a number of rather unsatisfactory reproductions of photographs of skulls. A complete treatise, of which this paper is only a preliminary summary, is promised.

Another paper by the same writer, published by the United States Department of Agriculture, consists of a synopsis of the North American weasels. No less than twenty-two species, of which half are new, are recognised; whether such a multiplication of specific names is necessary or desirable seems somewhat questionable. Two chief types are distinguished, the first including the boreal species, which do not range south of the northern states, the second, the southern forms, only one of which extends up to the lowest boreal zone. Between these main divisions occur two intermediate forms, which are particularly interesting from the fact that in both of them the females resemble one of the boreal species (*Putorius cicognani*), while the males are similar to two of the austral forms. According to Dr. Merriam, the explanation of this phenomenon is that the female in mammals is often less specialised than the male, and therefore approaches the ancestral type more nearly: the inference in the present case being that the intermediate form is derived from the *P. cicognani* type. On similar grounds it is shown that the arctic weasel is probably a descendant from the same form. It may be remarked that in certain closely-allied species of birds the same peculiarity occurs.

Of two papers by G. S. Miller, junr., on American bats, one describes the milk-dentition in *Desmodus*, a genus of blood-sucking bats; the other contains an account of a species of *Thyroptera*, an interesting peculiarity of which is the occurrence in the hind foot of a kind of syndactylism, the third and fourth digits being so closely united that their claws appear to form one large nail.

THE WEST PRUSSIAN MUSEUM AT DANTZIG.

IN the *Report* for 1895 of the Dantzig Museum, Dr. Conwentz gives an interesting account of a "prehistoric" boat dug out of a field in Baumgarth, near the River Drausen, in West Prussia. It was a saying among the people that a boat lay buried under this field, and that in old times pieces of the wood had been dug up. Public interest in the matter was aroused by the landowner, Mr. E. von Riesen, who in the summer of 1894 set to work and found in a ditch a blackened piece of oak, pierced by an iron nail. Thereupon the Museum authorities decided to investigate thoroughly, though, owing to unfavourable weather, their task was only begun in June, 1895. At the place where the boat was found the ground consists of a layer of peat one metre deep, under which lies river-sand. The boat was found in a natural position, with the keel downwards; its planks were loosened, and several pieces were missing. All the pieces found were sent to the museum, where they were carefully cleaned and soaked in a mixture of petroleum and varnish, to prevent contraction and drying-up of the wood. The whole boat has been reconstructed, and a figure of it is given, from which we see that the art of boat-building must have been already well advanced in those days.

The age of this boat is somewhat doubtful, but Dr. Conwentz brings forward some carefully worked out arguments, which he sums up as follows:—"When one considers that this boat, in its shape and build, resembles the vessels of the Vikings; that at the Viking time, about the middle of the ninth century, a traveller came over the sea from Schleswig to this neighbourhood, a journey whose details, as recorded in history, exactly fit my conclusion; that in this part countless coins and weapons are known from the Viking time; and finally that this boat was found buried away from the Sorgefluss and the

Drausensee—one is led to the conclusion that it is a Viking boat. It came from the north through one of the then existing channels into the Frische Haff, and on through the Elbing into the Drausen. Obviously it had a bad journey, since one plank has been repaired; and finally it became a complete wreck by running on a sandbank near the mouth of the Sorge. Since, however, the water was shallow and the shore close, the occupants saved their goods. Through the continuous movement of the waves the woodwork became loosened, and some pieces drifted away with the tide. By the gradual drying up of the water, the wreck became covered over by slime and marshy earth, and in this way the wood and the few iron parts have been preserved by complete isolation from the air."

Dr. Conwentz aims, he says, at making his Museum representative not only of the purely scientific relationships of western Prussia, but also (within limits) of the province of applied sciences. To this end the collection of fishing appliances belonging to the Fisheries union, as well as its library and collections of maps, and the valuable collection of appliances from the Apicultural Society, have been put in charge of the Museum, and stored in a room till extension of the main building will permit their being removed. The attendance, especially on Sundays, is very satisfactory, although the number of schools visiting the Museum might be larger.

The geological mapping of this province is proceeding slowly; but, through the generosity of the State and the Council of Landowners, who recognise the importance of this work, two more geologists will probably be added to the staff.

"Light! Light! more Light!"

The health-giving power of sunlight has long been believed in, but the belief has been acted on in an half-hearted way. With one hand we enlarge our windows, with the other we draw curtains across them; we send our children to the sea-side for a summer holiday, encouraging them to bathe and paddle, while for the rest of the year we make them wear boots and shoes and all the other necessary evils of civilisation, and coddle them up indoors as much as possible. A special retreat even has been provided among the mountains of Illyria, far from the eye of the police, where, as in a paradise regained, the sedentary sufferers of city life may wear no other covering than that which nature has provided, and may bathe themselves in pure sunshine. The belief then exists, but only recently has it been set upon a scientific basis. In his address as president of the chemistry and engineering section at the recent meeting in Glasgow of the British Institute of Public Health, Professor Wm. Ramsay explained how the violet rays of sunlight act upon moist organic matter, producing hydrogen peroxide; how this peroxide bocomes water and hands on the remaining portion of oxygen to the organic matter, which it thus destroys or changes. Now, these changes are destructive to the life of minute organisms, such as the bacteria in sewage, and the germs of many, perhaps all, zymotic diseases, such as typhus and anthrax. These are the conclusions to be gathered from the recent work of Professor Marshall Ward, Dr. Arthur Richardson, and Dr. E. Frankland.

We must have sunlight. In our rapidly-growing cities its admission is a necessity for the commonweal, its exclusion a crime. But hitherto the conditions of city life, in England at least, have tended more and more towards the exclusion of sunlight. The smoke that goes up, not only from our factories but from every private house, that stretches over London like a veil even on the clearest summer Sunday, this not merely acts directly as a screen against the sun, but condenses around its particles the vapour of the atmosphere, forming mists, pea-soup fogs, and rain-clouds, all which shut off from us just those violet rays that we need for the destruction of the rapidly-increasing bacteria. Professor Ramsay, speaking in the smoke-vomiting city of the north, urged the same remedies as have been urged by all who have thought on this subject; first, more stringent enforcement of the Smoky Chimneys Act, and of municipal bye-laws against smoke; secondly, the adoption of smokeless fuel, such as coke or coal-gas.

Professor Ramsay's valuable and thoroughly interesting address should be studied by all town and county councillors, and we should like to see it reprinted and placed in the hands of all householders and especially housewives. The gas companies might undertake its distribution along with the quarter's notice.

The Disposal of Sewage.

Professor G. V. Poore, at a lecture delivered at the Royal Institution on April 24, 1896, discussed the disposal of organic waste matter. He began by explaining in detail the general course of the circulation of organic matter, and the part played by fungi and bacteria in the cycles of change. Quoting from Mr. Megnin, the French entomologist, he gave an account of the successive sets of insects that appear in gradually decomposing animal matter; while on the authority of Mr. George Murray, he described the varieties of moulds that assist the decomposition of the dung of different kinds of animals. These interesting facts were the prolegomena to his first proposition, the proposition that the superficial layer of humus, full of bacteria, is the great cleansing filter of the world. Organic matter that is mixed in due proportion with this humus, if it be not flooded by water, is rapidly decomposed into a condition which makes it the best possible manure for crops. Just as a valuable soil is gradually formed on barren rocks by the growth and decay of various forms of animal and plant life, so, according to Professor Poore, a due use of the waste of animal life would continually add to the fertility of all soils, the gain being ultimately at the expense of the sea and the air.

He placed our actual modern use of sewage in strong contrast to what ought to be done with it. In the first place, he regards the modern system of water drains as in the wrong direction. The sewage is led below the humus "to the wrong side of the natural cleansing filter," and there it gradually poisons the wells and underground water-supply, while it is wasted from the agricultural point of view. He regards the elaborate drainage systems of modern suburban districts as a positive danger, and as a great waste of money.

We are prepared to agree with him that in thinly populated areas, the expense of elaborate water-supply and of elaborate main drainage systems is by no means necessarily a financial success, or a gain from the point of view of public health. But it is more difficult to agree that the possibility of water-drainage systems has produced the modern huge blocks and crowding of population. The ordinary conditions of modern life make it almost a necessity that people should live as near as may be to the centre of populous areas, and modern drainage is a mitigation rather than a cause of this concentration. The shortening of hours of labour, the establishment of means of communication between the centre and the suburbs at a cost which shall not be too large a tax by land owners upon wages, are the chief means which may be looked to for decreasing condensation of population, and for making possible a direct return to the soil of organic waste. On the other hand we cannot agree that the organic matter swept down the rivers to the sea is by any means a complete waste of capital. It is a well-known fact that the fisheries round the coasts are more valuable than the agricultural produce of our soil. The closest connection exists between sewage and fish. Where foul rivers actually roll into the sea animal life is not abundant, but as soon as the water laden with organic matter is diluted sufficiently by sea-water, a new circulation of organic matter begins. The prolific fisheries of the Dogger-bank, and of the region out from Grimsby are related to the sewage of the Thames. The rich fisheries of the Cornish coast return to England the organic waste discharged from the Bristol Channel, while the fisheries of the west coast and its lochs owe their origin to the Clyde, that "foulest sewer of Europe."

The Courtship of Grasshoppers.

The shrill note of the grasshopper is a familiar sound to the holiday-maker in the Alpine pastures. Professor E. B. Poulton has recently (*Trans. Ent. Soc. Lond.* 1896, pp. 233–252) given a most interesting account of his observations of the habits of these creatures in Switzerland, with the object of elucidating the relation between stridulation and courtship. He narrates his observations in detail and draws the conclusion that stridulation is only exercised by the males "with direct reference to females, or in rivalry to other males in the presence of a female"; only in one species, *Stethophyma fusca*, did the males stridulate in the absence of the other sex. When the male has secured a partner he, as a rule, ceases to make a noise. However, in the small species *Pezotettix pedestris* in which both sexes have vestigial wings, and the male is accordingly unable to produce sound, he obtains a female by "capture," jumping upon her back. While in that position he moves his hind legs alternately, recalling, in Professor Poulton's opinion, the lost power of stridulation.

A Registry Office for Snails.

The meaningless record of variations, mis-called "varieties," seems to afford a kind of conchological small-beer to many collectors of shells. The bands on certain British shells are a source of never failing delight to some; whilst all have one time or another had a turn at them. All appear equally ignorant of the fact that it has been fully done before by Sauveur (*Ann. Soc. Mal. Belgique* ii.), who first drew up the scheme of the eighty-nine possible variations in the five bands of *Helix hortensis* and *H. nemoralis*. The latest venture in the undertaking is a 'Label List' by the editor of *Science Gossip*, Mr. J. T. Carrington, published at the cost of one penny, that should rejoice the heart of the zono-maniac. A page of introduction is followed by a list of the named "varieties" (save the mark!) of *Helix pomatia*, *H. aspersa*, *H. nemoralis*, and *H. hortensis*. The last four pages, printed on one side only, are devoted to a repetition of the names of the last two species, accompanied in each case by one of the band formulæ.

The worst of it is, that like the farmer with the claret, "no one seems to get any forrarder," and no systematic use seems to have been made of these tables. The only published account we know is that by Mr. A. Belt (*Report Ealing Micro. and Nat. Hist. Soc.*, 1892), who proved the existence of twenty-seven out of the eighty-nine possible variations. We have also seen an unpublished record of thirty-three for the two species.

Nobody, unfortunately, has yet gone to the animal and endeavoured to show the origin and cause of these bands on the shell, and whether they have or have not any physiological bearing. The subject is being left to the variety-mongers, whose ultimate goal must inevitably be a registry office for snails.

I.

On English Amber and Amber generally.

II.

HAVING discussed the properties of succinite, and obtained a knowledge of its geological occurrence and distribution, it would be of interest to inquire into the plants from which it was produced somewhere near the beginning of the Tertiary period. It has already been mentioned that succinite is to be found together with rounded carbonised pieces of wood, but of course, these disconnected pieces need not have produced it. Only such specimens as are enclosed by the fossil resin belong with certainty to the succiniferous trees. Concerning the method of examining these woods, one was formerly content to get some splinters of them by cutting with a knife, and this was the way in which H. R. Goeppert, who made some very creditable investigations of succinite, proceeded. But these preparations are not sufficient for investigating the finer microscopical structure, wherefore I have made use of the method of examining petrified woods by microscope-sections that was invented sixty-five years ago in England : for William Nicol first prepared microscope-slides and H. T. Witham published the method in his "Observations on Fossil Vegetables," London, 1831. Thus I have obtained such correct and large sections of the wood that they could be figured in my monograph of the Baltic amber trees.[1]

In general, the preservation of the wood and bark is good, sometimes very good, because nature itself has encased the pieces in the liquid resin, just as we put up sections of recent plants in Canada balsam. Therefore, all the details of the structure are often as well seen as in living plants. The wood is formed of tracheids, which are arranged in distinct rings of growth, representing probably annual rings. The walls of the tracheids, especially the radial walls, are furnished with one to three vertical rows of bordered pits. Moreover, there are vertical resin ducts, surrounded by parenchymatous cells and horizontal medullary rays, which also often enclose a resin duct; the middle of the wood is filled by the medullary cylinder or pith.

[1] "Monographie der Baltischen Bernsteinbäume, &c." Mit 18 lithogr. Tafeln in Farbendruck. Danzig, 1890.

Regarding the origin of the resin, it must be noted that it was produced from the various organs of the trees, *i.e.*, from their roots, stems, and branches, and was also formed in different parts of these organs, not only in the wood cylinder, but also in the bark and pith. No doubt the chief production took place in the wood. The normal formation occurred in these just-mentioned channels or ducts, which cross the wood cylinder in a vertical and horizontal direction. Occasionally resin was formed in an abnormal manner, by foreign influences. So, for example, the common resin ducts could become enlarged and multiplied; moreover, new ones could arise by dissolution of abnormal parenchymatous cells, or of the normal tracheids in any part of the wood. The nature of the cause of these abnormal processes is so far unknown, but probably they were due to external influences.

All these masses of resin were formed in the interior of the stems and branches, and would also have remained there if there had been no injury to the bark and wood by which the resin-ducts could become exposed. Certainly those injuries occurred very often in various ways, for at no time has any natural forest existed which contained a single entirely sound and uninjured tree. This natural state of things is now-a-days not so well seen in the well-kept parks of England as in mountain forests of the Continent or of the north, where little or no artificial interference is made by man. If we pay a visit to the virgin forests of the present time, we are able to study at the same time the state of forests of past geological ages, before man appeared. First of all, every tree in life is damaged by the formation of the bark, and this process can be increased by the influence of the atmosphere and heat, by the action of fungi, insects, and other organisms. But much larger quantities of resin will flow out, if the wood itself is injured. This happens naturally to every stem when throwing off its older branches, and, therefore, the knot-holes are to be considered the proper points of outlet of resin. However, there are still more agents at work by which the wounds might be multiplied; as by the falling down of neighbouring trees during storms or when weakened by old age; then lightning and other atmospheric influences may deprive a tree of its branches. Sometimes small splinters of wood are enclosed by succinite, and, besides that, a few pieces of succinite present an exterior looking just as if they had caught fire in the forests of those ages.

The resin within the trees was very liquid, of a light yellow colour, and transparent, but in flowing out it mingled with cell-sap of the damaged tissue, and it acquired a dull appearance and a denser quality. In such a manner drops or irregular larger masses of resin were forced out of the knot-holes and other injured parts of the trees (Fig. 1, A). But, afterwards, through the influence of the sun, the enclosed liquids evaporated, and the thick clouded masses of resin became again thinner and clarified. Of English succinite I know some pieces which illustrate this process of clarifying very well. There are, for instance, in the possession of Mrs. A. Fox and Mr. W. George Sandford at Cromer, specimens, one half of each of which is dull and opaque, while the other is quite clear. In the liquid state the resin ran over the bark and formed successively thin lamellæ, called *Schlauben* in German. At this time little animals might pass over it, and small leaves, flowers, or other things might be blown against it by the wind; these becoming attached would be enclosed by the next flow. The chief animal remains consist of insects, particularly of Diptera and Coleoptera; however, there are also a good many arachnids, a few crustaceans, annelids, and shells of snails. Moreover, small

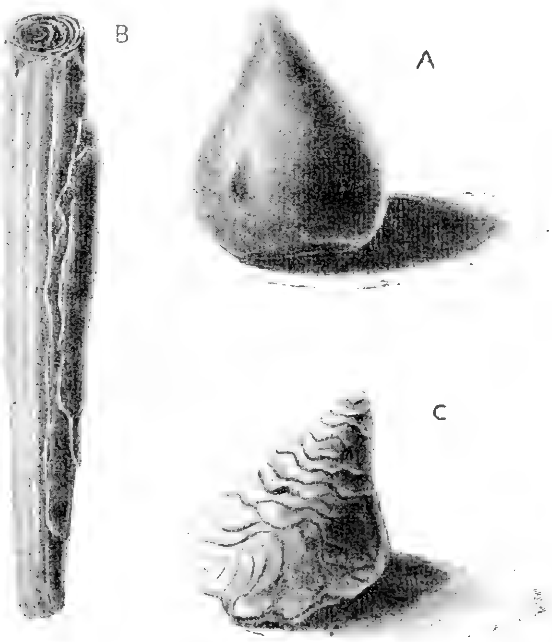


FIG. I.—EXAMPLES OF AMBER.
A, Amber drop; B, Amber stalactite; C, Amber stalagmite. (Original.)

feathers of birds and hairs of various mammals have been found in amber. Thus, in general, remains of many plants and animals of that period are enclosed in the resin of the succiniferous trees, and are preserved to these days in their transparent grave. Therefore, this kind of succinite is of the greatest importance in the examination of the flora and fauna of the oldest Tertiary, and such pieces are much sought after in the trade. In England I know many *Schlauben* without enclosures, and Mr. Reid has given me a small specimen from Cromer; but such pieces of English succinite containing the remains of plants and insects are also well known. Mr. Alfred S. Foord has published in the *Transactions* of the Norfolk and Norwich Naturalists' Society (vol. v., part i., pp. 92–95) a paper on such a collection, belonging to Mrs. Burwood, of Yarmouth, and he has figured therein an undetermined leaf as well as bees, beetles, flies, gnats, and spiders. Twelve years ago Mr. C. Reid mentioned some Diptera and spiders, determined by Mr. G. H. Verral, in his aforesaid paper (*op. cit.*, vol. iii., pp. 601–3). Although I have not been able to see these little collections, I believe that they consist of real succinite, and not of another kind of resin. I saw in the shop of Mrs. A. Fox, at Cromer, three pieces of succinite with dipterous insects belonging to the genera *Platyura* and *Xiphandrium* (?), according to the determination of Mr. Verral (*op. cit.*, vol. iv., pp. 247–8).

Further, it might happen that the resin in clarifying did not form lamellæ upon the bark of the trees, but flowed freely down and formed stalactites, hanging perpendicularly from the branches and twigs (Fig. 1, B). In continuation new flows could run over it, wherefore larger pieces show always a concentric structure. Just as in the case of the *Schlauben*, of course these objects may often enclose small organic remains, especially gnats and other little insects. If the resin dropped down from the stalactites to a lower branch or to the earth, small stalagmites could arise here, corresponding to those, and gradually increase in size (Fig. 1, C).

In general, much resin ran downward and mingled with dead organic remains which covered the ground of the amber forest; for instance, small particles of the destroyed woods of fallen trees, various wing-cases, and dung-pellets of insects. In such a manner there were formed upon the ground irregular pieces of succinite, which certainly are of scientific interest, but do not possess any notable value in commerce, for these pieces are only used for preparing varnish, and are, therefore, called shortly "Varnish" (*Firniss*). Also in England "Varnish" occurs, and I remember seeing two yellow pieces of it with particles of wood from Felixstowe, in the possession of Mr. Henry Miller, of Ipswich.

It is true the greatest quantities of succinite would be outside the trees, but an instance exists of pieces of succinite being formed in the interior of the wood. It was stated before that sometimes a tissue of parenchymatous cells abnormally appeared between the egular tissue of tracheids, and was dissolved afterwards into resin. If it happened that these closed reservoirs did not become opened by a fracture of the wood, the resin would become hardened and remain in the interior for ever. Long after death, when the wood was destroyed by the action of fungi and insects, those large pieces of succinite would become liberated. As they were formed in the interior, mixed with cell-sap, they look muddy and opaque, and they do not enclose any remains of insects or other organisms. They are called Plates (*Platten*), on account of the tabular shape, and yield a very valuable article for working.

After these remarks, the question to be discussed is to which genus the succiniferous trees belong. No doubt they are conifers, and I consider that all details of anatomy agree entirely with the genus *Pinus*, L., though it is undecided if they belong to the genus *Pinus* in the restricted sense, or to *Picea*, Lk. Since the succinite contains, moreover, the flowers and leaves of different pines (Fig. 2, B), as well as of a fir, probably it is not derived from one, but from several species of both genera, just as the recent resin in trade is obtained from various species of *Pinus*. Three pines with two needles (*Pinus silvatica*, *P. baltica*, *P. banksianoides*), one kind with five needles (*P. cembrifolia*), and one fir with plain needles (*Picea Engleri*), similar to the *P. ajanensis* of East Asia, have been described as occurring in succinite. Concerning the name of the succiniferous trees, it must be remembered that we are often obliged in palæobotany to label single organs of a plant with special names, although some of these may belong together. Therefore it is necessary to give a peculiar name also to the pine-wood enclosed in succinite, because it is unknown to

FIG. 2.—PLANTS INCLUDED IN AMBER.

A, Flower of *Cinnamomum prototypum* (after Conwentz "Angiospermen des Bernsteins"); B, Male flower of *Pinus Reichiana* (after Conwentz "Bernsteinbäume").

which of the above-mentioned leaves it belongs. Formerly it was called *Pinites succinifer* by Goeppert; however, I have proved in my monograph that there is no difference between that fossil wood and the wood of the recent genus *Pinus*, taken in a wider sense, wherefore the proper name should be *Pinus succinifera*.

Those amber forests, of course, did not consist of pines and firs exclusively, but also of *Thuja*, *Biota*, *Taxodium*, and other conifers. Moreover, there existed a considerable number of other trees, shrubs, and herbaceous plants, which I partly described and figured ten years ago ("Angiospermen des Bernsteins," mit 13 Tafeln, Danzig, 1886). First of all, there are some Monocotyledons, chiefly palms, for instance, an incomplete male flower of a date-tree (*Phœnix Eichleri*), some impressions of *Sabal*-like leaves, and so on. Added to these are remains of other families, such as female and male flowers of *Smilax baltica*, a little fruiting spadix of a kind of *Calamus* (*Acoropsis minor*), etc. However, many more Dicotyledons are represented in the succinite flora. Particularly do single incomplete or complete inflorescences of oaks occur pretty often, and a good number of species of that genus (*Quercus*) may be distinguished; also several leaves of oaks are known. It may be mentioned that the underside of the leaves and other organs of oaks are covered with stellate hairs, which, becoming free by the friction of the leaves one against the other, must often have filled the whole atmosphere of the forests of those days. The hairs were often carried against the succiniferous trees and came in contact with the resin, in consequence of which we meet them now very frequently in the pieces of succinite. Again, there are flowers of Spanish chestnuts (*Castanea*), a beech-like fruit (*Fagus succinea*), and leaves like those of *Myrica*.

Of the greatest importance are the remains of Lauraceæ, as they belong to the most characteristic plants of the succinite vegetation. One leaf of a cinnamon tree has been known for a long time (*Cinnamomum polymorphum*), and I have figured both surfaces of it in the second-named publication. It was in the possession of a merchant of Danzig, and was sold a few years ago for £50. Certainly this piece is of great interest; however, a more scientific value attaches to another specimen, including a flower of a cinnamon tree, which shows the anthers with valvate dehiscence and other details very well, (*C. prototypum*, Fig. 2, A); it belongs to the Natural History Museum of Danzig. Many other flowers also of laurels have been described and figured. Further must be mentioned a beautiful impression of a large leaf, quite similar to our Magnolias (*Magnoliphyllum balticum*), and two kinds of flowers of Ternstroemiaceæ. One is a magnificent flower of a *Stuartia*, the diameter of which is 28 mm., the second a group of flowers of a *Pentaphylax*, which I have called *P. Oliveri*. Moreover, there have been found various flowers of holly trees (*Ilex*), two sorts of stamens like those of *Deutzia*, and flowers of other Saxifragaceæ, which could not be identified with recent genera. Sometimes *Daphne*-like leaves (*Eudaphniphyllum Nathorsti*) and other leaves which may belong to the Proteaceæ are to be found. The families of Connaraceæ, Papilionaceæ, and Ericaceæ are also represented. Besides these a few flowers of Myrsinaceæ, an impression of an Oleander-like leaf (*Apocynophyllum*), some flowers of *Sambucus* and of various Santalaceæ have been described, and last, but not least, small branches and inflorescences of Loranthaceæ, chiefly those of an *Arceuthobium*-like appearance. We may, therefore, conclude that some mistletoes existed already in the amber period, and probably decorated the tops of the succiniferous pines and firs.

What is, however, the geological age of this amber period? I have mentioned before that the Blue Earth of Prussia, which contains the succinite as well as loose woods and various marine animal remains, belongs to the Lower Oligocene. Of course, the trees which produced the resin and the other organisms enclosed by it must have existed earlier. For this reason we may, I think, assume that the amber forests flourished in the Eocene period. It follows that the plants of those forests are not at all the same as those of the recent European flora, but rather that they bear a strong resemblance to the present native plants of East Asia and North America. That is to say, there many types of the oldest Tertiary remain still, while in our countries all the vegetation of that time has been destroyed by the glacial period. In England, however, the love and appreciation of parks and gardens is so great, and also the climate is so temperate, that we find in this country a good many of the very same trees and shrubs of East Asia and North America. It is interesting, therefore, to think that people in the amber district of England are surrounded even now by a vegetation partly resembling that of the amber period.

In conclusion, in thanking all those ladies and gentlemen who have had the kindness to assist my inquiries after succinite in England, and who have presented many a notable piece to the Natural History Museum of Danzig, which is under my charge, I should like to add that I shall be greatly interested to hear of new and remarkable specimens occurring in any English locality.

H. CONWENTZ.

II.

What shall we do with our Local Societies?

WHEN the votaries of science in all parts of the country are thinking of the national association for the advancement of science, it may not be amiss to consider briefly what is the essence of that science which the British Association is established to promote, and in what new way the association and other kindred but less influential bodies may yet take further steps in advance.

As Huxley often insisted, scientific knowledge only differs from ordinary knowledge in its greater precision, and science consists of such precise knowledge systematised. Mere guesses or unverified gossip cannot be dignified by the name of scientific knowledge, nor can the mere accumulation of facts, however precise, if not grouped round general principles, constitute a science.

Now, we have at our command a vast number of observers capable of adding to our stock of scientific facts, and many thinkers capable of generalising from these facts, though the work of both classes is in danger of being wasted or rendered virtually nugatory by want of organisation.

If one is engaged on research referring to some particular district he can readily turn to the publications of the local society or societies, though even in this case he may overlook some of them owing to their number, their unfortunately short life, or the limited publicity of their publications. Even with reference to such local work one may sometimes be tempted to wish that there had never been a field club at Stubbleton or Blankham, when a complete set of their *Transactions*, the precise value of which is an entirely unsolved problem, is neither to be found in the local library nor in that of the British Museum. This feeling, however, becomes far stronger when an Egyptologist hears of a paper recording original work on hieroglyphics in the *Proceedings* of the Shropshire Natural History Society, or when a meteorologist is referred to some valuable tabulated records of West Indian weather in the *Transactions* of the City of Lincoln Literary Club.

Science will, however, be benefited far more by an increase in the total number of local societies than by their suppression, provided only that their work be directed into useful channels and that their results be systematised. Much valuable work in most branches of science may be done by isolated students; but among the chief functions of local societies would seem to be (i) the education of a neighbourhood to some appreciation of science; (ii) the encouragement of beginners or of diffident and otherwise isolated students by the stimulus of rivalry, discussion, or co-operation; and (iii) the corporate record of local observations undertaken perhaps by many members. As a good illustration of this last function, the twenty years' record of the Marlborough College Natural History Society in botany, ornithology, entomology, and meteorology, or rather in meteorology and in the phenology of plants, birds and insects, may be instanced. Though contributed to by many (by many generations, we may say, in a scholastic sense), we owe this valuable scheme in its entirety to the Rev. T. A. Preston.

Whilst it is educationally desirable that at least every considerable town should have its local society, one of the first necessities of the case, if such societies are to contribute to the real advancement of science, would seem to be the precise demarcation of the area over which the systematic observations of each society are to extend. If not absolutely necessary for each town or village society, when these small bodies do not publish, this topographical position is essential in the case of every county club or larger district association. The ideal at which we should aim in this matter is the partitioning of the whole kingdom between various societies. Rutland, Huntingdon, Monmouth, and Westmoreland seem to be the only counties in England at present without some natural history society; but in many other counties there is no body recognising the whole county as its area of study. The county is, of course, by no means a scientifically ideal unit of division, but it appears to be the most practical. For many of the purposes of the natural history recorder the river-basin is far better; but if it is easier to arouse public interest and to ensure an *esprit de corps* in a county than in a river-basin, it will generally be comparatively simple to distribute the county records under river-basins, and so ultimately to secure, perhaps, a national census on the more scientific basis.

As has been pointed out elsewhere by the present writer (*Science Gossip*, June, 1896), it would add a desirable precision to their observations if every local society adopted a definite area of study; but, to avoid discontinuity in our records and useless duplication of observation, this is far more essential for all publishing societies. While for the sake of the facilities for winter evening meetings and cheap short-distance field meetings it is desirable to multiply local societies, it is not by any means necessary that they should all print "Transactions," or in fact anything except, perhaps, an annual report. Probably most of us who have had to hunt through local "Transactions" will agree that one publishing society for natural history in each county is amply sufficient. Here the example long ago set by Yorkshire is most valuable. In May, 1864, the West

Riding Consolidated Naturalist Society comprised six societies within an area of twenty miles, numbering more than two hundred members. For them primarily *The Naturalist* was started, and between 1865 and 1867 three goodly volumes were issued from Huddersfield. Then, unfortunately, the journal died from want of support, coupled with too low a price having been placed upon it. In July, 1872, however, it was rehabilitated for a short time as the *Yorkshire Naturalists' Recorder*, and since 1875 has appeared continuously as *The Naturalist*, while there were in 1878 no less than twenty-seven societies in the Yorkshire Naturalists' Union. Union is so truly strength that these Yorkshire naturalists have been able not only to maintain this interesting little monthly journal, but also to issue valuable *Transactions* in which have appeared such substantial works as Lees and Davis's "West Yorkshire" and J. G. Baker's "Flora of North Yorkshire."

A county union, or one embracing several of our smaller counties, and made up of delegates from each society, could arrange committees for joint investigation, and select papers for publication from among those laid before the constituent societies. In this selection it may well be hoped that they would be more likely to choose exclusively local matter than a body more narrowly local and perhaps, therefore, more amenable to purely personal considerations.

Joint publication is by no means the only object, however, of such unions. In the inaugural meeting of a south-eastern union of scientific societies, held at Tunbridge Wells last April, under the presidency of the Rev. T. R. R. Stebbing, F.R.S., it appeared that the ideas of the founders did not, at first at least, even include joint publication, but that the notion of union had sprung from the interchange of geological lantern-slides and a wish for joint field meetings, and, possibly, the re-reading of interesting papers at various centres.

These were only some of the uses of union that appeared in the initial stage, and the main object of the present paper is to suggest that such unions may not only tend to greater precision of work, economy of labour, and publicity of results, but may also afford a valuable means by which the smallest local societies, with their otherwise isolated observers, may be brought in touch with more central institutions, such as the Selborne Society, the Commons' Preservation Society, and, above all, the British Association. The peripatetic character of this great association does much in this direction for our largest towns, and the committee of delegates from those local societies that publish, which meets annually by its invitation, has also greatly helped to spread the influence of the association annually into many channels ramifying over almost all the country. There is still, however, a want of systematic completeness in the carrying out of this scheme, which might be to a considerable extent supplied by county associations, or unions embracing several counties.

It is most important that large erratic boulders, earthworks, megalithic monuments, natural springs, well-borings, earth-tremors, all meteorological phenomena, the migrations of birds, etc., should be systematically recorded over the whole country, and no better means for securing this result can be desired than the British Association committees. There is probably, however, not one of these committees that does not experience the lack of observers in many outlying districts. If the many societies of Lancashire were to follow the example of those of Yorkshire, those of the northern, eastern, and south-western counties to act on the initiative given at Tunbridge Wells, and what union there may still be between those of the Midland counties were to be consolidated and extended over the whole area, much would have been done.

It will be an important question for the South-eastern Union to decide whether they will not do well to enroll private members as well as delegates, a means of raising funds which is adopted by the Yorkshire Union; but next year's meeting, which is to be held again at Tunbridge Wells, though the congress is intended after that to be migratory, will have many other initial questions to decide. Meanwhile, it is much to be wished that at the Liverpool meeting of the British Association something may be done to encourage a step forward in the direction of a closer bond of union between organisations scattered over the whole country and the association itself.

It is hardly necessary to add that no system of unions or associations need involve any loss of independent self-control on the part of any local society.

G. S. Boulger.

[As we understand from Mr. George Abbott's letter to Sir Douglas Galton, which was read at the Tunbridge Wells Congress above mentioned, Mr. Abbott is in thorough sympathy with Professor Boulger's views. He has, in fact, sketched out a complete scientific organisation, and one not to be despised, although perhaps it rather recalls the method and precision of which French philosophers are proud than the somewhat random growth of most English institutions. He desires that the whole of England should be partitioned among a small number of scientific unions, in intimate connection with the British Association, as the supreme directing body. The area of each union would be similarly partitioned into districts allotted to the several component societies. Of these societies each would nominate an honorary corresponding member in every village of its district. Supposing the whole machinery to work with that perfection which the enthusiasm and philanthropy of its conception demand and deserve, all the people of this land will before long be brought into touch with "natural knowledge." They will learn to observe and to record. They will learn to value and to preserve. From numberless eyes and hands science will receive and welcome the infinite details of investigation and research, while by the proposed interdependence of all the parts of the body corporate, the control of experience and learning will be available to shield the ignorant and the beginner from the risk of publishing what is erroneous, of republishing what is already perfectly well known, or of hiding away in some obscure publication results that are really important.—Ed., Nat. Sci.]

III.

A Zoologist in Tierra del Fuego.

SOME ACCOUNT OF THE SWEDISH EXPEDITION, 1895-6.

THIS article is merely a short account of excursions made during this expedition, with a few remarks concerning the geographical distribution of some South American animals. Since all our collections are not yet in Sweden, it is impossible to make more than a rough classification, so that the results at present are only of a general nature.

The expedition—consisting of Dr. O. Nordenskiöld, as geologist and leader of the party, P. Dusén, civil engineer, as botanist, and myself as zoologist—was organised, mainly at the expense of Baron Oscar Dickson, to obtain, from an easily accessible country near the true Antarctic region, collections to be compared with those in the Riksmuseum at Stockholm, brought from the Arctic Seas, Spitzbergen, Greenland, and Siberia by other Swedish parties. As was to be expected, the original intention of working together had to be given up even at Buenos Ayres, where, in October of last year, Mr. Dusén, Mr. Åkerman (engaged as assistant zoologist), and I went on board the Argentine torpedo cruiser "Patria," bound for Tierra del Fuego, leaving Dr. Nordenskiöld and the pioneers to wait for another opportunity.

At the end of October we left La Plata. My expectations of being able to make some zoological investigations along the little-known east coast of Patagonia were not realised, as the vessel stopped only at Puerto Nuevo, harbour of Chubut, lat. 42° 45′ S., long. 64° 59′ W.; at Santa Cruz, lat. 50° S., long. 68° 32′ W.; and at Rio Gallegos, lat. 51° 40′ S., long. 69° 18′ W. The "Patria" stayed at Puerto Nuevo a week, so that I had opportunities to dredge and to collect some terrestrial animals; at the other two places I only picked up a few invertebrates from the beach and the land. However, though my collections are so small, I hope they will add somewhat to our scanty knowledge of the fauna of the Atlantic coast of Patagonia.

It is evident that great differences must exist among the marine faunas of these two countries, owing to the ocean currents—the cold

Antarctic along the west coast, and the tropical Brazilian southwards as far as the Strait of Magellan, possessing, according to Popper, a mean temperature of 10° C. The contrasts among the land fauna must be even greater, as the great differences of climate and of geological and physical structure necessarily exercise a considerable influence on the organic life in these regions.

I arrived at Punta Arenas (Sandy Point, lat. 53° 10′ S., long. 70° 54′ W.), capital of the Chilian territory Magellanes, on November 20, and spent a month, pending the arrival of Nordenskiöld, in making as complete a collection as possible of representative land and marine types, especially of insects, spiders, and freshwater animals, since I knew that these classes had not been taken by naturalists like Darwin, Cunningham, and Coppinger, who had previously visited Tierra del Fuego; nor, as I learnt at Punta Arenas, had the recent investigators, Dr. W. Michaelsen, in 1892, and Dr. L. Plate, in 1894-5, given them sufficient attention. My studies here were the more interesting to me, since Punta Arenas lies more or less on the boundary of the two Patagonian provinces, which differ in almost every respect. On the one side, to the east, may be seen the typical Patagonian landscape, the poor, arid, and very windy pampas; on the other, westward, the rainy Pacific coast, covered with immense, nearly impenetrable forests of evergreen beeches and a variety of vegetation, and having a temperature varying but slightly in summer and winter. In fact, a remarkably distinct line of demarcation is to be found between the east and west climatological provinces, some few miles to the west of Punta Arenas. East of Cape Froward, the climate belongs to the "pampas type," west of it to the extremely-pronounced South Chilian coast type.

In view of these circumstances, I deemed it worth while to stay in Punta Arenas, in order to ascertain whether the animals of the one zoogeographical province meet with those of the other. So far as my own observations may permit me to judge, I think this is the case in the vicinity of Punta Arenas; here I can mention only a few of the more obvious instances to support this belief, but when all the collections have been worked out I have no doubt that additional evidence will be forthcoming.

Among spiders the occurrence is striking of a large Lycosid, probably *Lycosa australis*, Simon, which I found rather abundantly later on in the southern districts of Tierra del Fuego, in its forest-regions, and in the southern and western archipelagoes, but looked for in vain among the pampas of Patagonia (at St. Cruz and Rio Gallegos), and of Tierra del Fuego. On the other hand, at no place south of the Strait, nor in the western archipelago, nor at Punta Arenas, could I find any specimen of a scorpion, which I met with for the first time at Chubut, and afterwards at Santa Cruz and Rio Gallegos. This seems to prove that it belongs exclusively to the pampas; yet I should not be at all surprised to find some specimens near Punta Arenas, as I learnt, during a visit to Ultima Esperanza, which is but 1° farther north, that a scorpion, apparently of the same species, was not rare there. It seems to me strange that I have never heard or read of the occurrence of myriapods so far south from naturalists who preceded me in this country, as I observed a species, probably a Lithobiid, at almost every place where I landed—along the eastern and western Patagonian coast from Santa Cruz and Ultima Esperanza to the Strait, at Punta Arenas, in Tierra del Fuego (both in the pampas and in the forests), and in the southern archipelago as far south as Tekenika, some miles north of Cape Horn.

Again, among vertebrates I should like to call attention to the singular distribution of a lizard, doubtless identical with *Ptygoderus pectinatus*, Dum. and Bibr. (=*Proctotretus magellanicus*, Hombr. and Jacquin.). Darwin remarks that no reptiles have been found at Tierra del Fuego, though they may exist, he says, as far south as the Strait of Magellan. Indeed, even Hombron and Jacquinet mention in their "Voyage au Pole Sud," Zoologie, t. iii., p. 6, the occurrence of a small lizard at Peckett Harbour, on the northern shore of the Strait. Cunningham procured specimens of the same species at Rio Gallegos and many other places in eastern Patagonia, and afterwards observed it for the first time at Philip Bay, on the northern coast of Tierra del Fuego. I myself found it fairly often along the northern and eastern coasts of this great island within the pampas region, and secured two specimens as far south as Rio Grande, lat. 53° 50′ S., the most southerly spot on the globe where reptiles are as yet known. Darwin, in fact, advanced the entire absence of reptiles south of the Strait as an argument in favour of his theory that the Strait was to be regarded as the distinct boundary between two entirely different faunas, and that Tierra del Fuego had no, or very few, species of insects, spiders, and other terrestrial animals occurring in Patagonia. In regard to insects, especially Coleoptera, it is mainly by the examination of the valuable collections brought back by the French "Mission scientifique du Cap Horn, 1882–83," that Darwin's view is proved erroneous. The observations of Cunningham and of myself also contradict his view as to the distribution of reptiles. Although the lizard referred to above evidently belongs to the pampas, it occurs as far west as Punta Arenas, where Cunningham found a specimen, though I was not successful in my search for it.

Another striking example of the tendency of pampas animals to go farther west towards the forests is the armadillo. During my stay at Punta Arenas, in February, a specimen was found for the first time, walking *con toda tranquillidade* through the main street of this town; however, as it was killed and thrown away before I had a chance to examine it, I cannot say to what species it belonged. At Santa Cruz and Rio Gallegos armadillos are said to be rather abundant.

Here I may remark that on several December evenings I observed a bat flying round among the old and hollow beeches on the hills above Punta Arenas, which I vainly tried to catch in order to ascertain the species. This is, so far as I know from the literature, the first time that any representative of this order has been met with so far south. I did not see bats in Tierra del Fuego, nor did I hear them spoken of as occurring south of the Strait of Magellan. I believe the species will eventually be found to belong to the Chilian fauna, thus extending along the Pacific coast, within the forests, very far south. This would not be at all surprising, since we know that some true tropical and sub-tropical birds have a very extensive range along that coast. Another interesting fact is the very strange distribution of a parrot (*Conurus smaragdinus*, Gmel.) which I observed in great flocks in the forests near Ushuwaia, at the Beagle Channel, in lat. 54° 49′ S., long. 68° 18′ W.; a humming-bird (*Eustephanus galeritus*, Molina) has also been observed by former naturalists, among others by Cunningham, Coppinger, and those of the "Challenger," and mentioned as occurring very commonly on the islands of Smith Channel and of the western entrance to the Strait.

To birds I did not pay special attention, as almost every naturalist, who visited these countries before me, was interested in ornithology. In fact, in looking into the excellent memoir on birds from Patagonia and Tierra del Fuego, published in the "Mission scientifique du Cap Horn, 1882-83," t. vi., p. 3, by Oustalet, one finds, at the very first glance, that the ornithology of Tierra del Fuego must be regarded as thoroughly well worked out. A more practical reason why I did not collect many birds was that my time was too short to allow me to spend possibly one or two days in skinning them. Besides, I consider even a fairly complete collection of birds, mammals, or other higher animals, to be, from a scientific point of view, of very little value, unless the naturalist has an opportunity at the same time of making careful observations on the biology of the species collected. Such an undertaking, to be exhaustive, requires at least one or two years' residence in one limited district. Moreover, as the breeding season of most birds was already past on my arrival in this country, I thought it more advantageous to spend the few months which were at my disposal in collecting other classes neglected by former naturalists. Still, a good many birds were shot during my later voyages in the Fuegian Archipelago, but as a rule I did not skin them, merely putting them directly into alcohol for future osteological or anatomical study.

In Punta Arenas, I secured a small collection of Rodentia, just as Nordenskiöld did in the eastern parts of Tierra del Fuego. I also picked up all remains of seals and whales as far as circumstances permitted, because these mammals are worth careful investigation, the last mentioned especially, for the sake of comparison with northern and Arctic species. From the same neighbourhood I got together what I hope I may call a rather complete collection both of marine and terrestrial invertebrates. Nor did I forget to look out for the freshwater pools, the fauna of which, I knew, had been so far very little studied. From the beach I got many interesting forms, and my dredgings in the vicinity of the harbour—carried on, during the first stop here, from the steam launch of the Chilian man-of-war "Magellanes," which the governor kindly put at my disposal—yielded specimens representative of the fauna living at different depths at the bottom of that part of the Strait.

I did not pay much attention to species already well known as characteristic of this zoogeographical province, and of a larger size, or possessing some other quality which might make them of value to museums; but, on the other hand, I was very much interested in the representative forms—that is, such animals as are to be met with both in the Arctic and Antarctic seas, but not in any of the intermediate oceans, sometimes resembling one another so much as to allow of no specific distinction, sometimes offering modifications so slight as to necessitate their being considered as varieties only.

The recent expeditions to the southern seas, among others the French "Mission" and the German expedition to South Georgia, 1882-83, have contributed greatly to our knowledge of these interesting forms. My collections, I am sure, will be found to contain some forms, at least of crustaceans (mainly the amphipods), and of hydroids (with whose Arctic representatives I am somewhat familiar), belonging to the same genera or even, I venture to say, to the very same species as occur in the North Atlantic or Arctic Oceans.

En passant, I would like to mention the occurrence in the Strait of Magellan of a *Nebalia*, which, after a rough examination, seemed to me very like our Greenlandian and North Atlantic *Nebalia bipes* (O. Fabr.). I think this is the first time any representative of this highly interesting and phylogenetically important order of crustaceans has been observed in the southern hemisphere. I found it rather common on the sandy *playa* at Punta Arenas, under stones, etc.; afterwards I got specimens, possibly of the same species, in the trawl at moderate depths in Admiralty Sound and in the western part of the Strait. I also carefully collected all forms belonging to classes not worked out by previous expeditions, *e.g.*, Tunicata, Annelida, Nemertinea, Turbellaria, Amphipoda, Entomostraca and Cœlenterata. Having read the vivid descriptions by Darwin and other naturalists of the numerous and varied forms living in abundance in the kelp-forests (*Macrocystis pyrifera*, Agardh) of the Antarctic Seas, I expected to find among that magnificent seaweed a rather interesting and easily accessible field for research. In this hope I was, however, greatly disappointed; for I am sure that in our zone of *Fucus* and *Laminaria* there is a more abundant animal life, both as regards the number of species and of individuals. As to the towing-net, I am sorry to say that I did not have much chance of using it, mainly on account of the windy, unfavourable weather which prevailed.

About December 15 Nordenskiöld and the pioneers arrived at

Punta Arenas by way of St. Sebastian and Porvenir, and the whole expedition started for the east of Tierra del Fuego. On New Year's day, after a long and wearisome journey on horseback, we reached Paramo, a small gold-mining settlement on the bay of St. Sebastian, lat. 53° S., long. 68° 15′ W. During this journey I did not collect much ; those familiar with this kind of travelling will understand that after some ten or twelve hours' riding, without food or water, one prefers to rest, on arriving late at night, at an *estancia* or some good camping-place. The only collection of some importance that I made along the northern and eastern coasts was at Gente Grande Bay, where we spent Christmas, and where I had some time for dredging. Here, too, I had opportunity to observe the guanacos (*Auchenia huanaco*). These animals are rather abundant in Patagonia : in the pampas near Punta Arenas they sometimes occur in herds of some hundreds. Though they are found in the pampas district of Tierra del Fuego, and even to the south of Lago Fagnano and Rio Azopardo, and, according to the *mineros*, in Navarino Island, yet they must be regarded as comparatively scarce to the south of the Strait. While the guanaco might, therefore, be considered as furnishing an argument against Darwin's view before referred to, the ostrich (*Rhea darwini*) is apparently an argument on the other side, it being found all over Patagonia, though not to the south of the Strait, and being replaced north of Rio Negro, lat. 40° S., by a closely-allied species, *Rhea americana*. The puma, again (*Puma concolor*), is common in the great forests near Punta Arenas, where the Indians trade in its skin, but has not been observed south of the Strait or in the archipelagoes. From the eastern pampas of Tierra del Fuego I secured a few specimens of a fox (*Canis magellanicus*), which occurs also in Patagonia, and a number of Rodentia. The troublesome little "tuco-tuco" (*Ctenomys magellanicus*) is extremely abundant in the northern and eastern parts of Tierra del Fuego, and in the pampas of southern Patagonia, being replaced farther north by other species, *C. brasiliensis*, etc. It forms one of the chief articles of food of the Onas Indians, whose women are very skilful in catching it. These also I have never heard spoken of as occurring south of Admiralty Sound, or in the southern and western archipelagoes ; they may, therefore, I think be considered as belonging exclusively to the pampas of Patagonia and Tierra del Fuego. The French expedition to Cape Horn brought back ten species of Rodentia, most of them from Santa Cruz, and only four species from the Bay of Orange. It will be interesting to see if any of those that we secured from the east of Tierra del Fuego or from Punta Arenas are found to be identical with those from the southern archipelago.

The two weeks at Paramo I occupied chiefly in collecting insects and *playa*-forms. The other members of our party left on January 8 for the mission station of Rio Grande, from which Nordenskiöld intended to start for the interior and the Cordilleras. Unable to obtain a boat for dredging purposes, I paid a short visit to Rio

Grande, and returned in the middle of January to Punta Arenas on board the "Condor." During trips to Useless Bay and Dawson Island and to Rio Seco, the dredge yielded a number of interesting forms, but the most valuable collections were obtained on a voyage of three weeks' duration to the southern archipelago. On this trip, which started on February 1 and was favoured by fine weather, I was able, through the kindness of Captain A. Fontaine, to make excursions ashore whenever I liked, and to dredge at some twenty different places in Beagle Channel and round the Islands of Navarino, Lennox, and Picton. I dredged as far west as Stewart Island, lat. 54° 5′ S., long 71° 29′ W., and south at Lagotowia in Tekenika Bay, some 30 miles north of Cape Horn. It is to be regretted that I did not reach a depth of 100 fathoms or more, but the currents were too strong (in the First Narrows of the Strait the tide sets at seven to ten knots an hour) to allow my small light trawls, even with supplementary weights, to reach the bottom. By dredging on the sea and collecting on land, I think I gathered a fairly representative collection of marine and terrestrial fauna. Spiders are singularly abundant, both in number of species and of individuals. Some species of phalangiids of strange appearance and remarkable size were found at Lagotowia and a few other stations. I may mention here the occurrence at Ushuwaia and at Gable Island of a Limaciid, the first representative of the family observed so far south, though, strange to say, I did not find it elsewhere. The weather not being quite so fine on our return journey, I was unable to dredge in the Atlantic as I had hoped. At St. Sebastian we called for Nordenskiöld and the others, and arrived at Punta Arenas again on February 19. Both in the Strait and at Porvenir I secured specimens by dredging.

On our initial programme the exploration of Lago Fagnano, which has never before been attempted, was put as one of the most important items after the researches in the eastern parts had been carried out. This large freshwater lake was discovered three years ago by the Chilian-Argentine Boundary Commission, and is represented on maps as about 90 kilometres in length, 10 to 15 in breadth, and in some places 90 fathoms deep. Its axis is from east to west; it is situated at the northern slope of the Cordilleras, and connected with Admiralty Sound by Rio Azopardo. The whole expedition started on February 25 for Admiralty Sound. At Rio Condor Dusén found a specimen of humble bee, probably *Bombus dahlbomii*, which has never before been observed in Tierra del Fuego. Three days afterwards we arrived at Rio Azopardo, and, trusting the information given us by the chief of the Boundary Commission that we would need only one day to go up the river, Nordenskiöld ordered the vessel to call for us in twelve days. Then he, Åkerman, I, and four others started at once for the lake, while Dusén and the rest stayed at our camping-place on the shore. However, we found that the difficulties of ascending the river with a boat laden with a heavy cargo of tents, provisions, dredges, tools, etc., were far greater than we had expected. Having traversed with great hardship three-fourths of the distance, we arrived on the fifth day at a waterfall, at least three metres high, and beyond that, we sighted a long series of rapids, stronger than those lower down. Consequently, we deemed it impossible to reach our destination in the short time at our disposal, either by water or by carrying the boat and its cargo through the thick vegetation bordering the river. The return journey down the river to the encampment, with the tide in our favour, occupied only two hours. Thus I had to return after having only sighted from a distant hill that beautiful basin which will, no doubt, some day prove very interesting for research, notwithstanding its analogy with some of our "relict-lakes." During my twelve days at Admiralty Sound, the weather was too bad to permit of my making any but terrestrial and freshwater collections; however, I dredged later on at a depth of 100 and 150 fathoms respectively at Martha's Bank and Cape Valentin.

Having by this time a good representative collection of the eastern fauna, I thought it would be interesting, for the sake of comparison, to visit the west of the Strait and the Pacific coast, and, through the courtesy of the Governor in Punta Arenas, Mr. Señoret, I was invited to start on board the "Huemul," sister boat to the "Condor," for Ultima Esperanza, a fiord never before explored by naturalists. Ultima Esperanza is the Spanish name of that very strange coast feature connected with Smith Channel by a narrow sound and by two narrower passages several miles apart, one of which is only 30 metres broad in some parts, while the other is rendered unnavigable by reason of several boulders just in the narrowest part. The tide sets through Kirke, as the northern passage is named, at the rate of ten or twelve, in spring even fifteen, knots an hour. At Isthmus Bay I found two tadpoles, probably *Nannophryne variegata*, Günther. Their occurrence along this coast has, I presume, been mentioned first by Cunningham, who found them at Eden Harbour and afterwards at Puerto Bueno, where he also met with another species, *Hylodes leptopus* (Bell); at present, then, Isthmus Bay is the farthest point south at which batrachians are recorded. They are another instance of the extension of terrestrial forms, originally sub-tropical, along that part of the South Pacific coast remarkable for its excessive rain and slight variation of mean temperature in summer and winter, and, as a result of these, for its luxurious vegetation. I should not be at all surprised to find this frog as far south as Cape Horn, just as other forms have so wide a range as from Chiloe Archipelago to Cape Horn, 800 to 900 miles. On arrival at the fiord, I found the water rather brackish, and, as I had expected, dredged at first with very little result—two mussels, a few annelids, a couple of amphipods and sea-stars. Therefore, I was the more surprised to find on the last day, when dredging in ten fathoms, numerous sponges, worms, amphipods, echinoderms, and a species of Cumacea. These were mostly quite new to me, and this was the only occasion on which I found Cumacea, an order so characteristic of Arctic and northern seas. It will be interesting to discover whether these forms are characteristic of these remote waters, or whether they are also found in the outer parts of the southern Chilian Archipelago, in which case they must have been pressed in the embryo stage by the tide through one of the two passages into the almost fresh surface-water of Ultima Esperanza.

In other respects, which I can only enter into briefly, was this inlet interesting. It was remarkably rich in waterfowl; the beautiful black-necked swan (*Cygnus nigricollis*, Gmel.) was far more abundant here than near Gente Grande Bay, where I had observed numbers before. Also worth recording was the unexpected appearance of a great shoal of whales in the innermost water, which was so fresh that the sailors used to drink it. So close were they that I recognised them as belonging to the Mystacoceti, and probably to the genus *Balænoptera*. Their size was estimated at about 50 feet; they were blackish in colour and the back was provided with a high and pointed fin, so that at a distance they resembled our northern *Orca gladiator*.

In regard to spiders and insects I was glad to find several species not met with in Tierra del Fuego, though possibly in part identical with those of the south Chilian coast. Still, I believe there must be a good deal of difference between the terrestrial fauna of Ultima Esperanza and that of the exterior archipelago, seeing that the climate of the former is more like that of the eastern parts of Patagonia, that is to say, with less rain and greater differences between the mean summer and winter temperatures—climatic conditions which exercise a great influence on the fauna as well as on the flora. I regret greatly that I did not have time enough to make larger collections from this part, which, being quite unexplored, will yield interesting results to both the zoologist and the botanist; but on April 5 we were obliged to leave. Stopping at the Otter Islands and at Borja Bay to make collections, I reached Punta Arenas three days later, and arrived at Plymouth, after an absence from Europe of eight months, on May 17.

I may now add a few words as to how operations were carried on. I have before hinted at what I thought the most important points, viz., to visit countries hitherto unexplored, and especially such seas as seem from their physical structure to be highly interesting, *e.g.*, the Atlantic coast of Tierra del Fuego, Lago Fagnano, and Ultima Esperanza. I tried in vain to get an opportunity of visiting the Otway and Skyring waters, never explored, so far as I know, for zoological purposes. Another point is to secure, if possible, a thoroughly representative collection of well-preserved terrestrial and marine specimens from a limited district. Although I am well aware that Michaelsen and Plate, among other naturalists, have done excellent work just in the neighbourhood of Punta Arenas, I hope my collections may contain some forms overlooked by these two eminent scientists, thus forming a useful complement to our knowledge of its fauna. Weak points in my collections, besides the small number of birds, the reason for which has been referred to, are the poor results from the towing-net and deep-sea dredgings, accounted for in great part by unfavourable weather and strong currents. During our expedition dredgings were carried on at thirty-six different places, to depths of from five to 150 fathoms, while terrestrial, freshwater, and *playa*-forms were collected at some thirty-three different localities at least. The towing-net was used at about fifteen places, and a number of fish were caught.

In regard to the preservation of the animals collected, it was only at Punta Arenas that I had time to use the new methods of fixation; most marine forms, therefore, I put directly into alcohol (70 to 80 per cent.) or into formalin (1 to 2 per cent.). The latter I found very good for fishes, tunicates, molluscs, annelids, echinoderms, and cœlenterates, but not for sponges, which I therefore put in spirit. Formalin preserved the shape very well, and in many cases the colour also. Animals caught in the towing-net or from fresh water I preserved by adding a few drops of 40 per cent. formalin to the water in the jar in which I kept them. Coleoptera (except very hairy ones), Hemiptera, spiders, and all larvæ I killed and preserved in alcohol. Other insects, such as Diptera, Lepidoptera, etc., I put into a bottle with cyanide of potassium, and afterwards kept dry in paper. I cannot yet speak of the quality of our collections, but I may give an imperfect idea of their number by mentioning that they are contained in some 1,300 jars, many of which had to be crammed with different species, owing to the difficulty of obtaining more glass jars in Punta Arenas. I hope, when all our material is worked out, to publish a fuller report, enumerating all localities visited, their position, physical relations, etc., and giving a historical review of all voyages to these parts, and a complete bibliography, as well as more detailed and accurate maps. The two maps accompanying this paper are drawn from an Argentine Government publication, and from Cunningham's "Notes on the Natural History of the Strait of Magellan and West Coast of Patagonia," Edinburgh, 1871.

Finally, I wish to offer my warmest thanks to the Chilian officers in Punta Arenas, especially to the Governor, Captain Señoret, and to Captain Gomez, of the "Errazuriz," who, with the greatest generosity, unparalleled in any country in Europe, put vessels at my disposal and gave me other opportunities of making trips. It also gives me pleasure to acknowledge my indebtedness to Captain Fontaine, Lieutenants Portaluppi, Valderrama, Sanchez, and the pilot, Mr. Hyden, of the "Condor" and "Huemul." Without their kind assistance, my zoological collections would have been worth very little.

Wisingsö, Sweden. AXEL OHLIN.

IV.

Casual Thoughts on Museums.

Part V.—Anthropology.

THAT some men and most boys are beasts we learn when we are very young from the ordinary conversation of schoolboys and draymen. The metaphor of these expressive rhetoricians is not only, as everyone knows, confirmed by sober science, but has been extended to all human beings. Man is no longer put in a separate order by himself, but is classed by the zoologist as the terminal link in the long chain of life. The mysterious secrets of that chain increase, instead of diminishing, with our knowledge, and its initial stages seem more puzzling than ever, for many of the keys and explanations of recent years resolve themselves into the substitution of one phrase for another, and it is not illuminating to substitute a red fog for a black one—but let that pass.

That man is a beast, allied by his structure, etc., to other beasts, is a scientific conclusion that has hardly yet penetrated into the museum mind, a mind which carries on the systematic study of life largely without any consideration of the one form of life about whose structure, variation and conditions we know most, namely, that form of which you and I are curious and perhaps unmatched examples.

Is it not a most remarkable fact that in this great empire of ours, with possessions in every climate and numbering men of all races among its subjects, we should not have a single example anywhere of an anthropological collection—I mean no collection in the least representing or worthy of the subject?

At Cromwell Road, and in some local museums, there are small and utterly inadequate and neglected and ill-arranged and uninteresting collections of human skulls and a few skeletons. At the Museum of the Royal College of Surgeons there is a larger collection of a similar kind, supplemented by a magnificent series of preparations of the internal organs and structure of human beings, and for the most part of morbid cases. But these are in no wise sufficient. They seem at present to exist merely for the purpose of exasperating the typical systematist, who hates internal *differentiæ* and loves to class his beasts by the presence of patches of colour in the hair or feathers. I do not mean by an anthropological collection a collection of dresses, weapons, tools, etc., used by savages, or of the gorgeous neckties and waistcoats of modern times. These things, *mirabile dictu*, belong to the province of Art, and the province of Art, that is, of human handiwork apart from the work of Nature, is well represented at Bloomsbury; there, by the munificent generosity, vigilance, and zeal of my friends, Sir Augustus Franks and Mr. Charles Read, an incomparable collection, admirably arranged, of savage garniture has been got together. Why is it not more studied?

I am not speaking, however, of man sophisticated and spoilt by the livery of civilisation, but of man in his condition of primeval innocence and beauty. What I want to see in the Natural History and other similar museums are models of different races of men, showing their bodily features, their colour, their size, their shape, and so on, by coloured casts and models such as may be seen in some foreign museums—showing what kind of hair they have, what their facial contours are, the relative length of their arms, the fashion of their insteps, feet and toes, and supplemented by skulls and skeletons, the scaffolding upon which the real human contours have been moulded. In this way, and in this way only, shall we learn what are the affinities of man, and perhaps also what are the lines of his pedigree.

I am, I know, only reflecting the thoughts and wishes of Sir William Flower, who has for years been an advocate of this view, and who, now that he is packing away out of sight the collections of skeletons upstairs[1]—which are useless as exhibition objects, priceless as they are in the students' room—will have, it is to be hoped, accommodation for exhibiting a really representative and well-arranged collection of casts and preparations of the various forms of man. This long-needed, and, by some of us, long-clamoured-for addition to museum collections is now within a measurable distance of being commenced, and there ought to be many ready to help it on.

We ought to impress, as the German and French Governments impress upon their Colonial Governors, their frontier agents, and their civilian and military officers, that it is part of the duty of such men, in such positions, to help the National Museums in every way. On the other hand, the museums should, as they mostly do, put prominently before the public eye the names of their benefactors. If Darwin and Owen deserve statues in the National Museums because of their scientific attainments and reputations, assuredly Hume and Tweedale, Enniskillen and Egerton, Davidson, Godman and Salvin, and many others, deserve to have their munificence and public spirit recorded in "everlasting brass." It is pitiful also to think of the collections which have been sent home and are piled up, unarranged, unnamed, and useless, because it is not given to all curators to have the *Furor Sharpei* nor the *Patientia Woodwardi Junioris*, nor the *Pertinacitas*

[1] If my accomplished American critic thinks that the fact, the prime fact, that mammals as a class have five fingers and five toes can be illustrated by a long gallery full of mounted skeletons better than by a series directed *ad rem* as in the Index Museum, he will not make many converts here.

Murrayi, for instance. Nor is this all; other collections (two certainly) of carefully and beautifully made casts of natives of India have been sent to this country to two exhibitions, and have been allowed to moulder away into dust and destruction. It is these things, and things like them, that take the heart out of men who would be willing to help the museums in every way. The sort of men we want are men endowed with the never-ending zeal of such English representatives as my friend Johnston, the Governor of Nyassa Land, who sends bales of specimens home by almost every mail, and proves that the really condensed essence of human zeal, and perhaps goodness, is only to be found in little men.

And what lessons shall we not learn from a real anthropological collection? I do not mean merely in regard to *ad captandum* issues like the antiquity of man, or the actual links by which the Pucks of our nurseries are united with the Pucks in the Monkey House at the Zoo—these are more difficult questions than many men used to think, and those who know the most about them feel the most mystified—but in regard to simpler and homelier issues, in which it is so much more easy to experiment upon man, whose direct ancestors on either hand we have records of, and whose modes of life are more accessible to study—questions of sexual selection, which has been ridden to death as so many other *à priori* theories have by the wild Darwinians; questions of the fertility of hybrids; of the persistence of types; of the occurrence and inheritance of sudden variations, and sports like families of six-fingered or of left-handed men; questions of the effects of environment as apparently exhibited in the production of the Yankee type, with the sharply chiselled face and long wiry hair, so like in many ways to the American Indian; the effects of close interbreeding, the inheritance of disease, and the effects of the mere struggle for existence, another of the issues upon which many Darwinians have gone stark mad. A closer study of savage man would have saved some of them from the quagmire into which deductive reasoning generally leads the man of science. The fact that well-fed and healthy animals and plants are generally less fertile than underfed and unhealthy ones has been splendidly shown in the case of man. Then there is that other hobbyhorse of the deductive zoologist, conscious or unconscious mimicry. That butterflies and birds in South America should mimic for protective purposes butterflies and birds in Africa seems a puzzle to an ordinary logician who does not treat *post hoc* and *propter hoc* as synonymous. Here again we may profitably turn to the lesson taught by human examples. I do not want to indulge in paradoxes, and to deny the efficiency of many of the arguments used by Darwinians, when duly limited and when duly restrained. No doubt the causes cited are efficient causes to a certain extent, in some cases very slightly and in others more so, but what I say and have always said is, that they have been absurdly exaggerated, and made to do service in every fantastic way, and if we are to cure many of these mistaken inferences we cannot do better than base our inductions more and more on man, of whom we know much, and meanwhile always keep before us as a warning the fruitful proverb, *omne ignotum pro magnifico.*

Even in regard to more critical problems, the study of anthropology in its proper inductive way, by bringing together types from various localities, promises much. If we are to be logical and consistent we must apply the same kind of *differentiæ* to distinguish men that we do to distinguish butterflies and birds, and give them the same value. Are not Esquimaux and Bushmen, Samoyedes and Australians, American Indians and Fantis, much further apart than any two species of monkeys, of larks, or of butterflies? That these various human species may have had a common ancestor who was human may be the case or may not. I am bound to say I know of very little evidence on the subject.

We know that in the caves of Brazil Lund found under the stalagmite the skulls of men whose facial type was like that of the American Indian, associated with the remains of the *Megatherium* and other extinct so-called Pleistocene beasts. In Europe we have found abundant remains of man also associated with the extinct beasts under the stalagmite of our caverns. Hence in so-called Pleistocene times it is clear that man existed both in the Old and the New World, and apparently differentiated as he is now differentiated on each side of the Atlantic. Further back than this we cannot at present go. We are told that the problem is one that is not to be measured by centuries, but, perhaps, by millions of years. I protest, not from any *à priori* prejudice, theological or otherwise, but simply because, having devoted a great deal of time and thought to archæology, I can see literally no evidence to justify such a conclusion. A great many thousand years ago, the types of man were apparently precisely what they are now. The Egyptian Fellah, the Hadandowah, and the Negro are all represented on the earliest monuments. Language also seems to get no nearer a common origin as we get further back, but rather the reverse. Sanscrit and Chinese, Babylonian and Egyptian, at the earliest stage to which we can trace them, are quite as far apart, if not farther, than any modern languages; on the other hand, when we get to the outskirts of human tradition and the records of language, we also get into a region of inquiry, where our archæological evidence becomes very scanty, and I see no traces in it to justify these magnificent postulates of hundreds of thousands of years, which seem to me born of a science closely akin to charlatanry. What then is the key? I am bound to say I know not at present, and I see no harm in saying so. I will also say, however, that that is why, like many others, I am desperately anxious to see anthropology made the subject-matter of closer study by a larger number of serious students, and to see a part of our great Museum devoted to its illustration. Hence these tears, and hence all this impudence.

HENRY H. HOWORTH.

V.

The Structure of the Graptolites.

THE following paper is an attempt to lay before English readers an account of recent additions that have been made, principally by Swedish workers, to our knowledge of graptolite structure. The literature referred to will be found at the end of the article.

Methods of Preparation.

To investigate the internal structure of graptolites, different workers have used somewhat different methods of research according to the nature and completeness of the material.

Törnquist (5 and 11), who had at his disposal pyritised specimens imbedded in slate and preserved in relief, ground a series of sections. For each section he used one specimen, with the advantage that the original of each drawing is preserved. Gümbel, and after him Holm (7 and 16) and myself (13, 14, 18), have worked with chitinous material imbedded in limestone, or, at least, in more or less calcareous rocks. For us, therefore, it was most practical to dissolve the specimens from the matrix by means of acid. For further examination of the cleaned specimens, Holm, as palæontologists so often have to do, has utilised the instructive accidental fractures, and has also made little dissections. He has, besides, drawn successive stages of ground specimens still in the matrix, while he has combined both methods by cleaning out ground specimens by suitable processes.

The following lines give a short account of the method I have used, which is more fully described in my work "Ueber die Graptoliten" (18).

For dissolving I have, according to the nature of the rock, used hydrochloric, acetic, and hydrofluoric acids. From pure compact limestones, from marly and glauconitic or strongly calciferous marl-slates, I have cleaned out graptolites with fairly strong, raw hydrochloric acid. Adhering slaty lamellæ and glauconite granules are afterwards dissolved in hydrofluoric acid. Acetic acid is only used when there is reason to believe that the specimen under examination is more than usually fragile.

For cleaning out graptolites from strongly argillaceous marl-slates one cannot use hydrochloric or hydrofluoric acid at once, but the lime has first to be removed by soaking with acetic acid, whereby the matrix keeps its shape, but naturally becomes of looser consistence. After having been washed with water the rock may be treated with hydrofluoric acid until the graptolite becomes free.

From siliceous rock I have cleaned out graptolites with hydrofluoric acid, using the most concentrated, fuming acid, at a strength of 55 per cent. Even from clay-slate itself graptolites may be cleaned out with hydrofluoric acid, although for various reasons rarely with good result. Cleaned out graptolites that are not to be further treated ought, after having been carefully washed in water, to be kept in glycerine in glass tubes stopped with corks and made air-tight with gold size, asphalt varnish, copal varnish, or something of the kind.

For examining the internal structure I have followed two different methods. The one, followed chiefly when dealing with Graptoloidea, consists of a kind of bleaching of specimens selected for that pupose. This bleaching I at first brought about by means of Schultze's maceration fluid, a re-agent long used by botanists, consisting of strong or concentrated nitric acid and chlorate of potash in solid shape. Subsequently, however, I have adopted another and milder re-agent, eau de Javelle or potassium-hypochlorite. In spite of the violence of the methods, one can, after some practice, venture upon bleaching even when only one specimen is at disposal. After bleaching, the graptolite should be washed in water and in alcohol of gradually increasing strength. It is now devoid of colour, but not clear. For clarifying, chloroform is best ; but often one can just as well use turpentine, toluol, oil of cloves, or other ordinary clearing fluid. Sometimes the graptolite is so colourless that it does not need to be bleached, but may be clarified after simple passing through alcohol.

The other method consists of making series of sections of the cleaned out graptolites. This method I have chiefly used for the Dendroidea, which on the outside have a periderm so thick that the thin inner walls would be consumed long before the outer periderm had time to become transparent. The method for making series of sections is the same as nowadays is used in most zoological laboratories. The interpretation of a series of sections is considerably facilitated by making a plastic reconstruction from it.[1]

The periderm may consist of pyrites or a yellowish brown, brown, or black substance, that has been called chitin, and that probably once consisted of some at all events chitin-like substance originating in a way similar to true chitin. I therefore consider the periderm as the epidermis of the vanished animals.

The Structure of the Graptolites.

I.—Graptoloidea.

In describing the structure of the Graptoloidea I shall begin with those that are morphologically simplest, that is, with the Monograptidæ,

[1] See Natural Science, vol. iii., p. 340, November, 1893, and vol. vii., p. 379, December, 1895.

taking *Monograptus dubius*, Suess, as an example (see especially 14). Figs. 1 and 2 represent the sicula end, Fig. 1 from the sicula side, Fig. 2 from the opposite (or anti-sicula) side. The sicula, except as regards the passage to the first theca, is bilaterally symmetrical, and consists of an older, less pointed, and thin-walled initial portion (*s*) prolonged into a hollow rod (virgula, *v.*), and one younger, larger, apertural portion (*s'*), provided with lines of growth and a mouth-spine (*sp*).

The sicula, having reached a certain size, produces, as is shown by the lines of growth in the periderm, a new individual, the first theca (t_1), which lies alongside the sicula and grows in the opposite direction. This first theca again gives rise to another theca (t_2), and so on. The thecæ in the Graptoloidea are all of one kind, but their shape varies in different groups and species, and has been used as the basis for division into genera. The thecæ may be somewhat cylindrical or prismatic in all their length; or sometimes they may be contracted at the mouth like the neck of a bottle, widening again into a broad aperture; or the outer edge of the mouth may be prolonged like a roof above the next theca and so on.[1]

Azygograptus I consider to be a *Didymograptus*-like form, in which the one branch is wanting, so that it has a certain resemblance to *Monograptus*. From this genus, however, it is clearly separated in time, which, perhaps, is of greater consequence in the case of graptolites than in that of any other fossils, since the graptolites have such a limited vertical distribution.

Dimorphograptus, whose sicula-region is constructed like that of *Monograptus*, may be considered as a transition-form between Diplograptidæ and Monograptidæ.

Among representatives of the Leptograptidæ, no one has as yet come across any material fit for the examination of the internal structure.

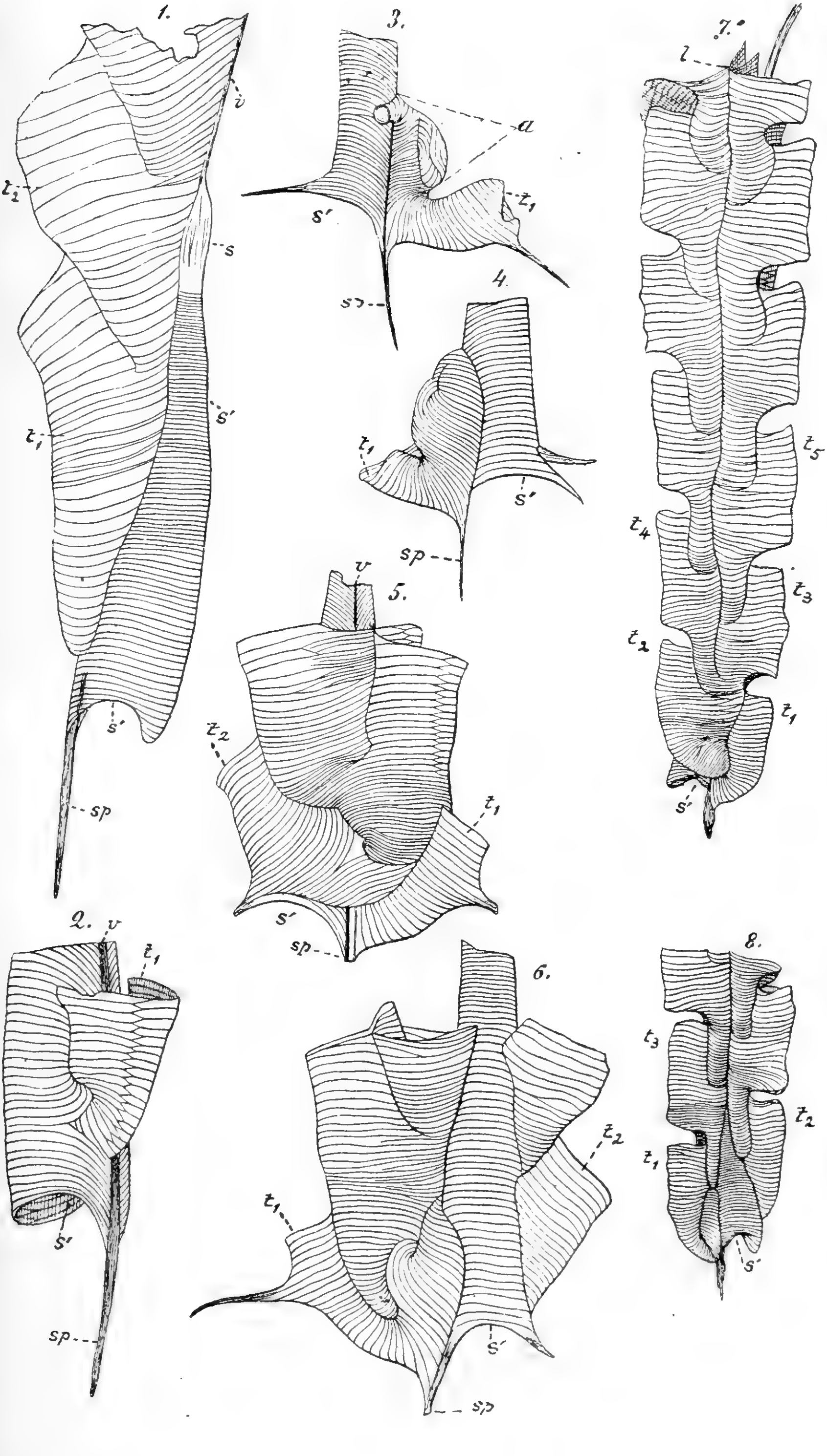
The Diplograptidæ were examined almost simultaneously by Törnquist (11) and myself (13). As regards the actual structure itself we are in accord, but we differ as to the explanation of it and the terminology to be employed. Here I shall first describe the structure of a species of *Diplograptus* and of *Climacograptus kuckersianus*,

[1] *Cf.* Jaekel (8) and Gürich (9).

EARLY STAGES OF GRAPTOLOIDEA.

FIG. 1.—*Monograptus dubius*, sicula end from sicula side. Fig. 2.—The same from anti-sicula side. Fig. 3.—*Diplograptus* sp., sicula end from sicula side. Fig. 4.—The same from anti-sicula side. Fig. 5.—A later stage from sicula side. Fig. 6.—The same from anti-sicula side. Fig. 7.—*Climacograptus kuckersianus*, sicula side. Fig. 8.—Lower portion of same, anti-sicula side. All greatly enlarged.

s, upper part of sicula. s', lower part of sicula; in most cases this is placed opposite the sicula-mouth. *sp*, mouth-spine of sicula. *v*, virgula. t_1, t_2, etc., first, second, and following thecæ. *a*, "connecting canal" of Törnquist, "bud" of Holm. *l*, longitudinal septum.


1.
v
t_2
s
s′
t_1
s′
sp
2.
v
t_1
s′
sp
3.
a
t_1
s′
sp
4.
t_1
s′
sp
5.
v
t_2
t_1
s′
sp
6.
t_2
t_1
s′
sp
7.
l
t_5
t_4
t_3
t_2
t_1
s′
8.
t_3
t_2
t_1
s′

Holm, according to my view, and shall subsequently show how Törnquist differs from me.

Here, too, as appears to be the case with all Graptoloidea, the sicula consists of the two essentially different parts, the initial part, that is prolonged into a virgula, and the aperture-part, with its mouth-spine. In *Diplograptus* sp. (Figs. 3, 4, 5, 6), the sicula-mouth is also provided with two paired lobes, whereas in *Climacograptus kuckersianus* (Figs. 7 and 8) it is more like the sicula in *Monograptus dubius*. In both it is bilaterally symmetrical. From the anti-sicula side of the sicula springs the first theca (Fig. 4), and immediately bends sideways past the mouth-spine over to the sicula side. Here it lies alongside the apertural end of the sicula, which, of course, had the start of it, and the two grow in the same direction. This first theca lies in the plane of symmetry of the sicula, on the same side as the mouth-spine. Such is also the case in *Monograptus dubius*, although the first theca there grows from the beginning in the opposite direction to the apertural end of the sicula (Figs. 1 and 2). To return to the Diplograptidæ: the first theca, having reached as far as the mouth of the sicula, begins to grow in another direction, bending outwards and upwards, towards the distal end of the rhabdome, either much, as in *Climacograptus*, or little, as in *Diplograptus* (Figs. 5 and 6). Before this change in the direction of growth has taken place, and immediately after the first theca has left the sicula, it in its turn gives origin to the second theca, which crosses over and places itself on the opposite side of the sicula (Figs. 3, 5, 6, and 7). This second theca again sends out the third theca, which places itself on the same side as the first.

It has long been known that certain Diplograptidæ are divided by a longitudinal septum. Figs. 7 and 8 show the origin of such a septum. The third theca (t_3) sends out two thecæ: first, one (t_4) towards the side of the second theca, and then one (t_5) towards the side of the first theca. The septum seems to originate in the same way, even when it begins further from the sicula end. When there is a longitudinal septum, the thecæ do not seem to be placed alternately to the same degree as when it is wanting. This is easily understood; for if there is no longitudinal septum, each theca springs from the opposite side of the adjacent proximal theca; where, on the contrary, there is a longitudinal septum, then in those regions of the rhabdome where the septum is, each theca arises from the adjacent proximal theca, and on the same side as it (Fig. 7).

In my opinion, the whole rhabdome thus consists of a colony of animals, in which each individual has budded out from the next eldest. Törnquist, however, contents himself with describing and naming the cavities that are surrounded by the periderm, leaving their nature undecided. The part of the first theca that lies between the passage to the sicula and the passage to the second theca (*a* in Fig. 3) is called by him the "connecting canal." That which was of old called "the common canal," namely, the set of the inner ends of the thecæ, Törnquist names the "biserial chamber." If, as in *Climacograptus kuckersianus*, a longitudinal septum is present, the "biserial chamber" passes at the beginning of the septum into two "uniserial canals." If, with Törnquist, we regard the peridermal units as representatives of units in a once living colony, then the sicula, the mother-animal of the colony, does not send out one individual but a kind of budding stolon, which passes, in the following order, through the "connecting canal," the "biserial chamber," and, if there is a septum, the "uniserial canals." In the "biserial chamber" this stolon buds alternately to either side; in each of the "uniserial canals" it buds to one side only.

The family Dicranograptidæ is still comparatively little known. On the other hand, the families Dichograptidæ and Phyllograptidæ are better known, and this especially through Holm's examination of *Didymograptus*, *Tetragraptus*, and *Phyllograptus* (16). It appears that the first stages of development of the rhabdome are, in the main, identical in these genera with the stages in Diplograptidæ, wherefore I need not give any further description of the structure of the sicula end in these families. Holm, however, seems not to have decided whether the individuals were formed by budding from a cœnosarc filling the "common canal," or from each other. He, therefore, sometimes speaks of the sicula in *Tetragraptus* and *Phyllograptus* as giving "origin to thecæ, which as in *Didymograptus* and *Diplograptus* are developed from each other, and therefore occupy different heights within the polypary," and sometimes of a "bud" and a "connecting canal." By "bud" Holm means the same structure as Törnquist calls "connecting canal," which I consider as nothing more than that part of the first theca that lies between the passages to the sicula and the second theca respectively (*a* on Fig. 3). By "connecting canal" Holm means something quite different to what Törnquist does, namely, the structure that I regard as the elder part of the second theca.

J. Hopkinson (6) has found specimens of *Tetragraptus serra* and *Didymograptus extensus* in which the common canal is both divided by transverse walls into as many chambers as there are accompanying thecæ, and partitioned off from the thecæ by walls.

Quite recently, at the end of 1895, H. A. Nicholson, and J. E. Marr (19), taking the shape of the thecæ as a marked character, regularly inherited, have arranged a genealogical tree for the family Dichograptidæ, in the same way as in 1895 I derived different groups of *Monograptus*, each by way of its corresponding *Dimorphograptus*, from *Diplograptus* and *Climacograptus* respectively (18).

Fig. 9, taken from Ruedeman (17) shows that colonies of *Diplograptus* were united by their virgulæ into brush-like or almost star-shaped colonies of a higher order, within which there was a division of labour. Beside the *Diplograpti* in the ordinary sense, easily recognised on the figure, we see a great number of organs of different nature grouped round the central point of union; to these Ruedeman gives the general name of central organs. But his work, which is described as "preliminary," does not give us enough information about these organs. For the present then I would merely remark that *a* in Ruedeman's Fig. 4 can scarcely be regarded as a gonangium, which means an individual or organ for sexual propagation; but that it ought rather to be considered as an individual

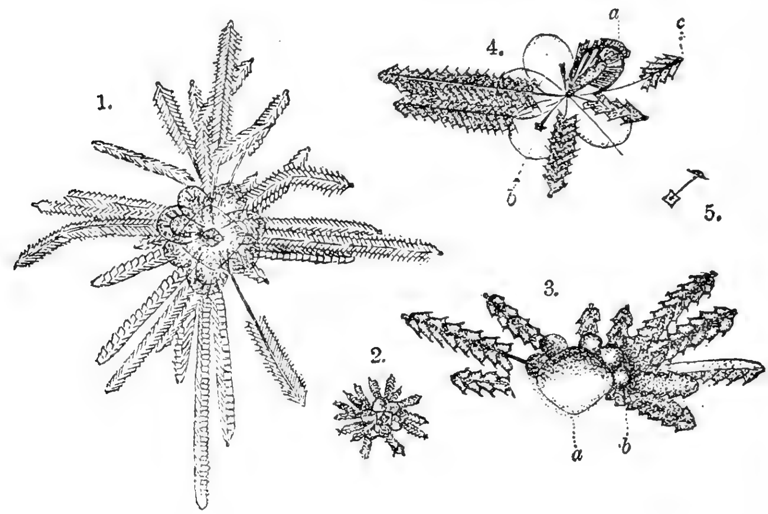


Fig. 9.—Colonies of *Diplograptus* (after Ruedemann).

for sexless propagation, a budding individual. It is of interest to get an explanation of the significance of the hollow virgula, so difficult to understand before. Because of this discovery, we cannot but conclude that all graptoloids were, at least temporarily, connected in this way so as to form parts of colonies of a higher order. This discovery may also give us valuable information as to the mode of life of the Graptoloidea.

Upsala. Carl Wiman.

(*To be continued.*)

VI.

Zoology since Darwin.[1]

WE younger men, whose scientific education begins under the jurisdiction of Darwin, can realise only with difficulty the excitement which his work on the origin of species[2] caused almost forty years ago in the realm of the natural sciences. It fell like a thunderbolt during a period of calm descriptive work, a period which had accustomed itself to regard the natural-philosophy ideas of the beginning of the century as unproved and unprovable sports of fancy, and which, therefore, mistrusting all speculation, clung anxiously to the foundation of fact. What life the selection theory brought into dry description, adding wings to the anatomist's knife, and opening out an extensive horizon before the short-sighted eyes of the systematist! Round the mummies of species, well fenced-in from one another by cleverly-composed Latin diagnoses, the bond of blood-relationship was suddenly drawn. The fossil remains of extinct forms, till then debarred from participation in existence, acquired flesh and blood, and demanded to be classed with the present-day fauna and flora in a single ancestral line representing the story of life on earth.

It is universally known that the idea of a natural genealogical descent of the present animal and vegetable world from the simplest primordial being was suggested long before Darwin's time, and was formulated in detail by Lamarck.[3] But the selection theory of the celebrated Englishman, Darwin, first based the idea upon a scientific foundation. The obvious phenomena of heredity and of variability are the foundations of his bold system, the axles of life's mechanism; and the motive power of this mechanism is the struggle of all living things for the preservation and procreation of life. The origin of the millions of varieties with their different forms, all adapted to special purposes, Darwin has made comprehensible by showing that the preservation of the individual, as well as of the species, entails a continual fight with life-conditions and with competing individuals—a fight in which that only can survive which best corresponds to, and

[1] Lecture delivered by Ludwig von Graff at his formal installation as Rector Magnificus of the K. K. Karl-Franzens University in Graz, November 4, 1895.

[2] "The Origin of Species." By Charles Darwin. Translated by J. V Carus under the title, "Charles Darwin über die Entstehung der Arten." Stuttgart, 1859.

[3] J. Lamarck, "Philosophie zoologique." Paris, 1809. Translated by A. Lang under the title "Zoologische Philosophie von Jean Lamarck." Jena, 1876.

best suits, the prevailing conditions. Thus a natural selection comes to pass: the existing species undergo adaptation, change, separation, and perfection. In the course of the countless great cycles of time, which have flown since the appearance of the first elementary primordial form of life, there arose in this manner the whole series of animal and vegetable organisation, of which man regards himself as the crowning-point. Darwin's teaching quickly became common property, and we trace its influence to-day in almost all spheres of mental activity. His opponents, who, the more they were outside the circle of naturalists, fought not so much against Darwin's own idea, the selection theory, as against the old theory of descent, have continually been growing fewer and quieter, in proportion as Darwinism, from being the standard of a special philosophical idea of life, has become the object of thoughtful scientific research. And the time does not now seem distant when Darwinism will no more be regarded as a party question than is the Copernican astronomical system.

We can then, without prejudice, ask ourselves the question, What influence has Darwin's work had on the development of zoology?

Firstly, it may be noted that at the time of the propounding of Darwin's theories, the two branches of natural history were in very different positions. While in the botanic system physiology had already gained its rightful place, an exclusively systematic morphological adjustment was still reigning in zoology. What wonder that a doctrine, whose main idea was to explain the origin of *forms*, had to bring about a revolution far greater in zoology than in botany? That Darwin himself was above all a zoologist, his examples and evidence being principally taken from the animal world, and that further, the phenomena of the "struggle for life" and of "natural selection" in the animal kingdom are much more obvious and varied than in the vegetable kingdom—these data must be considered if we want to explain why Darwinism took root so much more quickly and deeply in zoology than in botany. Nevertheless, in both it finally prevailed in the same way, and there can be very few examples in the intellectual evolution of mankind that produced such a revolution in the foundations of a science as did the selection theory in the branches mentioned. Description and superficial grouping gave place to the higher problem of the causal foundation of forms; the plodding industry of the describer had to be united with the method of comparison, the eye of imagination.

The first and most important task was the transformation of the system based upon Linnæus and Cuvier into a history of the descent of living forms. E. Haeckel, with his aspiring genius, sought to be fully just to it by sketching the first pedigrees in his ingenious system of the organic sciences—the "General Morphology of the Organism."[1]

[1] E. Haeckel, "Generelle Morphologie der Organismen." Berlin, 1866.

However premature under the then existing conditions of zoology these pedigrees may have been, there is due to them the immortal credit of having given the first impetus to the grand revolution in animal morphology of the last decades. Modern comparative anatomy dates from this period, in which C. Gegenbaur worked side by side with Haeckel. It has since then so completely become the chief part of scientific zoology, that our present text-books are given up almost exclusively to comparative morphology. The biogenetic principle formulated by Haeckel—that ontogeny (evolutionary history of the individual) is a short recapitulation of the phylogeny (history of the stock)—soon overmastered all branches of zoology, pervading comparative anatomy, evolution, and palæontology. Since the forms passed through by the ancesters of any animal are reflected, more o less recognisably, in the temporary varieties of forms during the individual's own development, evolution became the chief doctrine of post-Darwinian time. Its chief result at first was an enormous increase of zoological publications, about 2,900 on an average for one year being published in the period 1845–1860, and about 5,400 per year between 1861–1880.[1] Hand in hand with this increase in literary productions proceeded the improvement in the technique of research. Innumerable methods of staining permitted the growth of the cell to be more exactly studied, the cell-plasma and the nucleus and its elements to be separated according to their different staining capacities.

The tissues of the body, *e.g.*, muscles, nerves, and ligaments, nay, even the different stages of efficacy of the cells of one and the same organ, *e.g.*, the glands, could be separated in microscopic appearance by such new methods of coloration and impregnation. The old "pick and bruise" technique was supplanted by the microtome, whose pricelessness lies in its enabling us to dissect an animal in an uninterrupted series of extremely fine sections. Since by such means we can reconstruct the tissue of an object down to its elemental parts, we are now in a position to examine the inner structure of animals, whose small size had denied all information to the anatomical knife, or whose opaqueness had defied the bruise-method. And, moreover, let us remember the great advance in the serviceableness of the microscope by the construction of the new apochromatic lenses.

All this came as a great help to morphology, and in no earlier period of zoology had so many comprehensive and profound zootomical and embryological monographs been issued. The aim of almost all of these was the proving of the genealogical tree. While, however, the work of comparative anatomy was chiefly to elucidate the relationships of present day forms, evolution strove, in the incompleteness of palæontological results, to elucidate the older stages of animal history by a comparison of ontogenetic forms. One result of this striving is

[1] The authorities for these figures are the "Bibliotheca zoologica," by J. V. Carus and W. Engelmann, Leipzig, 1861, and the "Bibliotheca zoologica," II., by O. Taschenberg, Leipzig, 1887–1896.

the theory of the homology of the germ-membranes. So surely as the egg of all animals has the same value in form as a cell, and directs us to unicellular Protozoa as the starting point of all higher organisms, so surely also must the consequent embryonic phases of the multi-cellular-tissue creatures (Metazoa) show signs of common ancestry. Haeckel, starting from this premise, thought, in fact, that he could find the image of that ancestral form common to all multicellular organisms in the wide-spread evolutionary stage of the "Gastrula," which consists of two concentric cell-layers and a rudimentary (primitive) mouth.[1] These two cell-layers were determined to be the same (homologous) in all forms, so that here there seemed to be a means of tracing not only within the single lines of descent (phyla), but also through the whole kingdom of the Metazoa, the homology of the organs.

But if we examine without prejudice the facts brought forward, we must admit that this comprehensive attempt has as yet not been successful. The deeper our knowledge of evolution becomes, and the more exactly the comparison is undertaken, the higher also do difficulties tower above us. The essential point, however, is not that it requires a great stretch of imagination to refer all the evolutionary stages mentioned here to the scheme of the Gastrula, nor the circumstance that so often in adult animals organs, similar in form and function, actually originate from different germ-membranes; it is the fact that the primal germ-membranes arise not only in the members of different animal stocks, but occasionally even within one and the same phylum, in such different ways that it would be turning the old idea of homology[2] upside down if one yet regarded them as morphologically equivalent.

And here the hitherto exclusively morphological standpoint alone will hardly be of use. Experimental investigation, while tracing the causes of the various developed species, must first seek to make clear the "inner mechanism of the phenomena of life." Only on these lines can a secure basis be obtained for distinguishing between the "cenogenetic" (secondary falsifications of types) and the "palingenetic" (representing the originally inherited developmental tendency) characters.[3] And until a firmer foundation is worked out for this, a

[1] E. Haeckel, "Die Gastraea-Theorie, die phylogenetische Classification des Thierreichs und die Homologie der Keimblätter." *Jenaische Zeitschrift für Naturwissenschaft*, VIII. Bd. Jena, 1874.

[2] C. Gegenbaur, the Nestor of comparative anatomy, describes as homology (special homology) "the relation between two organs of the same origin, and proceeding from the same stock," and complete homology is present "when the aforesaid organ, even if modified in form, surroundings, and many other respects, has kept itself quite unchanged in position and relationship." (*Grundzüge der vergleichenden Anatomie*, 2 ed. Pp. 80–81. Leipzig, 1870.)

[3] E. Haeckel, "Die Gastrula und die Eifurchung der Thiere" (Chapter "Die Bedeutung der Palingenie und der Cenogenie"). *Jenaische Zeitschr. f. Naturwiss.*, IX. Bd. Jena, 1875.

satisfactory extension of the doctrine of the homology of the germ-membranes, propounded frequently with so much assurance, is not to be thought of.

Doubly valuable, therefore, seemed the morphological facts gleaned from another field of phylogenetic knowledge, namely, the history of fossil forms. Originally an aid to geology, it developed, in the period we are reviewing, into an independent branch of learning, and has borne richer fruit in proportion as it recognised the necessity of going hand in hand with the history of recent forms.[1] Zoology and palæozoology have both the one chief aim, to illustrate the history of animal life on our earth; and a collection answering to modern ideas, which would strive to show an exact picture of present genealogical materials and facts, would have to retain, arranged alongside of recent forms, the fossil remains of extinct species. The service which palæontology has done with regard to synthetic types and transition-forms, as well as to classical evolution-series, is the more important for the completion of the animal pedigree, since the exactness of description permitted by fossils, and the facilities they afford us for verifying their actual relations, lend a certainty and trustworthiness to most palæontological statements not possessed by the morphology of recent forms.

Darwin cautiously left untouched a number of questions not of importance to his selection theory. In fact, it is immaterial to this theory how one may imagine the primary origin of the simplest forms of life, so long as the existence of these forms is proved. In the same way the theories of descent and of selection were unaffected by the circumstance that at the time of their conception one could not picture the concrete foundations of heredity or the primary causes of variability. The existence of these phenomena sufficed as the foundations of the theory. But when, chiefly by German naturalists and philosophers, the amplification of the theory of descent had given rise to a new philosophy of the universe, these weighty questions had to be discussed. Yet, as regards the first of them, the primary creation of the organism, we have progressed no further than a theoretical formulation.

Since there are no chemical elements peculiar to vitality ("life materials"), and since a special "life force" could not be proved, our only alternative was to accept the idea of a "first origin" of the simplest organisms from inorganic elements with the co-operation of the forces active in such inorganic elements. Moreover, since the material

[1] Into this new path palæontology was led chiefly by K. von Zittel. By teaching and research, as well as by the inimitable arrangement of the palæontological collection at Munich, von Zittel has striven to penetrate deep into palæontology and zoology, and his splendid "Grundzüge der Palæontologie" is the result. *Cf.* also von Zittel's "Die Palæontologie und das biogenetische Grundgesetz," in *Aula*, a weekly journal for the academic world, I. Jahrg., p. 385, Munich, 1895 [translated in NATURAL SCIENCE for May, 1895], and also F. v. Wagner's Referat im Biologischen Centralblatt, XV. Bd., p. 840, Leipzig, 1895.

foundation of the life-process, protoplasm, belongs to the group of albuminous carbon combinations, one sought to refer the phenomena upon which life depend to the peculiar chemico-physical characters of carbon. But this so-called carbon theory of Haeckel, like the attempts of O. Bütschli and others, to imitate plasma-structure and plasma-movements by artificial mixing,[1] can as little replace our still defective perception, as can *living* protoplasm follow from a mixture of *dead* albuminous combinations.

An explanation, to some extent satisfactory, of the phenomena that take place at the first beginning of life, is nowadays the less likely to be gained, as chemistry has not yet given us any definite insight into the molecular structure of protoplasm, and as, moreover, from theoretical considerations, there comes the conviction that even the much-quoted "simple protoplasmic mass" is really of very complicated structure, and is not to be so glibly compared to an albumen-mixture.

Moreover, the enthusiasm with which one thought he could recognise in "bathybius" Oken's primary slime as an unindividualised protoplasmic mass covering the bottom of all oceans,[2] has cooled perceptibly. The supposed primary beings without a nucleus shrink also away, since we possess means to prove the existence of the nucleus even in cases where it remains undiscoverable by the primitive research-technique of olden time, and the supposition of a "spontaneous cell development" in organic fluids has given way to the sentence "omnis cellula e cellula." So as soon as it is proved that the last of the monera possess a nucleus like all other cells, there will yawn a much wider abyss between the most simple known forms of life and the inorganic individual, the crystal.

(*To be continued.*)

[1] O. Bütschli, "Untersuchungen über mikroscopische Schäume und das Protoplasma," Leipzig, 1892, as also later papers by the same author in the *Verhandlungen des naturh.-medicinischen Vereins zu Heidelberg.*

[2] The bathybius, as lately shown by Bessels, is probably nothing more than a plasmodium-like organism, whose distribution is locally restricted. *See* "Bronn's Classen und Ordnungen des Thierreichs, Protozoa." Newly revised by O. Bütschli. Pp. 179–181. Leipzig and Heidelberg, 1880.

SOME NEW BOOKS.

Williamson's Reminiscences.

Reminiscences of a Yorkshire Naturalist. By the late William Crawford Williamson, LL.D., F.R.S.; edited by his wife. 8vo. Pp. xii., 228. London: George Redway, 1896.

This is a book that reminds one of the biographies of Edwards and Dick. John Williamson, the father, was the curator of the Scarborough Museum for twenty-seven years, and the boy obtained his first insight into geological studies by assisting his father to name his collection of fossils, on the publication of John Phillips' "Geology of the Yorkshire Coast." Field-work suited young Williamson, and though his long winter evenings were "devoted to the detested labour of naming" "miserable stones," he recognised that this early practical familiarity with fossils moulded the entire course of his future life. After attending three Dames' schools, Williamson went to Pickering to be finished, and was much surprised to find that his first Latin lesson consisted of three lines of the "Æneid," instead of the sixty or seventy lines of Virgil he had been accustomed to. But he found that his new master demanded so thorough a knowledge that the three lines meant far more than the many lines of his earlier days. After a few months spent in France, Williamson returned to London in 1832, and before going home made the acquaintance of Murchison, who took him to the Geological Society and introduced him to Lonsdale; he varied these severer pleasures by a good round of theatres. On reaching Scarborough he found that arrangements had been made for him to enter the medical profession, and he gives a very amusing account of the preparation of the drugs by himself and the senior pupil, their subsequent delivery to the various patients, and the evenings spent with the housekeeper-servant in the kitchen. Other duties of the young medical student of those days consisted of lamp-trimming, sweeping the surgery, bottle-washing, and polishing the counter. The annual accounts seem to have been appalling, and the delivery of them occupied two whole days on horseback. The chief advantage of this early and severe medical training was the amount of open-air exercise it demanded, thus giving opportunities for plenty of collecting, and in the evening his drawings and notes communicated to Lindley and Hutton's "Fossil Flora of Great Britain" were executed at one end of the kitchen table, while the housekeeper prepared the dinner at the other.

Before the termination of his medical apprenticeship, Williamson had been urged to leave Scarborough, but it required considerable pressure from those who had taken an interest in him to induce him to do so. At last he received a letter definitely inviting him to meet the council of the Manchester Natural History Society on a certain day, with a view to his selection as curator of their museum. About September, 1835, therefore, Williamson found himself in Manchester, and though the surroundings were not altogether pleasant by reason of his being placed over the head of the old curator, he was in the midst of work congenial to him, and he threw himself heartily into it. But the difficulties and troubles of the curatorship ceased in 1840, when, after a three months' stay at Scarborough, he went to London and entered as a student at University College, meeting Lindley, who asked whether he knew W. C. Williamson, of Scarborough, with whom Lindley was perfectly familiar by correspondence. As fellow-students he had Sir William Jenner, Professor Erichson, and Sir A. Garrod. Returning to Manchester after his London work was finished, one of his old boyhood friends came forward with the means necessary to start him in a practice, and in 1841 he mounted his brass plate and started as a doctor. Always an energetic worker, Williamson occupied his leisure by investigating the history of the Diatomaceæ, and the structure of the Foraminifera and of bone. At the same time he commenced those minute studies into the structures of fossil vegetables with which his name will always be associated, the first dealing with the supposed *Zamia gigas* of the Lias of Runswick Bay. A second paper on the same subject was sent to Edward Forbes, and months afterwards, on enquiring about it, he received a penitent letter from Forbes to say that he had put it in so safe a place in his study that he could not find it, and it was subsequently returned to him by Forbes' executors in 1854. The death of John Owens, in 1846, affected Williamson's future career, for in 1851 he was chosen Professor of Natural History to the newly-founded Owens College. The story of his forty years' professorship, and the immense amount of educational and research work done by Williamson is clearly given in this biography, and the old story of the Clayton tree once more attests the enthusiasm of its describer.

From 1887 to the end the story of Williamson's life is briefly and sympathetically told by his widow, his second wife, who refers to his visit to the scenes of his boyhood in 1887, when all his old energy revived, and he was like "an old war-horse roused by the long-forgotten sound of his trumpet." He died in June, 1895, quite worn out. The volume closes with a list of his works, of which the first was published in 1834, and the last in 1895.

AGNOSTIC PALÆONTOLOGY.

ESSAI DE PALÉONTOLOGIE PHILOSOPHIQUE: ouvrage faisant suite aux Enchaînements du Monde Animal dans les Temps Géologiques. By Albert Gaudry. 8vo. Pp. 231, woodc. figs. 204. Paris: Masson & Co., 1896. Price 10 fr.

MOST popular expositions of the history of extinct animals are the work of compilers whose knowledge of the subject is merely the result of reading. Those engaged in actual research, as a rule, are too much absorbed in the technicalities of the enquiry, or too little skilled in popular modes of expression, to permit of their catering for the general public. When, therefore, an acknowledged master—an honoured veteran in the ranks of original investigators—undertakes this difficult task, we turn with unusual interest to what we are bound to regard as an authoritative review of the present position of the branch of science in question.

Professor Gaudry's new volume now before us is a work of the latter character. It is a supplement to his well-known three-volumed treatise on "Links of the Animal World during Geological Time," and is intended to be the expression of his matured judgment on the problem of organic evolution. It is a modest essay which will delight the amateur naturalist and the general reader, both by the charm of its elegant style and by the crowd of unfamiliar facts skilfully marshalled in the argument. From this point of view, we cannot speak of the book in terms of too high praise; we only decline to regard it as a serious contribution to science. There is a singular absence of logic in many of the sections, with too much tendency to bolster up a preconceived idea. There are none but the most inadequate references to the questions raised by the Neo-Lamarkians of North America—questions which are much too serious to be disregarded in any essay which claims to be "philosophical." Professor Gaudry, indeed, admits evolution, and even allows more than we can perceive; but the moment he approaches the possible suggestion of a law, he suddenly stops and pleads ignorance. He naïvely remarks: ". . . on doit avouer que jusqu'à présent on connaît très peu les causes des transformations des êtres. Je ne saurais m'en occuper. La tâche que j'ai entreprise me parait déjà assez difficile."

The main idea of the essay is, that there has been continual progress and a trend towards perfection in the world of life. The known fossils are described as favouring this idea in every way. Organisms in course of time have multiplied more and more on the surface of the earth. They have become more and more differentiated; they have increased in actual size. Each successive period has also witnessed an advance in the activity, sensibility, and intelligence of animals.

Such are the theses, and the various chapters deal with them in the order mentioned.

The idea that organisms are more numerous now than they were in the earliest times, is rather assumed than proved; but it is pointed out that their multiplication would be particularly facilitated in early times by the very general prevalence of a strong armour and the less sedentary character of most of the animals. Professor Gaudry also surmises that the sum of new arrivals exceeded that of the extinctions until the Miocene period, since when there seems to have been some diminution.

The facts concerning the differentiation of organisms form an old story; but the chapter on the size to which animals attain is of great interest and partly novel. Two pages of theoretical restorations, the one of marine and the other of land animals, illustrate the subject; and it is clear that the largest of all known animals are the whales of modern times.

In discussing the progress of activity, Professor Gaudry points out several instances in which the latest forms of a group exhibit more freedom of locomotion than the earlier forms, and remarks that at the present day there are the whales which are the best swimmers, the birds best adapted for flight, the horses best adapted for running, and man best adapted for walking.

There is little of importance to be said concerning the evolution of the senses of sight, hearing, smelling, tasting, and touching. The interesting chapter on the "progress of intelligence," however, affords an opportunity for repeating the now well-worn theme of the increase in size of the brain among mammals as they are traced through the Tertiary period. There are also some observations on the brain of the lower animals, with a very misleading figure of the brain cavity of the Permian Stegocephalian *Actinodon*, the diminutive proportions of which are almost certainly due to the flattening of the skull by crushing.

Finally, Professor Gaudry adverts again to another familiar subject, namely, the application of the results of palæontology to the determination of the relative age of rocks. He points out that horizons can be recognised not merely by their characteristic fossil species, but also by the general phase of evolution exhibited by each group of organisms in the fauna. This affords the opportunity for another review of the evolution of the fish-tail, the rhinoceros horn, the elephant's tooth, the deer antler, and similar phenomena which Professor Gaudry has so graphically described in his previous works. In fact, the present volume may be treated as a general introduction to his previous volumes, written (as all "introductions" ought to be written) at the close of his labours. We can only conclude by again recommending it to the notice of all who are in want of the essence of palæontology in an extremely pleasant and reliable form.

THE EYESPOT SILKWORM MOTHS.

DIE SATURNIIDEN (NACHTPFAUENAUGEN). Von A. Radcliffe Grote, A.M. Pp 28, pls. 3. Mittheilungen aus dem Roemer-Museum. Nr. 6. Hildesheim, June, 1896.

MUCH attention is now being given to the classification of the Lepidoptera, and a more natural system than that which contented a past generation of entomologists is being slowly marked out. In these studies English-speaking naturalists, on both sides of the Atlantic, are taking a leading part. In this country we have had Dr. Chapman's classical researches on pupal structures, and the careful, systematic work of Mr. Hampson and others; while in America Professor Comstock's discovery of the trichopterous "jugum" in the lowest moth-families, and Mr. Dyar's suggestive classification, founded on the tubercles of caterpillars, have proved of the greatest value. The present work, though German by language and publication, is from the pen of the eminent American lepidopterist, who has already issued, under the same auspices, a valuable study on the Apatelidæ or acronyctid group of owl-moths.

The Saturniidæ include those large silk-producing insects of which the Tussar moth (*Antheræa mylitta*) and the gigantic *Attacus atlas* are familiar examples to all who have examined a collection of Indian Lepidoptera. Abundant in tropical countries, and well-represented in North America, the family has but six European species, of which only one—the "Emperor" (*Saturnia pavonia minor*)—ranges into the British Isles. These insects, with their specialised neuration, reduced mouth-organs, and exceedingly complex antennæ, have considerable claim to be reckoned as the highest of the moth-families. Mr. Grote, however, places them after the hawk-moths (Sphingidæ). He formerly included the families of the common silkworm (Bombycidæ) and the "Kentish glory" (Endromidæ) in the same "super-family" as the saturniids, but recent study of the early larval stages of those insects leads him to consider them more nearly allied to the Eggar-moths (Lasiocampidæ) and their allies, and to place them in the super-family which he now calls "Bombycides," with the vast majority of families of the "Macrolepidoptera." This view of the affinities of the Endromidæ agrees with that held by Messrs. Hampson and Meyrick, but these naturalists would retain the Bombycidæ in the higher place. It may, perhaps, be suggested that the association of families into larger groups must always vary with increased knowledge, and that to lay stress on the definition of "super-families" is apt to obscure the subtle and complex relationships between the families. The saturniids, reckoned as a single family by most lepidopterists, are a super-family, according to Mr Grote, and are divided by him into two families—the Saturniidæ and the Agliidæ. In the former (higher) section the branches of the median nervure are forked, while in the latter (more primitive) group the lower branch arises from the cell. (It is a pity that writers on moth-neuration do not agree on nomenclature; in the system used by Mr. Grote the numbers of the nervures are reckoned from the costa, while Messrs. Hampson and Meyrick begin to count from the inner margin.) Mr. Grote considers the radial nervure and its branches of the highest structural importance, and points out that the great development of these and the consequent immense spread of the forewings in the Attacina is correlated with a reduction of the body parts and a high complexity in the antennæ. He considers, therefore, the Attacina to be the highest of the saturniids, and supports this view by their method of suspending the cocoon. While the other saturniids fasten their cocoons directly to stems or branches, or spin simply among leaves, the attacines use a leaf which they attach to the branch by an artificial stem of silk. This Mr. Grote believes to be a provision to guard against the falling of the leaf with its contained cocoon to the ground when the natural stem gives way. The wing-expanse of these insects is so great that they cannot rise from the ground, and by this mode of fastening the cocoon it is assured that the moths shall emerge in the upper air.

The value of Mr. Grote's work is materially increased by the very beautiful reproductions of excellent photographs of cocoons and living moths in their natural positions. GEO. H. CARPENTER.

BIRDS, BIRD-SONG, AND BIRDS' EGGS.

A CONCISE HANDBOOK OF BRITISH BIRDS. By H. Kirke Swann. Crown 8vo. Pp. vi., 210. London: John Wheldon & Co., 1896. Price 3s. 6d.

THE EVOLUTION OF BIRD-SONG. By Charles A. Witchell. 8vo, cloth. Pp. x., 253. London: A. & C. Black, 1889. Price 5s.

BRITISH BIRDS, THEIR NESTS AND EGGS. By various well-known authors. Illustrated by F. W. Frohawk. Part I. Ry. 4to. Pp. 48. London: Horace Marshall & Son, 1896. Price 2s. per monthly part.

FOUR COMMON BIRDS OF THE FARM AND GARDEN. By S. D. Judd. THE MEADOW LARK AND BALTIMORE ORIOLE. By F. E. L. Beal. Pp. 405–430 (Yearbook for 1895). U.S. Dept. Agriculture, Washington, 1895.

ALTHOUGH there is nothing to be desired in a handbook of British birds which we do not find in Howard Saunders' well-known "Manual" (not to speak of the works of Seebohm and others), it must be confessed that the question of bulk is sometimes a consideration to travelling naturalists. Saunders' book is a wonderful epitome of facts; but it takes up a whole corner in a portmanteau, and is too bulky to be carried in a man's pocket on a field-day. The same remark applies to most other books. Mr. Swann has sought to supply a tiny text-book, which should contain a description of the plumage of most British birds and their eggs, and which can at the same time be slipped into a corner of a bag, or knapsack, without inconvenience. He has asked too much, perhaps, when he claims that his modest booklet "*has had as yet no rivals*"; for Irby's "Check-list of British Birds" conveys a considerable amount of information, as do some other works of the same kind. Mr. Swann would have been wiser to describe his book as an annotated list of British birds; for this is precisely what it is. He does nominally include the majority of British birds, but *not* all. It is not easy to divine why no mention is made of the collared petrel (*Œstrelata torquata*), figured in the *Ibis* by Mr. Salvin, as killed on the coast of Wales, when room is given to *Oceanodroma crypytoleucura*, on the strength of a single specimen found dead in Sussex. The omission of the white-faced petrel (*Pelagodroma marina*) is equally inconsistent with the insertion of the capped petrel (*Œstrelata hæsitata*). Generally speaking, no attempt is made to describe the rarer species, though space is wasted on the plumage of the house sparrow, or even on informing us that the land-rail calls at night, as every schoolboy knows. Another drawback to the usefulness of the book is that the descriptions of plumage are nearly always based on adult male specimens, whereas it is immature birds that come most frequently into the hands of the novice. But the book is an honest attempt at assisting the public to become familiar with homely birds, and the author has made a fairly wise choice of the space at his disposal. We trust that a second edition may be called for, in which greater space could be given to explaining the changes of plumage through which most species pass. Mr. Swann may be glad to know that his fears for the extinction of the St. Kilda wren are not likely to be realised at present. This bird has become rather more numerous of late, presumably in consequence of the protection afforded to it by Macleod of Macleod, and his excellent St. Kilda factor, Mr. John Mackenzie.

It is always pleasant to find an author honestly in love with his subject. So many books are written to suit the convenience of publishers that one feels a certain relief at taking up Mr. Witchell's well-printed volume, which is a book of a very different kind. Mr. Witchell is an enthusiastic student of the notes of birds. He is not content to study the notes of adult birds, but starts his investigations with the cries of unfledged nestlings, from which he proceeds to discriminate the various sounds employed by different species to convey their emotions. The author is fortunately of a musical turn, and thus possesses special qualifications for his self-imposed task. A certain portion of the information which he has brought together is drawn from well-known sources, but by far the larger part has been gained at first-hand, and has the merit of being original. Perhaps the most telling chapters of his work are those which discuss the influence of heredity in the perpetuation of the cries of birds, and the influence of imitation in relation to bird-song. Fifteen years have passed since Mr. Witchell first began to study the subject. It is obvious from this circumstance that the theories which he propounds have been long considered, and bear some sign of concentrated thought. It is true that he has only touched the border of the subject, for his observations mainly concern certain species of *Passeres*, which are to be found in Britain.

Perhaps he may have opportunity of extending his observations at some future date. The field of research which he has entered is a wide one. But in the meantime he has succeeded in producing a very agreeable book—just the sort of book to read in a country garden on a summer's day, or in a punt on the Cherwell, for the matter of that. If anyone wants to read a chatty, informal book about wild birds, he should take in hand "The Evolution of Bird-song," for he is sure to be pleased with the writer's cheerful style and happy knack of registering interesting observations.

The rising generation of naturalists are fortunate in the number and quality of the works prepared for their use by the enterprise of publishers. Scarcely a month passes without the announcement of some fresh undertaking, intended to advance the cause of public instruction in the various bypaths of zoology. Especially is this true of British ornithology, which has, no doubt, an ever-increasing number of votaries. Many of the books on birds which emerge from the popular press appear to be somewhat superfluous. That objection cannot fairly be applied to the work at present under notice. For Mr. Frohawk supplies something that has hitherto been *unprocurable*—a series of beautifully designed plates of British birds, printed from copper plates, and published at a price which brings them well within the reach of the schoolboy and the artisan, neither of whom have much cash to spare for buying birdie books. The first part of this admirable publication furnishes twelve life-size figures, representing the missel thrush, song thrush, redwing, fieldfare, White's thrush, blackbird, ring ouzel, wheatear, whinchat, stonechat, redstart, and black redstart. The birds are depicted in their natural haunts, and the impressions are singularly soft. They form a curious comment on the faulty woodcuts of Yarrell, which have been reproduced in Mr. Howard Saunders' "Manual of British Birds." Mr. Frohawk is one of the most talented of English zoological artists, and the engravers have reproduced his drawings with delicacy and good taste. The plates in black and white are to be accompanied by coloured plates of the eggs of the species included in the work. The first of these plates appears in Part I. The colours are far superior to those of any other cheap series, and many varieties of eggs are shown on the same plate.

The text is well printed, and deals exhaustively with the life-history of the species which have most claim to be included in the British list. Whether Mr. A. G. Butler was the best ornithologist to undertake such an important order as the *Passeres*, must be a matter of opinion. But we have no fault to find with the way in which he has carried out his part so far; only it seems a pity that he gives *no* description of the rarer waifs and strays, such as the desert wheatear. If you tell a man that the desert wheatear has strayed to the shores of Britain, he at once wants to know what the bird looks like. But he will receive no help from Mr. A. G. Butler—not even a reference to Bree's "Birds of Europe," or any other work in which a figure is given. The reason for this withholding of details regarding the very rarest British birds is not apparent. So far as room is concerned, it would have been an easy matter to gain the necessary space by pruning some of Mr. Butler's rather lengthy paragraphs. The neophyte would have then been able to turn to his copy of this work with the certainty that he would find a description of the rare birds which whet his curiosity. Probably, he already knows what a common wheatear looks like, and would gladly have exchanged the plate of that species for one of the bird which is strange to him. But no doubt Mr. Butler has his own reasons for the course which he has adopted. It is satisfactory to know that the staff engaged upon the text of this work includes such competent authorities as Dr. H. O. Forbes, of Liverpool; Mr. W. B. Tegetmeier, F.Z.S., who treats of the game birds; Mr. O. V. Aplin, the Rev. M. A. Mathew, Rev. H. H. Slater, and one or two others. Mr. Frohawk's previous work is a sufficient guarantee that the very high standard of excellence which he has shown in the plates of the first part will be fully maintained throughout the entire work.

To turn to the United States, we are glad to find that the ornithologists there continue to prosecute their useful enquiries into the food of their native birds. On the present occasion Mr. S. D. Judd reports upon the food of the catbird (*Galeoscoptes carolinensis*), the brown thrasher (*Harporhyncus rufus*), the mocking bird (*Mimus polyglottos*), and the house wren (*Troglodytes aëdon*). Figures are given of the species referred to. The number of mocking birds examined amounted only to fifteen, so that it is unsafe to generalise upon the information gleaned from the contents of their stomachs. Mr. Judd tells us that a strong prejudice exists against this famous mimic on account of the injury which it is alleged to inflict on fruit. It is a bird which attaches itself to human society. "During the period of incubation the song of the mocker is at its best, and is heard at night from the male perched on the gable. Despite this token of its confidence in man, a planter in Florida killed over a thousand mockers and buried them under his grape-vines, because they had taken some fruit"! Mr. Judd admits that in Southern Texas the mocking bird is numerous enough to do some damage to peaches and grapes. "To prevent its ravages it is a common practice to tie up the vines in mosquito netting." On the other hand, the mocking bird is known to destroy many insects. Dr. Stiles states that even in Texas it feeds on large spiders and grasshoppers, while the late Professor Riley enumerated this species among the enemies of the destructive cotton worm. It would seem, therefore, to be entitled to a fair measure of consideration and forbearance at the hands of agriculturists. The catbird and brown thrasher receive much fuller treatment at the hands of Mr. Judd than is accorded to the more interesting mocking bird. It is unfortunate that the European house sparrow should be found to drive the house wren from its nesting-places.

A table is annexed to this paper, from which we learn the different percentages of food constituents found in the stomachs of no fewer than 213 catbirds and 121 specimens of the more retiring brown thrasher.

Mr. Beal deals at considerable length with the food of the meadow lark, three-fourths of which consists of insects, even in the winter time. Complaints have been received from farmers that the meadow lark pulls sprouting corn, and devours newly-sown clover seed. The evidence obtained by the examination of the stomachs of 238 meadow larks completely refutes the charge. The specimens which supplied material for laboratory investigations were collected in twenty-four States, in the district of Columbia, and in Canada, and represent every month in the year. It is only right, however, to observe that of the total insect food of the 238 birds examined, grass-hoppers, locusts, and crickets constitute by far the most important element, averaging 29 per cent. of all food consumed during the year. "Even in January they form more than 1 per cent., and increase rapidly until August, when they reach the surprising amount of 69 per cent." The Baltimore oriole, although a general favourite owing to its bright plumage and agreeable vocal powers, has to meet the objection that it levies blackmail on grapes and other fruit, as well as on garden peas. The report on the stomachs of no fewer than 113 individuals, shot between April and August, entirely disproves the notion that this bird is an enemy of the gardener. Mr. W. F. Webster does not appear to overstate the case when he observes that this bird "is worth its weight in gold as an insect destroyer." H. A. M.

Serial and Other Publications.

The 16th *Annual Report* of the Manchester Microscopical Society shows a satisfactory state of things in that the number of members is 214, and there is a balance in hand of some £23. The volume contains numerous interesting papers, of which we may especially notice "Animal Life of the Lancashire Coal Measures," by Herbert Bolton, illustrated by three half-tone plates from photographs of specimens. A thoroughly practical article on photo-micrography, by E. Hartley Turner, should be useful to others than the members of this society. The presidential address by Professor F. E. Weiss, deals with the influence of external conditions on reproductive processes in plants, showing how the method of reproduction may often be changed by a very slight alteration of surrounding physical conditions. Mr. A. Chopin, in notes on a recent visit to Cumbrae, quotes an interesting account by Captain Turbyne of his attempts on artificially fertilising echinoderms. He fertilised, about the middle of May, the ova of *Echinus esculentus* with the spermatozoa of *Asterias rubens*, and *vice versâ*. It is not stated what degree of development they attained, but "they lived for twelve days quite healthy till the heat killed them."

The Iowa Geological Survey, instead of waiting till its volume is complete for publication, is now issuing separate memoirs as they are ready. We have received "Geology of Woodbury Co.," by H. F. Bain, from vol. v., pp. 241 to 300; "Geology of Warren Co.," by J. L. Tilton, from the same volume, pp. 301 to 360; and "Lead and Zinc Deposits of Iowa," by A. G. Leonard, from vol. vi., pp. 1–66. All these were published in 1896, and are fully illustrated by maps, plates, and text-figures.

Mr. Fred Broughton Weeks has issued a Bibliography and Index of North American Geology, Palæontology, Petrology, and Mineralogy, for 1892–1893, forming No. 130 of the *Bulletins* of the United States Geological Survey. This is an extremely useful book, but its usefulness is considerably marred by the delay in publication. It should not be difficult to issue these annual bibliographies six months after the close of the year, and we are afraid that in this case also, as was pointed out in our note of last month, the delay is due to the Government rather than to the author, for the manuscript was handed in in April, 1895. The Palæontology of 1892 has already been published in the 121st *Bulletin*, by C. R. Keyes, although Mr. Weeks has omitted to state the fact in his introduction.

In our March number, p. 209, we referred to Norwich Castle Museum, and to its excellent illustrated guide by Mr. T. Southwell. A larger edition, price 1s. 6d., has lately been published. "The writer's object has been not to confine himself simply to an enumeration of the specimens actually to be seen in the cases, but rather to use them as illustrations of a general review of the orders to which they belong, and to make this intelligible, he has commenced, in each great natural division, by giving very briefly some slight particulars of the leading characteristics of the group and of the principles on which they are classified." This book will, we are sure, far more than fulfil the modest hope of its author, that it "may be useful to those who visit the collections."

Science for July 24 publishes the interesting presidential address on "The Advancement of Medicine by Research," delivered before the Massachusetts Medical Society, by H. P. Bowditch. He points out the inconveniences of the English law, which, while it secures no guarantee for the humane treatment of animals, is a source of serious annoyance to investigators, who have occasionally been debarred from making experiments of the highest importance. After reviewing the history of the anti-vivisection movement, the author gives illustrations of the lower sensibility to pain as we go down the scale of life, and the frequency under operations of reflex actions which do not denote suffering any more than do the flutterings of a decapitated chicken. Finally he touches upon the main question, the valuable results accruing from experimental research, such as the discovery of the circulation of the blood, with its vast influence on all modern surgery, and the diphtheria anti-toxin. We would recommend this sensible, moderate, and humane paper to all the well-meaning but ignorant class who wish to abolish, not to restrict, vivisection. In the issue for July 10, there is another common sense paper, touching on this topic, entitled "Physiology in the Schools," by S. H. Gage, of Cornell University.

The *Photogram* for August has a very serious note on a communication made by Dr. Baraduc, "a curer by means of animal magnetism" to the Société de Médecine, in which he states that his "vital fluid" is "a very real force," and deflects magnometers placed near his hands. "If dry plates (in darkness) be used instead of magnometers, the one opposite the right hand will be found on development to show cloudy masses, while the left hand causes dots like a shower of raindrops. . . . Carrying the matter a step further, the doctor finds that by firmly concentrating the mind on a definite object, so as to distinctly visualise a picture thereof, the image may be impressed upon a dry plate. He has found it necessary to concentrate his thoughts for periods varying from ten minutes to two hours, and the difficulty (for most folks an impossibility) of clearly visualising a thought, and of concentrating the mind thereon for any length of time, forms the great drawback to the process." We leave our readers to comment upon this. This number also contains some very beautiful reproductions of photograms of Warwickshire scenery, of which "Guy's Mill," by Dr. J. W. Ellis, deservedly gained the first prize.

Through a difficulty connected with the appropriation-grant for the U. S. Department of Agriculture, the publication of the journal, *Climate and Health*, has been stopped.

The Scientific American published a special double number on July 23, its fiftieth birthday.

A new illustrated entomological journal is announced from Neudamm. It is called *Wochenschrift für Entomologie*, and the subscription is three marks per quarter.

Annuaire des Musées scientifiques et archéologiques des Départements and *L'Année biologique*, under the direction of Yves Delage, are announced from Paris.

Literature Received.

The Biological Problem of To-Day, O. Hertwig: Heinemann. Catalogue of Fossil Bryozoa, J. W. Gregory: British Museum. 13th Report Bureau of Ethnology, J. W. Powell: Smithsonian Inst. Physical Geography, Skertchley: Murby.

A New Factor in Evolution, J. M. Baldwin: *Amer. Nat.* New Mexico Coll. Agric. Bull. 19, T. D. A. Cockerell. Ludwig and Modern Physiology, B. Sanderson: Royal Inst. Recherches biologiques, A. Giard: *Bull. Sci. de la France.* Collections of Fishes, O. P. Hay: Field Columbian Museum.

Nature, July 16, 23, 30, August 6, 13. Literary Digest, July 11, 18, 25, August 1, 8. Revue Scientifique, July 18, 25, August 1, 8, 15. Irish Naturalist, August. Feuille des jeunes Naturalistes, August. L'Anthropologie, VII., No. 3. Naturen, July–August. Amer. Journ. Science, August, Naturæ Novitates, July, 13 & 14. Amer. Naturalist, August. Victorian Naturalist, May. Science. July 10, 17, 24, 31, August 7. Scott. Geogr. Mag., August. Science Gossip, July, August. The Naturalist, August. Westminster Review, August. Amer. Geologist, July. Review of Reviews, August. Pop. Science News, August. Knowledge, August. Biology Notes, June–July. The Photogram, August. The Ornithologist, August.

OBITUARY.

THOMAS HICK.

BORN MAY, 1840. DIED AUGUST, 1896.

ONE of our earliest contributors has passed away in the person of Thomas Hick, the palæobotanist, lecturer in botany at Owens College, Manchester. Mr. Hick was born at Leeds in 1840, became B.A. of London University in 1866, and B.Sc. in 1870. He succeeded Marshall Ward as assistant to the late Professor Williamson in 1885, and his time was mainly devoted to vegetable physiology and histology, and to tutorial work. His earlier papers were connected with the structure of seaweeds, and his later with the elucidation of the structures of the fossil plants of the Coal Measures, on which his views were in friendly rivalry to those of Professor Williamson.

We learn from the *Manchester Guardian* that at a meeting held at the Museum, it was decided to establish some permanent memorial of Mr. Hick, and to collect a sum of money with a view to purchasing his collection of microscopic sections of coal plants and depositing them in the Manchester Museum. Any surplus will be devoted to the purchase of a portion of his library, to be given to the Yorkshire Naturalists' Union or to perpetuate his memory in such other manner as may be decided upon by the contributors. A large committee was appointed to carry out these resolutions, consisting of friends and scientific men representing Lancashire, Yorkshire, and other parts of the country. Professor Weiss was elected secretary and convener.

HEINRICH ERNST BEYRICH.

BORN AUGUST 31, 1815. DIED JULY 9, 1896.

IN Berlin Beyrich was born, there he worked, and there he died. His published writings, chiefly on palæontological subjects, were distinguished examples of conscientious works, and his first monograph, on the goniatites of the Rhenish Devonian, published in 1837, remains after the lapse of half a century one of the classics of cephalopod literature. Similar high rank must be assigned by students of echinoderms to his memoir on the Crinoidea of the Muschelkalk, while they regard his paper on the basis of the Crinoidea Brachiata as one the suggestiveness of which has borne good fruit. The trilobites also shared his attention, while his chief work, on the Mollusca of the North German Tertiary formations, remains unfinished.

The value of Beyrich's work was early recognised, and gained for him important official posts. As teacher of geology in his native city, he introduced to science many well-known geologists and palæontologists now working in Germany. He was also appointed a director of the Geological Survey of Prussia, and the Thuringian States, and became the head of the Museum of Natural History in Berlin. Along with Von Buch, Humboldt, and other famous men of the past, he was one of the founders of the German Geological Society; and these early associations it may have been that made him a *laudator temporis acti*, and that set his face against innovations. His last visit to this country was to the Geological Congress of 1888, he was elected a Foreign Member of the Geological Society of London in 1876, and one of his latest interests was the assistance he gave towards the compilation of the geological map of Europe now in course of publication.

Beyrich's death makes a widow of one well known in Germany as a writer for children, under the name of Clementine Helm.

JOHANN GEORG BORNEMANN.

Born 1831. Died July 5, 1896.

THIS geologist was born at Mühlhausen in 1831. In 1856 he went for a long tour through Italy, Sardinia, and the neighbouring islands, a journey which resulted in a series of papers on the geology of those places, and by which he is best remembered.

He was one of the enthusiastic band of German palæontologists who worked at the Foraminifera between 1850 and 1860, and his papers on these fossils from the Lias of Göttingen, the Septarienthon of Hermsdorf, and the Tertiaries of Magdeburg contain much valuable information. He died at Eisenach, where his son Ludwig Georg, himself a well-known geologist and a distinguished collaborator in his father's work, resides. C. D. S.

We have also to record the deaths of: Otto Lilienthal, who had demonstrated the possibility of *sailing* through the air, at one bound, some 500 metres with his first-constructed apparatus, while with his second machine, with its wing-like terminations moved vertically by means of a small compressed carbonic-acid gas motor, he had succeeded in sustaining and prolonging his *sail* for a longer distance by flapping these "wings"; J. Lloyd, compiler of a work on the flora of western France, on May 10, in Nantes, aged 87; Dr. F. Von Herder, botanist, on June 7, at Grünstadt; Dr. Kanitz, professor of botany in Klausenberg University; on March 26, in Yokohama, the conchologist B. Schmacker, aged 44; on June 10, Count E. Harrach, an enthusiastic zoologist; A. Gobanz, an authority on the geology and mineralogy of Greece, aged 70; on April 17, A. v. Sommerfeld, a lepidopterist, in Brazil, aged 30; and A. Sallé, a zoologist and explorer, especially known for his conchyliological and entomological researches in Central America.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced:—Mr. Vaughan Harley, to be Professor of Pathological Chemistry in University College, London; G. C. Druce, to be Curator of the Fielding Herbarium at Oxford; Dr. O. Burger, to be Professor of Zoology, and Dr. P. A. Pauly, to be Professor of Applied Geology, at Göttingen; Dr. H. Schenck, of Bonn, to be Professor of Botany in Darmstadt; Dr. E. Knoblauch, of Tübingen, to be Assistant in Botany at Giessen University; Dr. Schuberg, to be Extraordinary Professor of Zoology in Heidelberg University; Dr. F. A. Werf, Director of the Experiment Station at Java, to be Professor of Botany in Munich University, in place of Professor Rauwenhoff, retired; K. D. Glinka, Curator of the Mineralogical Department of St. Petersburg University, to be Professor of Geology and Mineralogy in the Agricultural Institute in Nova Alexandria, Poland; Professor A. A. Tichimirov, of Moscow University, to the Chair of Zoology and the Directorship of the Zoological Museum; Walter W. Froggatt, to be Government Entomologist, New South Wales, in place of the late Mr. A. S. Olliff. Dr. J. v. Gerlach, Professor of Anatomy in the University of Erlangen, Dr. Karl Müller, Professor of Anatomy in the Veterinary High School, Berlin, and Dr. Carl Claus, Professor of Zoology in Vienna University, have retired.

A BILL consolidating the educational institutions of London with a view to the establishment of a central university, has been introduced into the House of Lords by the Duke of Devonshire.

A SCIENCE hall, the gift of Dr. E. H. Williams, was formally presented to Vermont University on June 23. This building will cost about £48,000, and will contain, when completed, departments of electrical engineering, metallurgy, biology, chemistry, and physics. A geological museum and library is to be erected at New York University.

THE University Extension Courses at Odessa have been very well attended, considering that this is the first time they have been attempted in Russia. The attendances were as follows in the various branches of science:—anatomy, 350; bacteriology, 340; botany, 150; chemistry, 150; mineralogy, 130; physics, 300; zoology, 280. These courses last about three months, beginning in October and in January, and the charge for each course is only about 6s. per term.

THE National Collection of Plants, formerly in the custody of the U.S. Department of Agriculture, is now housed in the National Museum, Washington, where a staff of the members has been appointed to take charge of it.

WE are glad to see that a movement is afoot to give a public testimonial to Mr. Mark H. Judge, secretary of the Sunday Society, to whose efforts is largely due the recent Sunday opening of museums. The chairman of the testimonial committee is Canon S. A. Barnett, and subscriptions may be sent to Professor Corfield, at 61 Saville Row, London, W.

WE learn from *Nature* that at the opening of the Hawkes' Bay (N.Z.) Philosophical Institute, the Rev. W. Colenso, F.R.S., President, put before the meeting a scheme for the foundation of a museum to take the place of the present museum at Napier. He offered to give towards the realisation of his scheme the sum of £1,000 and a freehold site, and to supplement this with a second donation of £500 as soon as £500 was given by someone else. The total amount required to establish the museum is about £4,000. Referring to the conditions of the gift, Mr. Colenso said: "The museum must be a building which will be open every day of the week and Sunday afternoons too. I find that this is the case in Auckland, where large numbers visit the museum on Sunday afternoons. . . . There is another proviso, and that is, that the building must only be used for the purposes of a museum and library. There must be no concerts, no Liedertafels, no spouting, no mutual admiration societies, no globe-trotters, no tourists, and no parsons. I will not give a penny for persons of that kind. . . . . The museum proposed would be a museum for the east coast, not only for Hawkes' Bay proper."

THE principal part of the palæontological collection of the late Mr. William Pengelly, of Torquay, has been presented by his widow to the British Museum (Natural History) and to the Museum of Practical Geology, Jermyn Street. The fossils were obtained chiefly from the Palæozoic formations of Devon and Cornwall, but also comprise a series of bones and teeth from the Happaway Cavern, near Torquay.

MR. OLDFIELD THOMAS, of the British Museum (Natural History), returned last month from Uruguay and Argentina, whither he had gone to recruit his health. Notwithstanding the wintry weather experienced, he succeeded in bringing back an important small collection of mammals and insects. On August 21, Mr. A. S. Woodward, of the same museum, left for La Plata to examine the collections of fossil Vertebrata from the Pampas and Tertiary formations of Patagonia. South America has proved an attractive field to the British Museum staff of late, for it will be remembered that Mr. E. E. Austen returned only a short time ago from a collecting expedition up the Amazon.

THE collection of fossil fishes in the British Museum (Natural History) has just been enriched by a fine series of plaster casts and a few original examples of the armour-plates of the gigantic placoderms, *Dinichthys*, and its allies, from the Devonian formation of Ohio, U.S.A. These specimens were obtained from Dr. William Clark, of Berea, through the intervention of Professor E. W. Claypole, who has described most of the originals, and exhibited a nearly similar collection at the British Association meeting last year at Ipswich. The formidable jaws of *Titanichthys* and *Gigantichthys*, two feet in length, are especially striking.

IN the Natural History Reading Room at St. George's Free Library, Buckingham Palace Road, an attempt is being made to arrange an elementary series of zoological specimens, simply labelled and described, with a view of preparing the unscientific mind in some degree more to appreciate the exhibits in a public museum. The specimens of mammals, birds, etc., are accompanied by "reading cases," which consist of scrap-books and elementary volumes dealing with groups, these in their turn leading to more advanced text books or reference books for deeper study. The specimens are unduly crowded, but, as the notice card says, this is unavoidable, as the cases are intended for reference only, and to show at one view the principal members of one group. The object of this Natural History Room is to enable those interested to obtain sufficient knowledge of animals to refer them to their proper relationship, and thus to spread a more definite understanding as to the difference between mammals, birds, molluscs, crustaceans, etc. Even in the present day of educational progress, it is astonishing to notice the number of people who persist in calling whales, oysters, and crabs, *fish*, and if the St. George's Free Library can stamp out these absurd errors in their parish they will have done some good. A series of elementary penny hand lists are sold in the museum, as completed.

As announced in our last number, the Museums Association met in Glasgow from July 21 to 24, and was even more successful than we predicted. The presidential address of Mr. Paton gave a history of the Municipal Museums of Glasgow, which, as well as the Hunterian Museum at the University, were visited during the meeting. H. Coates and A. M. Rodger described the arrangement of the Perthshire Natural History Museum. E. M. Holmes, of the Pharmaceutical Society's Museum, dwelt on the difficulties of discovering type-specimens in many Botanical Museums. Dr. G. Bell Todd's paper on "Colour Tinting and its application to Microscopic Work" had no connection with museum technique. H. Bolton exhibited labels that he had drawn up for the Salford Museum (see NATURAL SCIENCE, vol. viii., p. 140), in order to explain the geological systems, and some discussion took place as to the possibility of issuing sets of labels suitable for more than one museum. F. A. Bather satirically enquired how museums might best retard the advance of science, suggesting many answers from the experience of most of us. In a second paper he advocated the use of electrotypes in Natural History Museums, and exhibited electrotypes of various fossils, which had been prepared by Messrs. Dellagana, of 106 Shoe Lane, E.C., and which met with general approval. G. W. Ord struck rather a new vein in explaining how chemical science and industry might be explained by museum methods; he was treated as the youthful enthusiast, or the prophet in his own country, but Glasgow might do worse than put Mr. Ord's ideas into concrete form. W. E. Hoyle read a letter, written long ago by Huxley, to the Natural History Society in Manchester, in answer to their enquiries as to the best form for a museum. Dr. Sorby's lantern slides constructed from actual marine animals, some of which had been exposed in the Museum at Sheffield for a year, were exhibited by E. Howarth. J. Rankin reported on the present state of the marine station at Millport. An account, by Clara Nördlinger, of a visit to Miss T. Mestorf, the directress of the Schleswig-Holstein Museum of Antiquities at Kiel, was read by W. E. Hoyle, and gave rise to an interesting discussion as to the employment of women in museums; the experiences of various curators had been as various as *il donne e mobile*. T. White advocated the use in museums of such reflectors for electric light as are employed in the picture galleries of well-known dealers.

THE Berlin Academy of Sciences has made the following grants:—Professor Weierstrass, for the publication of his works, M.2,000; Professor Klein, for apparatus for researches in crystallography, M.118; Dr. Burger, for zoological explorations in the Andes, M.3,000; Professor Fütterer, for geological explorations, M.1,000; Dr. Tornquist, for geological explorations in Vicenza, M.1,500; Professor Wernicke, for a photographic atlas of sections of the brain, M.2,000.

A UNION, whose aim is the thorough geological exploration of the northern portion of German East Africa, has been founded in Berlin under the title, "Irangi Gesellschaft." An expedition under its auspices, headed by Lieutenant Werther, and accompanied by two geologists, starts for that locality shortly, and will remain there some fifteen months.

THE citizens of Munich have collected M.71,200 for the Academy of Sciences in that city, to be devoted to the promotion of research.

THE last part of the *Proceedings* of the Bath Natural History and Antiquarian Field Club (vol. viii., no. 3), just received, contains the forty-first annual "Summary" for the session 1895-96, and shows the club to be in a remarkably flourishing condition. Natural History, however, occupies a very small part of its attention, and the extent to which even its prominent members are versed in the most elementary principles of the subject may be inferred from a question of the president, who is reported to have innocently enquired (p. 266) whether any of the Upper Lias fishes in the Moore Collection belonged to species still existing at the present day! We are grateful for the brief paper on this collection which the club has obtained from Mr. A. S. Woodward, but it is strange that a centre of culture like Bath should produce so little geological and biological work.

IN the Report of the Easter excursion of the Geologists' Association to Swanage, Corfe, and Kimmeridge, just published, are some excellent process reproductions of photographs, showing the strata at Tilly Whim, Durlston, and Stair Hole. In the same part of the *Proceedings* will be found the reports of the excursions to Chippenham, Kellaways, and Corsham, including an account of the method of quarrying the Box stone.

THE Geological Society of South Africa, which was founded last year for the purpose of preserving the records of the earlier geologists who have written on South Africa, as well as of promoting discussion and investigations on the more recently discovered portions of the colony, has lately come into possession of a most valuable collection of manuscripts and papers, written principally by the late Mr. Andrew Geddes Bain and Mr. G. W. Stow. Among these are the original drawings on a large scale, coloured, of all the sections taken across the country by the late Mr. Stow, and also the numerous papers, including lectures, read before various scientific societies by the father of South African geology, Mr. Andrew Geddes Bain. The society is at present discussing the advisability of erecting a permanent building, to be used as a museum and meeting-room; upon its walls the drawings of Mr. Stow would be exhibited. Mr. David Draper, the secretary of the society, is at present on a short visit to this country.

A PRESENTATION, probably in the form of a portrait, is to be made to Professor N. Story Maskelyne by scientific men in England and abroad. Contributions will be received by Professor A. H. Green or Professor H. A. Miers, of the Oxford University Museum.

THE statue to Mr. Pasteur, to which we referred in a previous number, is now finished, and is said to be an excellent likeness. It will be erected in the market-place of Alais, where he carried on his researches on the diseases of silkworms.

WE are glad to learn that there is every possibility of a permanent museum being founded at the Millport Marine Biological Station, Island of Cumbrae. This is chiefly possible through the generosity of the Marquis of Bute, who has granted a free site of half an acre. As a nucleus of the collections, there will be the valuable material gathered by the veteran naturalist, David Robertson. The station is prepared to supply specimens to laboratories or museums for either dissection or exhibition; a note upon it appeared in our April number, p. 284.

THE Municipality of Perth having adopted the Free Libraries Act, it is hoped that the museum of the Perthshire Natural History Society may be taken over by them. This would give the valuable museum, which was described in NATURAL SCIENCE for January, 1896 (vol. viii., pp. 41–45), that stability which cannot be ensured by any private body.

THE Minister of Public Works of the Argentine Republic has commissioned Mr. Antonio Gil and Professor José Cilley Vernet to undertake an agronomical investigation into the production of cereals in the province of Buenos Ayres. The investigation will be conducted partly in person and partly by a series of questions addressed to agriculturalists throughout the district, and at its conclusion a detailed report is to be prepared, and presented to the Minister. A full list of the questions to be circulated is given in the *Revista de la Facultad de Agronomia y Veterinaria La Plata*, no. xviii.

DR. EMIL GOELDI continues his practical instructions to collectors in the June number of the *Boletim do Museu Paraense*, contributing also a long biography of Johannes von Natterer, which includes an account of his several voyages, and a portrait. He mentions the great accessions to the collections during the year 1894, especially among the vertebrates and insects. The Geology of Para, by Professor C. F. Hartt, finds a place in the *Boletim*, and Dr. Erich Wasmann prints a paper on the insects commensal with the ants and termites of Brazil.

IN the *Daily Chronicle* for Saturday, August 8, there appeared an interesting account of "The Club" which was founded by Dr. Johnson and Sir Joshua Reynolds in 1764. The literary naturalists who have been members of this exclusive body are Oliver Goldsmith (for his "Animated Nature," a translation of Buffon), Sir Joseph Banks, Sir H. C. Englefield, Dean Buckland, Davies Gilbert, Professor Owen, the Duke of Argyll, Sir R. I. Murchison, and Professor Huxley.

DR. FORSYTH MAJOR is expected to reach London before September.

ANDRÉE, after a successful landing on the Dansköar, building of the balloon-house, and filling of his balloon, has been obliged, by a continuous northerly wind, to postpone his ascent, probably till next year. He has however succeeded, we learn, in making a trial trip. The Conway Expedition arrived safely at Hammerfest on August 20. Conway, Gregory, and Garwood succeeded in crossing Spitzbergen. The "Windward," which picked up Nansen, brings favourable news of the Jackson party.

THE State College, Centre County, Pennsylvania, is constructing a truncated pyramid of 220 representative building stones, according to the *Engineering and Mining Journal*. This is to be called a geological polylith, and it is intended to be not only an instructive object lesson, but a notice that the Pennsylvania State College is founding a bureau of information concerning the distribution and qualities of building stones. The pyramid will represent in its construction the strati-graphical position of the rocks.

Science gives some statistics obtained from physicians as to the results of anti-oxin, which on the whole are very favourable, the mortality being decidedly lower than formerly.

BRIGHTON is degnerating. The scheme for altering and extending the Museum, the Library, and the Art Gallery has been shelved indefinitely.

THE first reading of the Bill to introduce the use of the metric system into this country took place in the House of Commons on July 30.

THE British Association, which meets at Liverpool, on Wednesday, September 16, has arranged for a series of excursions to suit the archæological, geological, zoological, and botanical visitors. The geologists will be led by Boyd-Dawkins and Lamplugh, and will visit the Isle of Man. The zoologists, under the guidance of Herdman and Thompson, will dredge between Port Erin and Ramsey. The botanists, under Weiss and Kermode, will also visit the Isle of Man. A scientific handbook to Liverpool and the neighbourhood is in course of preparation, and the usual facilities will be offered to visitors by the owners of manufacturing and engineering works for an inspection of their buildings. The reception room will be at St. George's Hall.

CORRESPONDENCE.

SOWERBY'S "MINERAL CONCHOLOGY"—GERMAN AND FRENCH EDITIONS.

I SHALL be extremely obliged if anyone can inform me of the date of issue of the several parts of the two editions of Sowerby's "Mineral Conchology," published by Louis Agassiz, between about 1839 and 1844. I have tried the usual sources, and, beyond some scattered facts, have obtained little information. Professor Alexander Agassiz, who possesses his father's own copies, tells me that they are bound without the wrappers, and points out the curious indifference of bibliographers as to dates in these early days, as Louis Agassiz himself must have been sensible of the importance of keeping a record.

540 King's Road,
London, S.W.

C. DAVIES SHERBORN
(*Index gen. et spec. anim.*).

IN his notice of my "Ethnology" (NATURAL SCIENCE, August, 1896) the writer charges me with stating that zoologists detach from the class mammals the apes and half-apes, as if these animals were not mammals. This inference would have been avoided had the reviewer quoted the concluding words of the sentence in question: "they [the apes and half-apes] are the chief or most highly specialised members of the class" (p. 17). I may not have "a scientific mind," as he says; but I trust I am not the lunatic I am here made to appear by the *suppressio veri et suggestio falsi* device. It would be well if those who pique themselves on their "scientific mind" paid also a little attention to fair play and accuracy of quotation.

79 Broadhurst Gardens,
South Hampstead, N.W.
July 30, 1896.

A. H. KEANE.

[The passage in question reads thus: "Zoologists detach from the Class Mammals the large and widespread group of Apes and Half-Apes (Lemurs), which in all modern systems constitute the independent order *Primates*, so named by Linné because viewed as a whole they are the chief or most highly specialised members of the class." We quoted the first sentence as an example of careless writing. We have nothing more to add.—THE REVIEWER.]

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.*

TO OUR SUBSCRIBERS AND OTHERS.—*There are now published* EIGHT VOLUMES OF NATURAL SCIENCE. *Nos.* 1, 8, 11, 12, 13, 20, 23 *and* 24 *being* OUT OF PRINT, *can only be supplied in the set of first Four Volumes. All other Nos. can still be supplied at* ONE SHILLING *each.*

Price of set of Vols. I., II., III., IV.	£2	0	0
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,, ,, ,, *I.–VIII.*	£3	0	0

It will shortly be necessary to RAISE *the price of Vols. I.–IV. still further.*

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

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NOTES AND COMMENTS.

Sir Joseph Lister's Address.

THE Presidential Address delivered by Sir Joseph Lister before the British Association, was eminently uncontroversial in character, and does not demand any detailed comment in these columns. Speaking as an exponent of the healing art to an assembly which excludes medicine and surgery from its discussions, he confined his attention to a quiet review of some of the more striking benefits which these arts have received from pure science. The increasing interdependence of science and medical and surgical practice is indeed a fruitful theme for retrospect to one who has played so considerable a part in the development of modern surgery, and Sir Joseph was at no loss for matter for his discourse. He touched, naturally enough, upon those subjects in particular with which he has, in the past, been more specially concerned. After some passing remarks on Röntgen rays and anæsthetics, he devoted the bulk of his address to the applications of bacteriology to medicine in general and surgery in particular. No portion of the address will have been listened to with more interest than that dealing with the development of antiseptic surgery, but such is the modesty of its chief pioneer, that no one who cannot read between the lines would gather, from his words, how great was the part Lister played in its inception and perfection. It is probable that there has never been a practical application of a scientific principle which has so directly saved human life as this. Not merely has the mortality from wounds and operations been enormously reduced, and the terrible results of wound infections become chiefly a matter of history, but operations which were before undreamed of have become almost commonplace owing to the security given by Listerian methods. Sir Joseph eagerly ascribed to Pasteur the foundations upon which antiseptic surgery has been built, and to those other bacteriologists, especially Koch, who have done so much to increase our knowledge of wound infections and their intimate causes, he dealt a full meed of credit. He touched also on the work of

Pasteur, Behring, and others in preventive and curative inoculation, and had a word in season on the matter of vaccination. In conclusion, he spoke of Metschnikoff's work on phagocytosis in terms of acceptance with which some may not wholly agree. The share in producing immunity which the phagocytic powers of leucocytes seem to bear, may be, and possibly is, very considerable; but that it is the main defensive means possessed by the body against micro-organisms is certainly still open to question. Be that as it may, the debt which modern medicine and surgery owe to science is very clearly brought out by Sir Joseph's quiet and dispassionate survey in his Presidential Address.

The Old and the New Physiology.

The interesting and suggestive address given last January by Professor Burdon Sanderson at the Royal Institution on "Ludwig and Modern Physiology," affords much food for reflection. Its main theme is the immense and continuous progress which physiology has made since it has been pursued on strictly experimental lines from a frankly physico-chemical standpoint. To Ludwig more than to any other man, as Professor Sanderson shows, is physiology indebted from its modern foundations, aims, and methods; and this, not only for the clearness and definiteness of his own aims and his own brilliant powers as an experimentalist, but also from the intense and unselfish personal influence which he exercised over his pupils, and which has made the Leipzig School famous throughout the world. It was Ludwig who gave the death blow to the old "vitalist" doctrines which had previously animated physiology, and the vagueness of which had proved so unfruitful in results. The sketch of Ludwig's career and life-work serves Professor Sanderson as the text for some instructive remarks on "The Old Vitalism and the New." It is evident that he is not much in sympathy with the so-called "new vitalism" of Bunge, Driesch, and others, though he extends towards it some degree of tolerance because it does not interfere with the strictly experimental methods which have hitherto proved so admirable in their results. Yet no one who has read Professor Bunge's fascinating book on Physiological and Pathological Chemistry can fail to have been impressed by the case which he makes out for something above and beyond the ordinary known physico-chemical laws of inorganic nature for the interpretation of even such simple vital phenomena as are presented by unicellular organisms, and of which he instances the power of food-selection shown by *Vampyrella*, and the extraordinary capacity shown by *Arcella* for righting itself, when upset, by the spontaneous local development of gas bubbles in its protoplasm. To suppose that such facts are to be explained by postulating a "vital force," is to commit the error of the old "pre-scientific" physiology. But the proof of the existence in the living cell of a force or forces above and beyond those which reign in the inorganic world—the definition and measurement of such forces, so as to bring them within the range of experiment—these are tasks which may await the physiologists of the future. Professor Sanderson does not, it is true, take too hopeful a view as to the likelihood of such discoveries. Yet following on the lines along which physiology has already progressed so far, when all that is explicable by known physical and chemical law has been explained, the as yet unknown and undefined "vital forces," if such exist, will stand out the more clearly, and present a more definite front for attack from the experimental side.

Experimental Psychology.

A YET newer form of science is experimental psychology. The wonderful energy with which the American Universities have taken it up bears fruit in many interesting records of laboratory work, published in the *American Journal of Psychology*, or the *Psychological Review*, or independently. The Yale Psychological Laboratory, which is under the direction of Dr. E. W. Scripture, has published the record of its third year of work. If the output seems small, it must be remembered how much time has to be spent in organising a new laboratory and in providing apparatus. Among the new apparatus described is a very simple instrument for testing colour-blindness and also for detecting colour-weakness. It depends on the use of different intensities of light: a simple arrangement resembling that of an ophthalmoscope allows red, green, and grey to be seen together in different shades, the colours being looked at through three windows fitted with grey glasses of different darkness. There are two principal researches in the volume. The first, by Dr. Seashore, is an interesting study of "illusions and hallucinations in normal life." He traces the influence of the size of objects on our judgment of weight, larger objects of the same weight being over-estimated, and smaller ones under-estimated. Noteworthy is the persistence of the illusion in spite of practice. In a second set of experiments Dr. Seashore found that it was possible by exciting expectation to produce hallucinations of various kinds in the absence of any physical stimulation. Sometimes there was a direct suggestion, sometimes the repetition of the stimulus a sufficien number of times led the patient to imagine it when it was absent. Thus hallucinations were produced of warmth, of a least perceptible difference of two lights, of a change in the intensity of illumination, even of actual objects. This investigation, though not surprising, is of some importance in itself, and as indicating a source of error in psychophysical experiments. Dr. Moore has a study of how fatigue affects the accommodation of an eye that is endeavouring to locate a point half way between two others on the line of sight. The error grows immensely with fatigue, though less with the single eye than with the two eyes. Some experiments are also recorded by

Mr. Weyer designed to discover the reaction-time of a dog; this was found to be ·089 seconds for an electrical shock to the forepaw, which reacted by withdrawal. Attempts were made also at determining the time of discrimination, but over and above the difficulty of apparatus, it is plain enough that such experiments, interesting as they are, are of doubtful value through the absence of introspection on the part of the subject.

THE PSYCHOLOGY OF THE CHILD.

THE recent deliverances of Professor E. D. Cope on the subject of consciousness and evolution have naturally attracted the attention of psychologists as well as biologists. At the meeting of the American Psychological Association at Philadelphia, in December of last year, he expounded the view (now easily accessible in his recent "Factors of Organic Evolution") of consciousness as a special factor in evolution, and as having been present from the beginning. The May number of the *Psychological Review* contains some remarks by Professor J. M. Baldwin on Dr. Cope's address and on one by Professor William James which followed it, which are well worth attention. In particular Mr. Baldwin indicates very clearly the error into which Mr. James at least seems to fall, of supposing that those who have recourse to brain-processes for their explanation of mental events deny the causality of consciousness itself—though, doubtless, this denial is implied in the epi-phenomenon theory of consciousness. The chief point, however, of Mr. Baldwin's paper is to plead for an ontogenetic study of the human mind in the mind of the child. He urges that to recognise consciousness as a factor in evolution is rather against than for the Neo-Lamarckian theory of heredity, having regard to the large part which consciousness plays in the child's life, and its relatively small endowment of natural heredity. And he points out how, from a psychological study of childhood, he has been led to promulgate a theory of organic selection, as he calls it, which represents a factor overlooked in current theories. This theory, which is expounded in his "Mental Evolution in Man and in the Race," holds that pleasant stimulations lead to reactions which tend to retain the stimulation, and so to repeat themselves by a kind of circular reaction, and that this form of reaction while it "represents habit, since it tends to keep up old movements," also "secures new adaptations, since it provides for the overproduction of movement-variations for the operation of selection."

A DICTIONARY OF PHILOSOPHY AND PSYCHOLOGY.

AN enterprise of much importance for psychology and philosophy is announced by Messrs. Macmillan in the shape of a dictionary with the above title, to be edited by the indefatigable Professor Baldwin. It is to contain definitions of terms used in the philosophical sciences, with historical matter to justify the definition, and with bibliographical references. Intended, as it is, not only to fix the very unsettled usage of terms, but also to serve as an introduction to the various philosophical departments, it will apparently treat its subject with a liberal hand. There can be no doubt of the usefulness of such a book if well executed, and certainly the publishers have secured a goodly array of contributors, mentioned in the preliminary announcement, who are an excellent guarantee of success.

Natural Science at Cambridge.

The thirtieth annual Report of the Museums and Lecture Rooms Syndicate, Cambridge, for 1895 has been received. We have already noticed some of the additions to the Museum of Zoology, and we may now add a series of over three hundred unnamed specimens of Bryozoa given by Miss E. C. Jelly, preparations of Mycetozoa presented by Messrs. A. & J. J. Lister, and over one hundred sections of recent and fossil plants from the collection of the late Professor W. C. Williamson. The arrangement and naming of the general Herbarium is progressing, with the assistance of numerous specialists, among whom may be mentioned Mr. F. Crepin who has named 1,500 sheets of roses, and published a paper upon them in the *Journal of Botany*. The number of students attending lectures in botany appears to be considerable if we may judge from the fact that 76 attended Mr. Seward's lectures in the Michaelmas term, 1895, while 89 attended those of Professor Ward in Lent term, 1896. Most of these are of course elementary students, who, by the way, are so numerous that accommodation cannot be found for them in the proper laboratory, and they have to overflow into the museum. The elementary biology class in the zoological laboratory reached the huge number of 174 during Easter term, 1895, but the advanced zoology class did not exceed twelve.

The most important addition to the physiological department during the past year is the new animal house, in which animals can be kept under proper conditions all the year round. It is satisfactory to find that seven persons, in addition to the staff, have been doing research work in the laboratory during the year.

The number of students working at the geological museum has been 125. The Professor of Geology reports:—"We are again indebted . . . for very valuable gifts to the University, namely, a collection of Devonian Fossils, figured and described . . . in the Monographs of the Palæontographical Society, and of a number of Brachiopods, figured and described by Davidson in his Monograph on the group." No doubt the donor has a very proper affection for his old university, but considering that Davidson's collection has been bequeathed to the British Museum, and that an attempt has been made to place together there all the specimens figured in his Monograph it seems to us rather regrettable that these Devonian Brachiopods should have been sent to another collection. We have also noticed in the Monograph on Devonian Fossils above alluded to very numerous acknowledgments of the "great kindness" and "very kind help" received by the author from most of the assistants in the Geological Department in the British Museum. Doubtless the gentlemen in question are only too delighted to aid so enthusiastic a worker, but the public and the Trustees may well ask where the gain is to their Museum.

Graptolites.

Cambridge geologists, following the lead of Mr. J. E. Marr, are paying much attention to graptolites, and it gives us pleasure to present them and our other readers with the article on the structure of those animals contained in this and the previous number. The views of Gerhard Holm have been fully placed before English palæontologists by the translations of his papers that have appeared in the *Geological Magazine*, whereas the slightly different opinions and important results of Wiman, with the exception of quite a short review in the *Geological Magazine* for September, 1895, have not received any exposition in the English language. The observations of this Scandinavian author, as well as of those quoted in Dr. Wiman's paper, refer to the morphology of the graptolites; but our readers are not likely to forget that these animals are of even greater importance in their geological aspect, and of the recent results in this direction a concise account was given in *Science Progress* for July of this year by Mr. Marr, whose own applications of these fossils to the correlation of strata have not been among the least important.

For the correlation of strata it is naturally most necessary that the determination of the species should be exact. "More harm," says Mr. Marr, "is done by a wrong determination than good by a correct one. The graptolites are by no means easy of identification by those who have not made them a special study, and it is particularly desirable that no determination should be recorded by tyros, unless it is absolutely certain, for when once a wrong name has crept into a list it is exceedingly difficult to remove it." These remarks are quite as applicable to other fossils as to graptolites, and may well be commended to the notice of the hard-working gentlemen who draw up the ponderous lists of fossils published in the *Memoirs* of the Geological Survey. It is now generally supposed that the deposits in which graptolites are found were deposited in deep waters at some distance from continents, since graptolites are often found in association with animals of a deep-sea habit, and especially with tests of Radiolaria. This, however, as Mr. Marr appears, though not very clearly, to suggest, is not due to the absence of graptolites from rocks of very different character deposited close to land, such as the coral-reef rocks of Gotland, but merely to the fact that deposition was so slow in these deep-sea deposits that the proportion of these ubiquitous organisms to the cubic foot was naturally greater. Mr. Marr gives a useful list of the graptolitic zones, with special reference to the rocks of England, and suggests that the absence of graptolites from deposits lithologically similar to those in which they are present, "is most readily explicable by climatic change." The article ends with a word in favour of fossils. From recent organisms the biologist has been able to ascertain that evolution occurs; but how it occurs is left for the palæontologist with his long series of species to describe. That the study of graptolites has not been in vain is proved by the best of all tests, namely, that the palæontologist in his workroom has been able to predict the existence of forms which were subsequently discovered by the geologist in the field.

Fossils.

The Palæontographical Society celebrated its jubilee last July, and an account of its rise and progress appears in the September number of the *Geological Magazine*. This is accompanied by the reproduction of a photograph taken in 1856 of four of the early geologists who interested themselves in the movement: Professor Morris, Professor Prestwich, Mr. Searles Wood, senior, and Mr. F. E. Edwards.

The officers of this society for the ensuing year are: President, Dr. Henry Woodward, he being succeeded as a Vice-President by Rev. G. F. Whidborne; Treasurer, Mr. R. Etheridge, F.R.S.; Secretary, Rev. T. Wiltshire; Council, Dr. W. T. Blanford, Rev. T. G. Bonney, Rev. R. A. Bullen, Rev. A. Fuller, Dr. J. Harley, Dr. H. Hicks, Dr. Wheelton Hind, Mr. J. Hopkinson, Professor E. Hull, Professor Rupert Jones, Mr. J. E. Marr, Dr. J. S. Phené, Mr. W. P. Sladen, Mr. B. Woodd Smith, and Mr. H. Woods. And yet, as a recent writer in *Nature* complains, "the geologists, zoologists, and botanists of the British Islands regard palæontology as an inferior science"; surely not, when it can be represented by such "potent, grave, and Reverend seniors"! By the way, is it strictly and scientifically accurate to say, in the words of the interesting account above alluded to, that "the officers cheerfully *give* their services"?

It is a curious fact that, of the eighty-seven writers who during the past ten years have published original work in British Palæontology, only twenty-five are members of this society, while most of the best-known names are conspicuously and lamentably absent. To induce these renegades to join the ranks of the faithful, our contemporary publishes a little computation of the average number of pages and illustrations published each year, with the average number of species described. The result is "far and away beyond what has yet been accomplished by any Continental Palæontographical Society for a subscription of one guinea annually." No one will deny the quantity, but what about the quality? Few wish better to this hardworking and jubilant society than we do, in proof whereof we present them with a key to their perplexities in the reminder that palæontography is not always palæontology.

WANTED—A LECTURE THEATRE.

THE Swiney Lectures, under the auspices of the Trustees of the British Museum, are this year to be delivered by Dr. R. H. Traquair, who has announced for his subject "The Geological History of Vertebrate Animals."

The lectures will be given at 5 p.m. on the Mondays, Wednesdays and Fridays of October, beginning on October 5, in the lecture theatre at the South Kensington Museum of Science and Art, since the Natural History Museum, with which they are connected and whose specimens they are supposed to illustrate, is still without that much-needed addition. Such a convenience is more needed at this museum than at most, for, as is well known, no specimens can be removed from its walls for the illustration of any lectures or demonstrations whatever. What a contrast is, say, the Hamburg Museum, which has an excellently constructed theatre, in which courses of lectures on all manner of scientific subjects are given right through the winter months! The curators of this museum take their share in lecturing, and endeavour to co-operate with the various educational institutions and learned bodies of the town. Can anyone suppose that the museum loses by this?

With us, however, the vast treasures of a national institution remain a closed book to those who support them, while the authorities of many of our local museums recognise their educational duties and, by free lectures, instruct the public in their own property. At Manchester, for instance, lectures commence on October 24 with the geological history of the district round Manchester, by Professor Boyd Dawkins, and are continued by Professor Hickson, November 14, on the inhabitants of the seas; by Professor Weiss, January 16, on economic botany; by Dr. Burghardt, February 6, on soils, their nature and origin, and by Mr. Hoyle, Boxing Day, Easter and Whit Mondays, on birds.

FRUITS OF TRAVEL.

THE results of the travels of Dr. Forsyth Major and Mr. Alphonse Robert, during the past twenty-two months in Madagascar, have been most interesting and important from a zoological point of view. The districts traversed were Imerina, Betsileo and Tanala. Work in the swamps can only be done at most for three months in the year, so it was not possible to do much systematic digging. The travellers were, however, rewarded by a fine series of *Æpyornis* remains, which comprised all the important parts of the skeleton and several skulls,

ERRATUM on p. 226 of this number:—

for "another species of this genus," *read* "another species of *Phororhacos* to that figured in NATURAL SCIENCE, vol. viii., p. 296."

besides some remarkable remains of extinct Mammalia, the descriptions of which will, we hope, be made public immediately. No less than twenty new forms of Rodentia and Insectivora were secured, one of the most singular being a web-footed form of the family Centetidæ. Small collections of land Invertebrata were made, and a large series of plants, which latter includes several new orchids.

The collections made during the Conway Expedition to Spitzbergen have also arrived in London. These include a fairly complete series illustrating the natural history of the island. Mr. Battye obtained skins of most of the species of birds found on the island. Mr. E. J. Garwood and Dr. Gregory, who worked together on the geology, obtained collections from all the known fossiliferous horizons ranging from the Devonian to the Pleistocene. The latter also brought back a collection of plants from the interior, and a general zoological collection. For further remarks on this subject we refer our readers to Dr. Gregory's article in this number on the "Arctic Work of 1896."

Extinct Birds.

The collections of Dr. Forsyth Major above referred to have thrown considerable light on the structure of the skeleton of *Æpyornis*, the extinct struthious bird of Madagascar, long known only from a few leg-bones and vertebræ. In a paper, descriptive of the new specimens, lately published in the *Ibis* (July 1896), Mr. C. W. Andrews has figured the skull, sternum, and shoulder-girdle for the first time. The skull seems in many respects to resemble that of some of the Dinornithidæ, though it is much less depressed; one very interesting point is the presence on the frontals of numerous deep pits which seem to indicate that in the living bird the head was ornamented with a crest of large feathers. The sternum is a very remarkable structure, being extremely broad in proportion to its length; it is said to resemble most nearly that of *Apteryx*, but to have undergone still further reduction. In the shoulder girdle, the coracoid and scapula form a very open angle with one another and are co-ossified as in the other Ratitæ. In this portion of the skeleton *Æpyornis* appears to approach the cassowary, with which, moreover, numerous other points of resemblance have been pointed out by Milne Edwards and Grandidier. The author also describes some small bones which he regards as humeri; if this determination is correct, the wing would appear to have undergone a somewhat greater reduction in proportion to the size of the bird than in the cassowary. The numerous points of similarity between the Æpyornithidæ, Casuariidæ, and Dinornithidæ are of much interest from the point of view of geographical distribution, but whether they necessarily indicate a former southern land connection between the areas inhabited by these birds, or can be explained as the result of descent from a common ancestor in the northern hemisphere, is a question on which widely divergent views are held.

In *Novitates Zoologicæ* for March, in a paper on *Diaphorapteryx Hawkinsi*, the extinct flightless rail of the Chatham Islands, Andrews has touched upon the question of a southern land connection between the New Zealand and Mascarene areas. It will be remembered that Forbes attached great importance to the occurrence of *Aphanapteryx*-like rails in these two widely separated regions, but it appears that this phenomenon may be accounted for by supposing that they have originated independently in the two groups of islands from rails which gradually lost their power of flight as a direct result of their insular habitat; or in other words these flightless rails "are of no value in determining former geographical conditions, since they are themselves the outcome of the present one."

In a recent paper (*Annales des Sciences Naturelles* (Zoologie), ser. viii., tom. ii., 1896, p. 117) on the extinct birds of the Chatham Islands, Milne Edwards arrives at different conclusions, and is strongly in favour of a southern land-connection, adducing in support of his opinion the similarity between the Ratitæ of the several regions. He, however, asserts that these Ratitæ have probably originated from flightless rails of a type represented in recent times by *Ocydromus*, *Aphanapteryx*, *Diaphorapteryx*, etc. But if this is the case, there seems to be no reason why these ratite birds, like the flightless rails, may not have arisen quite independently in the several regions, their similarity likewise merely resulting from the possession of similar ancestors and from parallelism of development.

A photographic figure of a nearly complete articulated skeleton of *Diaphorapteryx Hawkinsi* was published in the *Geological Magazine* for August, 1896, and though too small to be of any value in matters of detail, it gives a very fair idea of the general proportions and appearance of this remarkable rail. A restoration of a huge skull of another species of this genus, by Mr. W. Barlow, was exhibited at the meeting of the British Association.

A Reconstructed Moa Skeleton.

The Annual Report on the Museum of the Royal College of Surgeons of England contains a rather strange flourish about a "magnificent specimen of the gigantic extinct bird the Moa (*Dinornis maximus*), from the South Island, New Zealand," recently purchased through the kind services of "Mr. Hutton, of Canterbury, N.Z." "The bones did not," says the Report rather disappointingly, "belong to one bird, but they have all been carefully matched as regards size, and the few not present have been supplied by accurate casts made from real bones. This skeleton," continues the Report, resuming its triumphant tone, "is especially interesting as possessing both coraco-scapulars and both big toes [? hind toes]: neither of these are present in the specimen displayed in the British Museum."

Captain F. W. Hutton, of Christchurch—if he be the Mr. Hutton intended—has such an intimate knowledge of the *Dinornis* skeleton, and is himself so stern a rejector of "faked up" specimens, that we are quite sure the restoration in question is an accurate one, as admirably adapted to the needs of the science student as to those of the British public. But there is nothing so "noticeable" or "especially interesting" in the fact that a restoration is a complete one; the British Museum, probably, is quite as rich in coraco-scapulas and hind toes of Moas as even the Museum at Canterbury College, Christchurch, and, even without plaster's artful aid, could produce restorations of more than one species, the scientific value of which would diminish in proportion as their popular attractiveness increased.

We deprecate the idea, unconsciously suggested in the paragraph from which we have quoted, that there is any rivalry between two such institutions as the Museum in Lincoln's Inn Fields and that in Cromwell Road; but the paragraph has produced a false impression on writers for the public press, which those in possession of the facts feel it their duty to correct. No great harm, however, would be done, if the labels attached to such exhibits always stated, as clearly as does the Report, how these specimens had been composed. This, we fear, is not always the case, even at the British Museum. Still, here is a chance for the Geological Department to go one better: why should not Dr. Henry Woodward, with the capable assistance of Mr. C. W. Andrews, Mr. W. Barlow, and Mr. Pickhardt, reconstruct a *Dinornis maximus*, not as a naked skeleton, but in his habit as he lived? So many remains of the integument and feathers of these huge birds are now known, that the restoration not only is possible, but might actually be probable.

Sponges.

One of the most recent additions to the exhibited collections of the British Museum (Nat. Hist.) is a case in the "Index Museum," containing a series of specimens, diagrams, and labels, illustrating the nature of sponges. The object of the series is to set forth the simpler features of sponge structure, such as the fact that sponges are animals in which currents of water enter and leave the body, after traversing a more or less complicated system of canals, and that this body is supported by a skeleton. The sponge is regarded as an organism with two layers, viz., (1) the collar cells, lining part of the canal system, and (2) the "derm," forming the bulk of the sponge body, and including the metabolic, skeletal, and reproductive elements. The epithelium which covers the outer surface, and which lines the canal surfaces not clothed with collar cells, is considered to be merely a layer of modified derm cells, and not a special ectoderm layer. At the same time, it is suggested that the flat epithelial cells lining the "out-current" canals may, in some sponges, be altered collar cells. Fortunately, not much space is devoted to these controversial questions, which, after all, from the point of view of the exhibited series, are only of academic interest.

The series begins with a definition of sponges. Then follows the description of a simple Ascon sponge belonging to the "Olynthus" type, *i.e.*, consisting of a simple thin-walled sac, opening at the top by the ascule, and with the thin wall perforated by pores. Five tiny specimens resembling little tags of white thread are exhibited, and by the side of them explanatory water-colour drawings. Next follows a short account of the canal systems, which, after the scheme of Vosmaer, are grouped under four types, ascending from the simplest to the next highly evolved.

A series explanatory of the classification, which is based on the nature of the skeleton, follows. The group is divided into two classes, Calcarea and Silicea; the Silicea are divided into two sub-classes, Hexactinellida and Demospongiæ; and the latter sub-class is divided into four orders, Tetractinellida, Carnosa, Monaxonida, and Keratosa. The various divisions are illustrated by typical specimens and diagrams.

The results of Professor Dendy have chiefly been drawn upon for describing the Calcarea, those of Professor F. E. Schulze for the Hexactinellida and Keratosa, and those of Professor Sollas for the Tetractinellida. The illustrations of the Monaxonida are mainly original. Comparatively full descriptions have been given of the Venus' Flower-basket, the Glass-Rope Sponge, the Crumb-of-Bread Sponge, and the Fine and Common Bath Sponges. A very interesting column is devoted to the Freshwater and Boring Sponges.

Evidently the greatest care has been taken to render the labels concise, and, at the same time intelligible. To this end several changes are introduced into the nomenclature: for instance, "whip-chambers" (Geissel-kammern) for "flagellated chambers"; "in-current" and "out-current" for inhalant, exhalant, excurrent; "derm" for the confusing expressions ecto-meso- or meso-ecto-derm. The design of the whole series, and the manner of mounting and arranging the specimens is very satisfactory, and the result does credit to Mr. R. Kirkpatrick.

Anders Retzius.

On October 13 the centenary of the birth of the zoologist and anthropologist, Anders Retzius, is to be celebrated in Stockholm, and his son, Professor Gustaf Retzius, hopes, by that time, to have completed the great work on the human brain, that has occupied his energies for the last nine years.

The Retzius family has had among its members so many naturalists of eminence, that, to prevent confusion, we may recall some of the work done by this particular Anders Retzius, who is not to be confused with his father, Anders Johan, or with Anders Adolf. He published, for the most part in Swedish, several minor studies in comparative anatomy, confining himself chiefly, though not entirely, to the Vertebrata. Among these were the important "Microscopical Researches on the Teeth," published in the *Handlingar* of the Swedish Academy for 1836. His main work, however, was done in craniology, where his writings, if not very numerous, were most suggestive. Thus, it is to him that we owe the terms brachycephaly and dolichocephaly, and the formulation of the cranial index. It is interesting to note that precisely fifty years have elapsed since the British Association published his paper "On the ethnographical distribution of round and elongated crania," and it was, therefore, appropriate that this jubilee, as well as the centenary, should have been celebrated at Liverpool by the Anthropological Section of the Association, on September 18, as well as pleasing that the genial Professor Retzius of to-day should have been present to receive the congratulations.

Librarians on Dewey.

The Library Association of the United Kingdom met at Buxton during the first week of September and, among other things, discussed the Dewey decimal classification. Our correspondent writes: "It was very noticeable that everyone who had tried the system was in favour of it. The criticisms of the opponents either were directed against all schemes of classification, and not against Dewey in particular, or else showed entire misconception of the principles and practice of Dewey. We had the time-honoured objections that certain books belong to two classes; that the press-marks became too long, etc., etc., as well as the confusion between classification on the shelves and classification in the catalogue. However, there were a large number present who had tried the system and spoke warmly of it from long personal experience; and this, after all, is the main thing."

The Flora of the Alps.

The recent issue of the Linnean Society's *Transactions* (vol. v., pp. 119–227) contains a valuable contribution to plant-geography in general and alpine botany in particular. In a lecture at the Royal Geographical Society in 1879, on the origin of the flora of the European Alps, the late John Ball told how a passion for mountain scenery had led him from youth onwards to pass much of his time in the Alps, and to visit, among other mountain districts, the Carpathians, the Pyrenees, the mountains of Southern Spain, and the hills of our own islands. "It was impossible to collect the plants of all these districts without being struck at once by the resemblances and the contrasts presented by their respective floras, and without being led to endeavour to account for them." Selecting the southern side of the main chain of the Alps as having the richest and most varied flora, he divided it into fifty districts, and set himself to collect materials from published works and herbaria, but chiefly from his own repeated visits. For nearly thirty years he worked at the collection and tabulation of the plants of these fifty districts, and their distribution on other European mountains. Unfortunately, at his death, in 1889, the work was still incomplete, and for his conclusions from all this mass of material, we are entirely dependent on his lecture at the Geographical Society of ten years before. Mr. Thistleton Dyer undertook the editing of the table, which occupies one hundred pages of the Linnean Society's *Transactions*, and will be a valuable basis for further work. Without doubt, facts of the highest interest lie buried in its columns, but it will need a skilled botanist, and one who has studied Alpine floras well, to bring them to light. If the entries are treated as mere symbols, misleading or false conclusions will arise. In working in this way with all the plants of a flora, critical and doubtful species will, unless great care be taken, exercise an important influence on statistical results. A safer and simpler method of studying the relations of the local floras of large areas is the one recommended by Mr. C. B. Clarke in an address to the Linnean Society, to which we referred in NATURAL SCIENCE (vol. viii., p. 366, June, 1896). It is the selection of a limited number of common and unmistakeable plants, and a careful elaboration of their distribution and habitat.

According to Mr. Ball the Alps, as a whole, contain 2,010 species of flowering plants, representing 523 genera and 96 natural orders. Compared with the floras of other regions, a large proportion of the species, more than two-fifths, are found in all parts of temperate Europe, the majority extending to Siberia, and many even to North America. "These are clearly plants that have a considerable power of adapting themselves to varied physical conditions, and whose vigorous organisation has made them victorious in the struggle for existence." Of these, however, not one in twelve (actually only 65 in 792) can be reckoned as plants of the higher mountain region; most of them are common enough in the lower zone, but grow equally well in the woods and heaths and waste grounds of Middle Europe. Subtracting also some Mediterranean stragglers, we have a special Alpine flora of about 1,150 species. Of these "more than one-seventh are endemic, rather more than half are common to the Alps and the Pyrenees, just two-thirds are common to the Alps and Carpathians, while rather more than one-sixth are common to the Alps and the north of Europe and Asia." Compared with other mountain regions not immediately adjoining, the closest affinity is found to be with the mountains of Northern Asia, notwithstanding the vast interval of space and the great difference in climate. Of every twelve Alpine species, three are to be found in the Altai, but only two in the Caucasus, a mountain mass with a rich flora and a much more favourable climate. Finally, a comparison between the Alpine and Arctic floras shows that only 17 per cent. of the species of the former are found in the latter, in strong contrast to the 25 per cent. which are common to the Alps and the mountains of Northern Asia. The conclusion to which Mr. Ball was therefore inclined, is that the Alpine flora owes but little to a migration from the North. "What," he says, "should we have to say of the remaining 83 per cent., including at least four generic types peculiar to the Alps, and a very large number not found in the Arctic regions?" "Is it credible that in the short interval since the close of the Glacial period, hundreds of very distinct species and several genera have been developed in the Alps, and—what is no less hard to conceive—that several of these non-Arctic species should still more recently have been distributed, at wide intervals, throughout a discontinuous mountain chain some 1,500 miles in length, from the Pyrenees to the Eastern Carpathians?" Many of these non-Arctic types are, moreover, represented in the mountains of distant regions, not by the same but by allied species, which must have had a common ancestor. *Wulfenia*, for instance, has one species in the Alps, another in Northern Syria, while a third allied species has its home in the Himalaya.

The origin of the flora of the European Alps remains an unsolved problem; but towards its solution Mr. Ball's table will, in the right hands, afford considerable help.

Clover Hay.

In commenting on our note of last July (p. 11), "A Danger of Clover," a correspondent of *Farm and Home*, who signs himself "Pateley Bridge," remarks:—"Trifolium hay is not a common article in this country, but when it is made into hay, it is generally owing to a larger area having been sown than is required for green meat, and is usually allowed to stand until no longer fit for this purpose. This makes it pretty old before it is cut for conversion into hay. I have never met with a case of calculi, or, indeed, any worse intestinal trouble than colic, resulting from the excessive consumption of old trifolium in the shape of green meat, and I cannot understand how any accumulation of the hairs can cause 'peritonitis,' as stated in the report; but if the minute hairs which invest the glume of the oat, and which are especially abundant in poor, thin samples, can, when felted together and combined with a portion of earthy matter and inspissated mucus, form large tuberculated concretions, it does not seem unreasonable that the hairs from the calyx of trifolium should be capable of producing similar mischief."

The Iceland Earthquake.

News of a severe earthquake which occurred in Iceland, on August 26 and 27, has been brought by the steamers "Laura" and "Quiraing." The shocks extended over an area of forty miles in the south of the island, and destroyed many farms and two churches, besides killing a number of sheep and cattle. A slight shock was also felt on September 2. The hot springs in the neighbourhood have assumed the form of small geysers, and the phenomenon is regarded as due to an approaching eruption of Mount Hecla.

Scorpions.

Professor Malcolm Laurie has been examining numerous scorpions with a view to determining the classificatory value of the anatomy and development. His results, published in the August number of the *Annals and Magazine of Natural History*, lead him to be "more than ever convinced of the great value of the mode of development as a basis for classification," and he considers "the structure of the lung-book lamellæ of subordinate but considerable value."

There are two chief types of development among scorpions which Laurie describes as apoikogenic and katoikogenic. The first (ἄποικος, away from home) type, is as a rule abundantly supplied with food-yolk, the egg early leaves the follicle in which it is formed and passes into the cavity of the ovarian tube; the second type (κατοικος, at home), so far as observation has yet gone, is devoid of any appreciable amount of food yolk, while the egg develops *in situ*, and the embryo as it becomes too large for the follicle, extends down and occupies a diverticulum from the ovarian tube, at the distal end of which the egg is originally formed. The author's investigations lead him to believe that the apoikogenic type of development is the most primitive. It is only one step from the laying of the eggs, which is almost the universal custom among the Arthropoda. With regard to the structure of the lung-books, Professor Laurie is inclined to consider the "spinous" type as the original. It is interesting to note that his classification coincides very closely with that proposed by Pocock, which was based on external structures.

Lepidosiren.

Dr. Günther prints in *Nature* (July 23) a letter from Dr. Goeldi, of the Para Museum, announcing the discovery of *Lepidosiren* at the mouth of the River Amazons. The exact locality of the specimen is Fazenda 'Dunas,' on Cape Magoary, Island of Marajó, and it is the third that has been seen in that locality. A brief examination of the specimen led Dr. Goeldi to agree with Dr. Günther and Professor Lankester in considering that there is only one species of the fish, and that *L. dissimilis*, *L. gigliona*, and *L. articulata* are merely synonyms of *L. paradoxa*. Although there are six Amazonian specimens in European museums, this additional discovery is of much interest and importance.

I.

The Arctic Work of 1896.

THE year 1896 will long be memorable in Arctic annals. It opened sadly, hopes for a vigorous effort to explore the Antarctic Continent having been damped by the inability of the British Admiralty to help in the work; and although we have heard of many expeditions, British, Belgium, and German, which were preparing, not one of them has yet started. The disappointment thus occasioned has, however, been completely effaced by the rejoicings over the return of Dr. Nansen and his colleagues of the "Fram."

The story of Nansen's daring march is well known from his graphic narrative published by the *Daily Chronicle* (August 17 and 19), from which, in the main, the following outline has been compiled.

Nansen left Europe in 1893 in order to reach the Pole by floating with the ice-pack from the north of Siberia to the Greenland Sea. It was well known that off the Arctic coast of eastern Siberia the water drifts northward; also that currents flow southward from the Pole down each side of Greenland and along the eastern coast of Spitzbergen. Nansen thought it probable that these movements were all part of one great current, which flowed right across the Pole. Support was given to this idea by two considerations: firstly, the marine fauna of the Greenland coasts is remarkably similar to that of Siberia; secondly, in 1881 the steamer "Jeannette" (better known by its old name of the "Pandora") was crushed by ice to the north-west of the New Siberia Islands (155° E. 77° 15′ N.), and some years later various articles, supposed to be relics of the "Jeannette," were found off Cape Farewell, at the southern end of Greenland. Accepting these two arguments as rendering the existence of the Polar Current most probable, Nansen proposed to get frozen into the pack near the point where the "Jeannette" was nipped, and then float along the same course into the Greenland Sea. The "Fram" was accordingly designed with especial reference to capability of withstanding ice-pressure, and supplied with stores for six years. Nansen left Norway early in 1893, and the last news from him was sent from Jugor Strait, the south-western entrance to the Kara Sea, in August of the same year. It had been arranged that he should pick up a further supply of dogs from the Olonek River, but owing to some delays in rounding Cape Chelyuskin, it was not till September 15 that the

"Fram" reached the estuary of the river. It was then too late to risk an approach to the land, so the ship's head was turned north-eastward for the New Siberia Islands, which were passed on September 18. Here the pack ice compelled the course to be changed to the north-west, and thus the "Fram" was finally frozen into the ice-pack in 78° 50′ N., 133° 37′ E., or about 20° too much to the west.

Thence the expedition floated to the north-west, although the course was apparently irregular, changing with the winds. Up till the point where the "Fram" was beset by the floes, the depth of the sea was only 90 fathoms; but north of this it deepened rapidly, and the depth varied from 1,600 to 2,200 fathoms, until the "Fram" approached shallower water north of Spitzbergen.

All through the winter of 1893 and the spring of 1894 the resultant course of the "Fram" was north-westward; in the summer, the direction was reversed, as the prevailing winds, following the ordinary Arctic rule, were from the north. In the winter of 1894–5 the "Fram" again went northward, crossing the highest previous record of 83° 24′ (attained by Lockwood during the Greely Expedition) on Christmas Eve. In the following month she ran her greatest risk from ice-pressure. She had been designed so that if the lateral ice-pressure exceeded a certain amount the ship should be squeezed upward out of the ice; Mr. Colin Archer's calculations were found to be reliable, and the ship rose above the ice as her skilled designer had expected. On March 3, 1895, the latitude of 84° 4′ was reached, and the "Fram" again drifted southward. Expecting that this would be the highest latitude reached, Nansen and one companion, Lieutenant Johansen, left the ship on a sledging expedition toward the Pole. They took three sledges, two kayaks (Eskimo canoes), twenty-eight dogs, and provisions for themselves for one hundred days. The two explorers started on March 14 from 83° 59′ N. and 102° 27′ E. The ice was almost stationary, and good progress was made to the north. In eight days they advanced 1° 11′ northward; after this, progress was slower, as the ice moved southward—the average up till April 4 being a little over three miles a day. Three days later at latitude 86° 14′, after only another eleven miles had been gained, it was deemed advisable to return. The explorers, however, had travelled 2° 15′ northward in three weeks. On April 8 the return journey toward Franz Josef Land was commenced. On June 4, at latitude 82° 18′ N., the ice began to drift northward, and by June 15 they had been carried 8° further north. A week later they found the first sign of proximity to land, as they shot a seal (*Phoca barbata*), and afterwards at the same place got three bears. As the snow was in bad condition and they now had plenty of food Nansen stayed there for a month. They started again on July 22, and two days later sighted land; this, however, they could not reach until August 6. On August 12 they came to the first large island of the Franz Josef Archipelago, and on August 26 went into winter quarters. They lived in Eskimo fashion, in a hut of skins, stones, snow, and earth; used blubber for fuel, and fed on blubber and bear meat. On May 19, 1896, they started for Spitzbergen, keeping south-west down a broad, frozen sound, to the open water and small islands to the south of the archipelago. On June 16 they thought they heard dogs barking, and next day heard a shot fired. Johansen stayed with the kayaks while Nansen went off in search and found Jackson's party in their winter quarters: the Norwegian explorers subsequently returned with the "Windward" to Vardö.

While Nansen and Johansen were making this daring march, the "Fram" had again turned northward, and, slowly drifting, reached the latitude of 85° 57′. This was the furthest point north at which an observation was possible, for clouds prevented the exact distance further from being determined, though it has been estimated on the "Fram" at as much as 30′ north of the 85° 57′ point. The ship then drifted to the south-west until, in February, 1896, it reached a point 84° 9′ N., 15° E.; there it remained stationary until released by the break-up of the pack in July. After that the vessel steamed southward through the leads, until she reached open water to the north of Spitzbergen on August 12.

It is as yet too early to attempt to discuss the value of the fresh information brought back by the "Fram" expedition; we may, however, briefly refer to the chief results. In the first place, there is no doubt now that the area round the North Pole is a deep ocean basin. In a remarkable lecture delivered to the Geographical Society in 1894, Professor Lapworth predicted, from geological considerations, that this would be found to be the case. As the orthodox view represented the Arctic Ocean as a shallow-water area studded with islands and archipelagoes, the correction of this error is of great importance in geography, meteorology, and geology. The depths proved by the "Fram" show that the great depression west of Spitzbergen is not a basin surrounded by shallow sea, but is widely open to the north, where it spreads over the polar area. The depth of this ocean renders it improbable that many islands will be found in it. It has been confidently asserted that there must be land to the north of Spitzbergen, as birds are seen flying northward from it. The voyage of the "Fram" has, however, shown that there is no land in the position expected, and once again we are taught that birds make mistakes as well as other animals. Another bogey from which Nansen has relieved us is that the whole of the central Arctic Sea is full of ice of immense thickness and great age. He found that, except for local heaps and hummocks, it is only about thirty feet thick, and thus the great "palæocrystic ice" and floe-bergs of north-western Greenland are proved to be exceptional. After this discovery, geology will no longer be burdened with the incubus of a recent Polar ice-cap. Another interesting geological contribution is Nansen's collection of Jurassic fossils in northern Franz Josef Land.

In regard to the Trans-Polar Current, it seems very doubtful whether Dr. Nansen's theory be true. At first sight, when we compare the projected and actual routes of the "Fram," and allow for the fact that the vessel was frozen in further west than was intended, their agreement seems clear proof of Nansen's theory. When we enquire more closely, however, the results of Nansen's voyage appear as fatal to the existence of the supposed current as they are to the explanation offered by some English geographers of the facts from which Nansen argued. The idea that a steady current flows across the Pole from north-western Siberia receives little support: the "Fram" drifted in accordance with the prevailing winds; when the wind reversed its direction the "Fram" floated backward. It was the winds and not an ocean current that carried it on its course.

It is, no doubt, true, that ocean currents are due to the wind, and that, if the prevailing winds blow from the New Siberia Islands to the Pole, and thence southward into the North Atlantic, there will be a drift of water in the same direction. But this in an open ocean such as the Arctic, would simply mean a superficial, variable drift, and not a true ocean current.

It is important to notice that the "Fram" floated northward in the winter and spring, and southward in the summer: this is exactly the opposite of what many of Dr. Nansen's critics predicted. They explained the northward drift of the ice off the Siberian coast as due to its being forced back by the discharge of the great rivers; in that case the northward movement ought to have been at its greatest in the early summer, and to have stopped in the winter.

In spite of the poverty of the Arctic sea, and Nansen's short journey on land, naturalists will await with impatience the detailed account of the results of his expedition. These will, no doubt, be found to repay the magnificent patience and courage of Dr. Nansen and his colleagues. His march with Johansen must certainly be reckoned as one of the most daring feats in the annals of Arctic travel; but its courage was far exceeded by the reckless hardihood with which, instead of returning to the "Fram" (as the explorers could, no doubt, have done, had they arranged to do so), they set off for Spitzbergen, a journey of ten times the length. Such a feat was only possible to men skilful with kayak and ski, who knew how to live on the feeble resources of an Arctic island. For daring and neatness of execution, the Nansen Expedition is probably unrivalled in Arctic history, while, to find a parallel for the extent of new area traversed and richness in results, we have to go back to the days of Franklin and Parry.

While the voyage of the "Fram" has been collecting the materials for a final solution of the "Trans-Polar Current" question, great doubt has been thrown on the most striking piece of evidence which suggested it. The resemblances between the fauna of the Greenland and Spitzbergen seas do not count for much, as the whole circum-polar fauna is remarkably uniform. The argument from the

"Jeannette" relics was more weighty. It is true that these may be genuine without proving the truth of Nansen's theory; for the Norwegian ice-pilots claim that the relics must have drifted westward, parallel to the Siberian coast, and been carried by the Polar Current, round the southern end of Spitzbergen, into the Atlantic, and thence across to Greenland. There are many facts which show that this route is possible. But the alternative routes are now of little importance, as Dr. W. H. Dall[1] has adduced weighty reasons for the conclusion that the supposed discovery of the "Jeannette" relics was a hoax; these relics have played such an important part in recent Arctic discussions, that his paper must rank as not one of the least important contributions to the Arctic work of the year.

Nansen's return with the "Windward" has directed prominent attention to the work of the Jackson-Harmsworth Expedition in Franz Josef Land, whose geographical task has been considerably restricted by Nansen's revelation of the area to the north. So far as a possible approach to the Pole is concerned, Jackson is handicapped by the nature of his base of departure. The country was chosen on the idea that it offered the only line of approach which had not been proved impossible. Nansen now tells us that he regards it as a good place in which to come out of the Polar pack, but as one of the worst places from which to enter it. It seems therefore doubtful whether the members of the expedition are likely to beat their record of 1895, which this year they were unable to equal. But this limitation of their sphere of operations does not in any way mean that the expedition will not be successful. The opportunities for a full year's meteorological record north of 75° occur very seldom: now, thanks to the generosity of Mr. Harmsworth, there will be available a complete three or more years' two-hourly record for a locality at 80°. Such a contribution to science is of inestimable value.

The two previous maps of Franz Josef Land, those of Payer and Leigh Smith, are necessarily very incomplete. During Payer's daring sledge excursion in June, 1874, by which the islands were first reached, the opportunities for mapping were very limited. Hence, it is not surprising that there are many alterations to be made in those portions of Payer's map which were inserted on the strength of occasional distant views in bad weather. Payer's reputation as a scientific geographer is well established; and when Jackson's map appears and we are able to compare it with Payer's hasty sketch, we shall probably feel regret for the Austrian traveller's limited opportunities, and respect for his courage, rather than surprise at his errors. Fortunately, we may now expect from Mr. Jackson a detailed map of the archipelago, and from his colleagues, Messrs. Fisher and Child, a reliable account of its geology, botany, and zoology. A complete monograph on Franz Josef Land will well repay Mr. Harmsworth's

[1] "On the supposed 'Jeannette' relics." *Nat. Geogr. Journal*, vol. vii., pp. 93–98.

munificent generosity, and the persevering and courageous efforts of Mr. Jackson and his colleagues.

The easiness of access of the western coast of Spitzbergen has rendered that island one of the best frequented of Arctic lands. An old prophecy of Reclus' has this year been fulfilled by the erection of a tourist hotel on the shores of Ice Fjord. Five excursions will be made there every summer, so that in future this will be a convenient base for explorations. Up to the present year very little work had been done in the interior. Baron Nordenskiöld and Palander traversed the inland ice of North East Land in June, 1873; the late Gustaf Nordenskiöld marched from Horn Sound northward to Bel Sound in 1892, and in the same year Mr. C. Rabot made a short excursion inland from the extreme head of Ice Fjord. Otherwise, explorations have been limited to a day's march from the coast. Sir Martin Conway, therefore, organised an expedition in order to cross Spitzbergen and work out the topography, geology, and natural history of a zone across it. The expedition landed in Advent Bay on June 19, and spent two months in exploration. During this time Conway crossed to the east coast at Agardh Bay, making a careful map of the route, while his companions, Mr. E. J. Garwood and the writer, studied its geology and natural history. Meanwhile, Mr. Trevor-Battye and Mr. H. E. Conway worked in Ice Fjord and Dickson Bay.

Subsequently the whole expedition, in a small iron steamer, the "Expres," visited the Seven Islands, and went down Hinlopen Strait to the broad Olga Strait. It was hoped thence to work through Hell Sound, or Walter Thymen Strait, into Stor Fjord. If that could have been done Spitzbergen could have been circumnavigated; but the two straits were choked with fast ice, and the steamer was driven eastward, almost to Prince Charles' Islands. The ice here, also, was impenetrable, and the steamer had to return through Hinlopen Strait, and thence back to Advent Bay by the west coast. Subsequently, Mr. Trevor-Battye and Mr. Garwood ascended Hornsund Tind, the highest peak in Spitzbergen, and returned to Norway in the "Expres."

The Conway Expedition, though much shorter than any of the others, covered a good deal of ground, and has returned with much fresh information and large collections from the hitherto unknown interior of one of the most instructive of Arctic islands. While Sir Martin Conway was mapping the interior of Spitzbergen, Baron de Geer and Lieutenant Knorring were engaged in a detailed trigonometrical survey of Ice Fjord, and a study of the snouts of the glaciers that flow into it.

Considerable attention was attracted to Spitzbergen this year, as it was made the scene of a very novel effort in Arctic exploration. Unfortunately, some delays in preparation and the unfavourable conditions of weather have kept back Andrée's contributions to Arctic results till next year. His balloon was not ready till late in July; and to have started after the end of that month would have greatly increased risks already enormous. Andrée has, however, shown that it is possible to fill a balloon in the north of Spitzbergen, and to keep it inflated for several weeks. Both of these feats were declared to be impossible by some of Andrée's critics, though it is gratifying to remember that the English military aëronaut, Colonel Watson, ridiculed these fears.

Andrée's return has subjected him to a certain amount of hostile criticism; but it is impossible to talk to him without feeling that he is an enthusiast and thoroughly in earnest. Pike's Bay, where he erected his gasworks and balloon-shed, is generally accessible in a wooden vessel in May, or even in April. South winds very rarely occur in Spitzbergen after July 24–25, though they are not unusual in the end of June and the beginning of July. If, therefore, Andreé can next year reach his starting point much earlier, and be ready to start by the end of June; and if he can then keep his balloon afloat for three weeks, the chances are that he will travel a long way toward the Pole, and then be carried southward. If he reach the 70° parallel, the chances are nine to one that he will be able to descend on land. Daring, therefore, though this balloon adventure be, it does not seem quite such an act of idiotic and wilful suicide as many of Andrée's critics declare.

J. W. Gregory.

II.

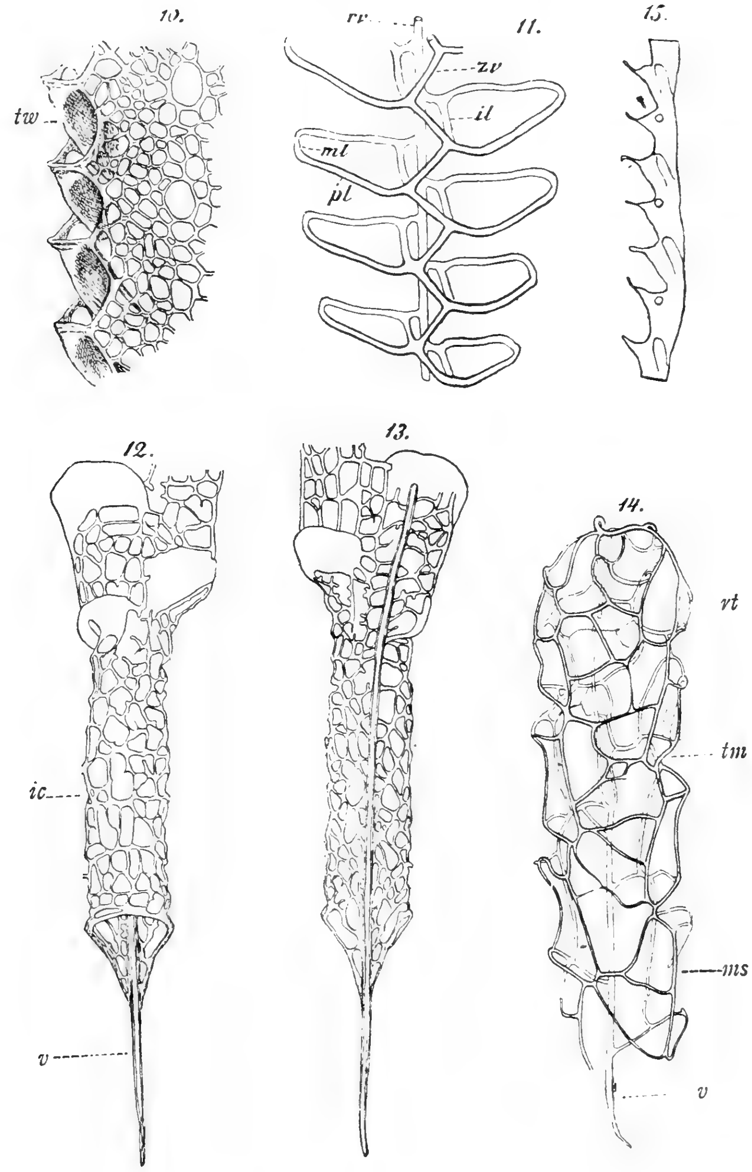
The Structure of the Graptolites.

II.—Retioloidea.

THIS group is not yet well enough known for us to establish a definite plan of structure, supposing such to have existed. In any case, the group seems rather isolated from the rest of the graptolites, as well as considerably more heterogeneous than the other groups. Consequently a general account could not be given in a small compass, but would involve detailed abstracts of several papers, especially of those by Tullberg, Törnquist, Holm, and myself, together with the reproduction of many figures. I therefore only reproduce some figures from Holm (Figs. 10 and 11) and myself (Figs. 12–14).

Fig. 10 shows a part of the net-work of *Stomatograptus törnquisti*, Tullb., with the large pores and remains of the interthecal walls. Similar interthecal walls have been observed by Holm in *Retiolites geinitzianus*, Barr. Fig. 11 is taken from one of Holm's drawings of the last-mentioned species, but has been simplified by the removal of the whole net-work between the main strands: *rv* is called the straight virgula; *zv* the zigzag virgula; *pl* the parietal strand separating two thecæ; *ml* the mouth strand separating the mouths of two adjoining thecæ, also called the inner cross-rod. How the proximal end was constructed, if there was anything like a sicula, and, if so, how it was constructed, cannot be gathered from the material to hand.

In the work (7) from which these figures are taken, Holm describes some fragments of a new species, which he refers temporarily to the genus *Retiolites* under the name *R. nassa*. Of this species I have succeeded in obtaining such good material that it has, perhaps, become the best known representative for the group Retioloidea (Fig. 12–14). Except for the complete strand and mesh system, and the lower theca-edges developed into a kind of lid, nothing of the periderm remains but here and there in the meshes small fragments of a membrane, which probably among other things filled the meshes. There is only one virgula, and it is straight. Morphologically it does not correspond to the virgula in the Graptoloidea. A true sicula cannot be distinguished, though there is an organ or individual corresponding to it. This initial canal, as I at present call the part from the proximal end to the first theca, is almost circular in section, with a depression where the virgula is situated. A certain regularity



STRUCTURE OF RETIOLOIDEA.

FIG. 10.—*Stomatograptus törnquisti*, part of the net-work. FIG. 11.—*Retiolites geinitzianus*, the main strands of the net-work. FIG. 12.—*Retiolites nassa*, proximal end from the anti-virgula side. FIG. 13.—The same from the virgula side. FIG. 14.—Distal end of same, showing main strands only. FIG. 15.—*Dictyonema rarum*, a portion from the side, showing nest-shaped organs. All greatly enlarged.

tw, thecal wall. *tm*, thecal mouth. *rt*, rudimentary theca. *v*, virgula. *rv*, straight virgula. *zv*, zigzag virgula. *il*, inner strand. *pl*, parietal strand. *ml*, mouth strand. *ms*, main side strand, limiting the thecal field and the anti-virgula field. *ic*, initial canal.

in the arrangement of the meshes may be traced, in the fact that on the virgula-side (Fig. 13) stouter strands bend downward and run round. These join the virgula at an acute angle. In the specimen here represented they are only five in number. The proximal one is somewhat coarser, and probably formed the mouth of the individual. In the distal region of the initial canal, on the other hand, the meshes are quite irregular. I have noticed the initial canal in only twelve specimens, although I have had several hundred at my disposal. One of these is complete, and has a length of 26 mm. A glance at Figs. 12 and 13 shows that the closeness of the meshes varies greatly. I do not believe that the different sizes of mesh correspond to different ages in the full-grown rhabdosome,[1] but consider them simply as instances of variation.

With the ceasing of the initial canal the rhabdosome begins to assume another shape. At the height of the second theca, from out the confusion of meshes there appear at the angles four main strands, which run through almost the whole rhabdosome. These main strands divide the rhabdosome into four fields, almost at right angles to one another: the virgula field, the two halves of which form an obtuse reëntrant angle; the opposite plane or anti-virgula field; and the two somewhat convex thecal fields situated on either side. At the same height as these main strands there arise in the middle of the thecal fields, by each theca-mouth, discontinuous and somewhat thinner longitudinal strands (Fig. 14). Each theca-mouth occupies the whole width of the thecal field, and is therefore bounded at the sides by the vertical main strands. Above and below the theca-mouths are bounded by two horizontal cross-strands connecting the main strands. The more meshes there are that occupy the intervals between these few strands, the broader become the lower cross-strands of the theca-mouths, till finally where the meshes are most compact they grow into crescentic plates covering more than the whole theca-mouth.

The first theca does not lie in the thecal field, which in this part of the rhabdosome hardly yet exists, but obliquely, so that its lid (Fig. 13) is attached by one corner to the virgula itself. All specimens with an initial canal, that I have seen, belong to fine-meshed individuals.

As the meshes become closer they arrange themselves somewhat differently. In the anti-virgula field they have no definite arrangement, neither can any main strands of the second order be distinguished. In the virgula field, on the contrary, they tend to arrange themselves in four longitudinal series. This, however, is not generally carried to any great extent, and one can hardly speak of any new main strands. In the thecal fields this arrangement is more evident. The strands are not hollow; not even the virgula is that.

[1] Owing to an error this word was printed "rhabdome" in the first part of this article.

At a certain distance from the proximal end the virgula leaves its former place in the periderm net and runs free within it, so as to rejoin the periderm in the middle of the distal spine. The periderm also changes. In the region of the most distal thecæ the main strands begin to be effaced again; the periderm often becomes somewhat swollen out, and again assumes a somewhat circular shape. Almost the only regularity distinguishable in this confusion of meshes is the union of the strands in the distal spine, in such a manner that it seems as though the virgula, which here meets them, branches dichotomously four times, and in that way passes into the net-work. Further, two pairs of branches of the fourth division include two triangular meshes, which lie opposite each other in the effaced thecal fields, and these triangles Holm has explained as the rudiments of the last thecæ. The interior cross-strands are not present here.

As Holm has already pointed out, as regards the arrangement of the thecæ, this species bears the same relation to *Retiolites geinitzianus* as *Climacograptus* bears to *Diplograptus*.

The material examined is from Lilla Carlsö, a small island near Gotland, and is said to come from bed *c* of Lindström, which corresponds to the Wenlock Shale.

III.—Dendroidea.

In 1890 Holm described in *Dictyonema cervicorne*, Holm, some appendages to the thecæ, shaped like birds' nests, and considered that they might possibly be gonangia. Subsequently, when I examined Dendroidea, by means of series of sections, I discovered in the periderm cavities situated just like these nest-shaped organs. In Fig. 15, which represents *Dictyonema varum*, Wiman, a little hole is to be seen near every second theca. On the opposite side there are similar little holes alternating with those on the visible side. It is these that correspond to Holm's nest-shaped organs.

We now proceed to Fig. 16, which represents selected sections from a complete series of this graptolite, and compare the different sections with Fig. 15.

In all Dendroidea one can distinguish three different kinds of individuals: *nourishing individuals*, which I also call thecæ, since they doubtless correspond to the thecæ in the Graptoloidea; these are denoted in Fig. 16 by t, t_1, t_2, etc.; *budding individuals*, which are denoted by k_1, k_2, etc.; and *sexual individuals* or *gonangia*, denoted by g, g_1, g_2, etc.

In section 1, Fig. 16, are seen three thecæ t, t_1, and the small undenoted hole to the right of t_1 between g_1 and k_1; besides these are seen two gonangia, g and g_1, and finally two budding individuals, one of which consists of the cavity in which the above-mentioned t_2, g_1 and k_1 lie, the other of k_1. In section 2 the gonangium g, which up till now has been on the left side, has pressed between t and the other individuals, and opens on the right side. In section 3, t

begins to cease. In 4, t_2 begins to grow. In 5, t_2 has further widened itself. In section 6, the budding individual k_1 has produced three new individuals, which have not yet had time to become large enough to press their own walls against those of the mother animal. The new individuals are: one unnamed theca, which ought to be denoted by t_3; one gonangium, g_2; and one budding individual, k_2. In all Dendroidea the individual is always formed in this manner.

In section 7 the new individuals t_3, k_2 and g_2 have pressed their walls against those of the mother animal, so that the whole section has become as it were a reflection of section 1. Moreover, in section 7 just as in section 1 the individuals have begun to

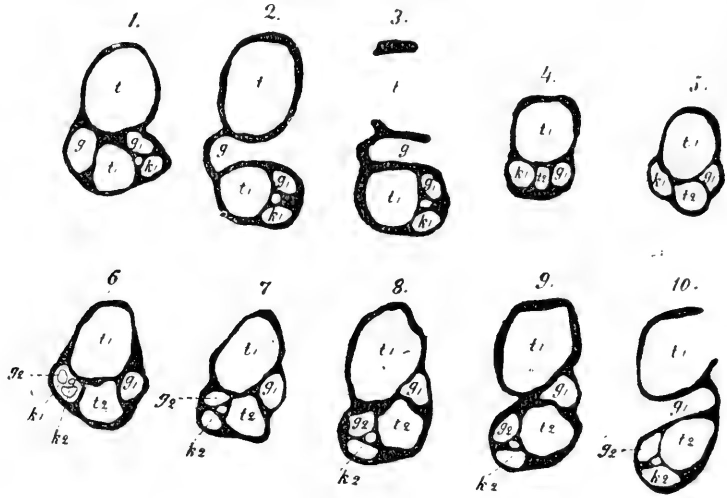


FIG. 16.—SERIES OF TRANSVERSE SECTIONS OF *Dictyonema varum*.
For explanation of lettering, see text.

be shoved apart in order to let the gonangium g_1 pass over to the left side. This separation is increased in sections 8 and 9; and finally g_1 opens in section 10, which is the reflection of section 2.

In *Dictyonema varum* the gonangium is situated on the one side, and opens directly outward on the opposite side of the branch. In *Dendrograptus* (?) *bottnicus*, Wiman, which as regards its internal structure otherwise differs little from *Dictyonema varum*, the gonangium also opens directly outward, but on the same side of the branch as that on which it is formed.

In *Dictyonema peltatum*, Wiman, the gonangium also opens on the side on which it has grown, not, however, immediately outward, but in or almost together with the theca, next to which it is situated. The same is the case in *Dendrograptus* (?) *œlandicus*, Wiman, and *Dendrograpticus* (?) *balticus*, Wiman.

In *Dictyonema peltatum* I have had an opportunity of noticing an occurrence which may be quite common in the Dendroidea, although in consequence of the nature of the material it cannot very often be observed. This was that the newly-formed budding individual, when at about the same stage as k_2 in section 6 of Fig. 16, and thus before it had become joined to the wall of the mother animal, had already formed within itself a new triple generation. A section through such a region therefore passes through no less than nine individuals.

Of *Dictyonema flabelliforme*, Eichw., I have not had altogether satisfactory material; a cross-section of this species, however, makes it highly probable that it too is built on the same plan. At all events, its branches are not as simply constructed as those of the Graptoloidea. It was naturally of interest to study how the branching took place. Fig. 17 is meant to show its origin in *Dendrograptus* (?) *œlandicus*. Section *a* is almost on the same stage as section 6 in Fig. 16. We have thecæ 1 and 2, and to the right the gonangium, which opens

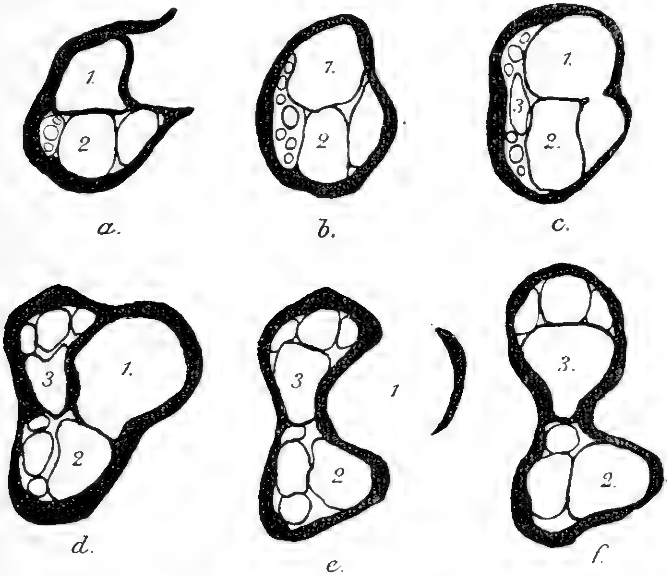


FIG. 17.—SERIES OF TRANSVERSE SECTIONS OF *Dendrograptus* (?) *œlandicus*. For explanation of lettering, see text.

in theca 1 in section *c*. To the left of theca 2 are the three new individuals, of which the larger one in the middle is a theca. Now, if the branch were not about to divide, the upper of the two other new individuals would be a gonangium; but that is not the case, for if we go to section *b*, we see that *both* the small new individuals were budding individuals, since each has produced three new individuals of ordinary shape. In section *c* these new ones assume a somewhat different size, and begin to group themselves in two divisions. In section *d* this grouping has considerably advanced. In *e* the old theca 1 is coming to an end, and in *f* the new branches are just about to separate. Of the previously existing individuals that were in the mother branch, in this genus there is in the new branches only one theca, viz., 2. I have noticed almost the same mode of branching in *Dendrograptus* (?) *balticus*, *Dendrograptus* (?) *bottnicus*, and *Dictyonema peltatum*. It seems, therefore, to be fairly common. There are, however, some variations. For instance, in *Dictyonema peltatum*, of the individuals already developed in the mother branch, an old theca passes up into the one branch, and into the other an old theca and an old gonangium.

I now proceed to the description of a dendroid graptolite o somewhat different structure, *Ptilograptus suecicus*, Wiman, Fig. 18. Here at the outset we have to distinguish between twigs and branches. The branches carry twigs springing out feather-fashion alternately to right and left, and these consist of four individuals, opening one after the other. The first opens on the back, in the angle between the branch and the twig, and therefore is not visible on Fig. 18. The second is seen opening on Fig. 18. The third again opens on the back of the twig, at about the same height as the second. The fourth is terminal. On the branches, which together give the rhabdosome a bush-like growth, no individuals open, but on the other hand they are all placed immediately on these. In Fig. 19, section *A*, are seen four individuals, *a*, *b*, *c*, and 1, which will open in connection with a left-hand branch. The individuals a_1, b_1, $\dot{c}_1$, and 2 open with the next right-hand branch. Of individuals belonging to the next left-hand branch only b_{11} is as yet ready; *d* is a budding individual, and such never open outwards.

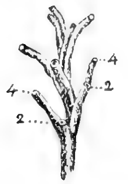


FIG. 18.—BRANCH OF *Ptilograptus suecicus*.

2 and 4, openings of second and fourth individuals in the proximal twigs of the right and left sides.

As sections *A* and *N* are the reversed images of each other, we can make the series as long as we want. Towards the proximal end we may prolong the series from *A* backwards, with the reversed images of sections *N*, *M*, *L*, etc., and towards the distal end we may prolong it from *N* onwards, with the reversed images of sections *A*, *B*, *C*, etc. If we now, to begin with, follow the series backwards to the reversed image of section *N*, we find that the individuals c_1, 2 and *d* in *A* are three young brother individuals, of which *d*, as is shown by section *F*, is a budding individual, while 2 is a theca, and c_1 is a gonangium. Frequent repetition of the same operation shows that the individuals belong together in generations in the following way. In the table I begin with the oldest generations:—

Generation.	Gonangium.	Theca.	Budding Individual.
1	—	*b*	—
2	*a*	b_1	—
3	*c*	1	—
4	a_1	b_{11}	—
5	c_1	2	*d*
6	a_{11}	b_{111}	d_1
7	c_{11}	3	d_{11}

From this table the age of each individual is at once seen. The individuals arise, as usual, in threes. Of these only two open, the gonangium and the theca. Now, since the individuals open in fours, one might expect that these four individuals would belong to two consecutive generations. That, however, is not the case, for the four individuals of each separate twig belong to three different generations, as is shown by a comparison between the above table and the following statement of the components of each twig:—

Thecæ *b* and I	Gonangia *a* and *c*	Left-hand twig.
,, b_1 ,, 2	,, a_1 ,, c_1	Right ,,
,, b_2 ,, 3	,, a_2 ,, c_2	Left ,,
,, b_3		

On each twig there are thus two thecæ and two gonangia. The gonangia are so placed that the elder always opens like *a*, the younger

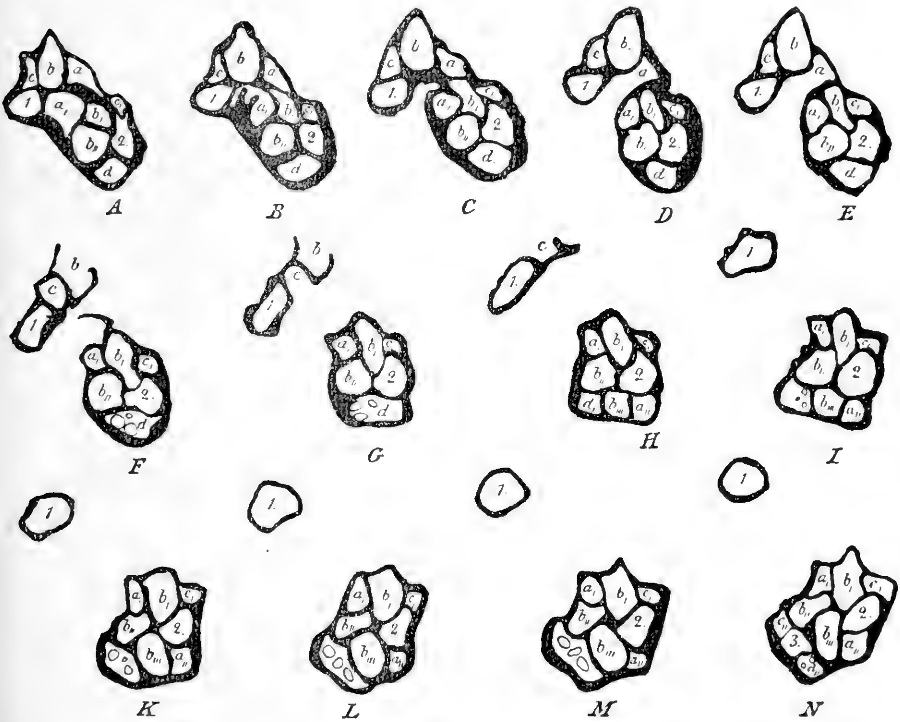


FIG. 19.—SERIES OF TRANSVERSE SECTIONS OF *Ptilograptus suecicus*.
For explanation of lettering, see text.

like *c*, and thus it is that they always come to lie on the back of the twigs. The two gonangia belong to two consecutive generations. The thecæ, on the contrary, that open in any one twig are originally separated by one or two generations. The elder theca opens like *b*, the younger like I.

The only real difference between this genus and, say, a *Dictyonema* will thus consist in the individuals here being kept together for some time, so as then to open in alternate groups, which I call twigs. As has already been shown by the note of interrogation always placed after the name *Dendrograptus*, I am uncertain to what genus the forms ought to be referred. This depends on the fact that the old generic diagnoses were drawn up at a time when the structure of the dendroids was as good as unknown; they are therefore generally of no, or at least of undecided, value, and always taken from the external characters of specimens found in slate, and usually in a bad state of preservation. The classification therefore needs a thorough revision, but the time does not seem to me yet ripe for such an undertaking, since we are not yet in a position to estimate the relative value even of characters collected from the internal structure. For instance, a classification of the Dendroidea according to the way the gonangia open might perhaps be as artificial as the old one. At all events, we had better postpone the task of classifying till more is known about the structure of the proximal end.

Thus, forms with a sicula, such as *Dictyonema flabelliforme*, and forms without a sicula, such as *Dictyonema peltatum*, are now put together, on account of the connecting fibres between the branches. I do not yet know the structure of the proximal end in more than the last-named *Dictyonema* and one still undescribed form.

In *Dictyonema peltatum* a large number of branches spread centrifugally within a disc, and then rise up at different distances from the middle of the disc, branch, anastomose, and join again by means of the ordinary connecting fibres, thus giving to the rhabdosome the ordinary funnel-shape. The proximal ends of the branches do not at all possess the intricate structure that characterises the distal parts, but in cross-section look just like a branch of *Monograptus*, except that the virgula is missing. In the region where this simple structure passes into the more complicated one, the rhabdosome was broken when cleaned out from the flint.

The other undescribed species begins with a disc, from which a stem proceeds, much as in *Odontocaulis keepingi*, Lapw. A section through the lowest part of this stem also resembles the cross-section of a *Monograptus*. There is no virgula. The periderm is very thick. The one hole is larger, and is the section of a theca that opens on the stem. The other one is small, and very soon proves to be a budding individual, in that it, some sections higher up, has produced and contains the ordinary three individuals: a theca, a budding individual, and a gonangium. Probably the course of growth is the same in each separate branch of *Dictyonema peltatum*.

There is no reason for fitting in the graptolites in any of the classes of the animal kingdom that now exist. The resemblances to *Rhabdopleura*, the bryozoans, the hydroids, and others, are only such as easily arise between colony-building animals of even a widely-separated systematic position. Even as to their approximate position in the system not much more can be said than that they are Invertebrata;

and this need not seem strange if we remember that even a recent animal of well-known anatomy may within a fairly short time be assigned to widely-separated classes of the animal kingdom.

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Upsala. CARL WIMAN.

III.

An Introduction to the Study of Anthropoid Apes.—II. The Chimpanzee.

The Chimpanzee in Europe.—However desirable, it is almost impossible to give an approximately accurate statement of the amount of material, the live animals studied in confinement, the skeletons and carcases studied in museums and dissecting rooms, upon which is based our knowledge of the chimpanzee species. There is to be found in literature the description of parts belonging to over two hundred chimpanzees, but of that great number the anatomy of only one animal has been described with an approximation to completeness, that of Gratiolet (131), and even it lacks much. Small parts of many specimens have been studied and recorded with great accuracy, and by piecing these together one may obtain a rough mental picture of the structure of the species. The partial character of our knowledge results not from lack of material, but rather from its abundance. In the Gardens of the Zoological Society of London alone, during the last fifty years, there have been about fifty chimpanzees, and that number probably only represents about one-third of the live visitors to Europe. The chimpanzee, if its health could stand it, would take very kindly to confinement, for, when young at any rate, it is of a lively, playful, and contented disposition. As a rule, it does not keep its health in confinement in Europe. Of eight chimpanzees that came to the Gardens at Rotterdam, four lived between 1-27 days, four between 100-380 days. In the Gardens at London it appears to fare better, Sally, for instance, living eight years. Although a few instances might be collected of animals that have passed from three to five years in confinement, I do not think that, on an average, one could insure the chimpanzee for a six months of life in Europe. Of the animals in confinement, males and females occur in about equal numbers, but adults are unknown.

The Nervous System.—There are partial records of forty-eight chimpanzee brains, but, almost without exception, they deal with the surface anatomy only. A great deal of the work on this part of the subject is very excellent. Of treatises dealing with the fissures of the brain, Cunningham's best repays consultation (115, 116), and Rüdinger's (188) is of great worth. Very good descriptions and figures are given by Giacomini (130), Moeller (165), Beddard (93), Benham (94), Chapman (111), Dwight (123), Embleton (126), Barkow (90), Marshall

(158), Parker (178), Schroeder and Vrolik (196), Symington (202), Turner (207), while Traill (206), Tyson (208), and Macartney (155) give very fragmentary accounts. The convolutions, sulci, lobes, and fissures have been treated in a general way, but from fresh material, by Broca (103), Gratiolet (131), Hamy (136), Kükenthal and Ziehen (151), Pansch (176), Parker (177), and Rohon (185). The Island of Reil, its limiting sulci and opercula, the third frontal convolution, have received a great deal of attention, and respecting them the following authors may be consulted: Bischoff (4, 5), Cunningham (116, 117), Hervé (48), Marchand (157), and Rüdinger (188*a*). Of the deep anatomy of the brain, its commissures, its tracts, its deep and basal centres, and its peduncles, nothing is known except from inference. The ventricles have been touched upon by Schroeder and Vrolik (196), Moeller (165), Marshall (158), and Macartney (155). Moeller (166) has examined and described the *Hypopophysis* and *Epiphysis cerebri*.

The extent to which the cerebellum is overlapped by the occipital lobes of the cerebrum has been a matter of very keen observation, and has quite a considerable literature of its own. Like all points of anatomy that have given rise to a great deal of discussion and contradiction, it has turned out to vary widely with the individual, and to have received an amount of attention quite outside its real importance. As far as this matter concerns the chimpanzee, observations have been made by Chapman (111), Cunningham (115, 118), Macartney (155), Marshall (158), Moeller (166), Schroeder and Vrolik (196), and Wilder (213). For papers dealing with the weight of the chimpanzee brain, see Moeller (166) and Keith (146). There is no microscopic work on the brain, except that of Moeller (168). The *medulla oblongata* has been figured by Barkow (90), and its nerve centres examined and described by Kallius (145) and Cunningham (117). The external appearance of the spinal cord has been described by Kallius (145). Moeller (166, 167) has examined the finer structure of the optic chiasma.

The cranial nerves of the chimpanzee have never been examined with any degree of detail (Vrolik, 210). The *lumbar plexus*, especially the spinal nerves that enter into its formation, has received a very great deal of attention from Von Jhering (143), Ruge (191), Rosenberg (187*a*), and Utschneider (209). Hoefer (140) has given a full description of the nerves of the upper extremities, and Macalister (154) gives a figure of the *brachial plexus*. The nerves of both extremities have been dealt with by Champneys (110), Hepburn (45), Chapman (111), Gratiolet (131), Nepheu (170), Sutton (201), Traill (206), and Vrolik (210), but only the first two writers give at all a full description.

The Muscles.—Although the myology of eighteen chimpanzees has been described, only Gratiolet's (131) is an approximately complete treatise. Tyson's (208), Traill's (206), Vrolik's (210), Wilder's (212), Beddard's (93), Champneys' (110), Huxley's (49*b*), Embleton's (126), and Sutton's (201) are fairly full. Partial records of dissections are given by Chapman (111), Dwight (123), Fick (127), Humphry (142), Macalister (154), Mayer (160), Symington (76), and Wyman (215). The muscles of the extremities have been very fully investigated by Hepburn (45), and from the articles of Brühl (108) and the fine figures of Barkow (90) a good deal may be learned concerning the myology of these parts. The muscular anatomy of the face has been very accurately worked out, although in very few specimens, by Ruge (70) and Rex (69*a*). The muscles that act on the digits have received much attention from Bischoff (100, 101), Brooks (106, 107), Keith (148), and Windle (214). Records of the *rectus abdominis* are given by Ruge (190) and Keith (148); of the *serratus posticus* and *obliquus abdominis externus* by Seydel (198, 199), and of the *levator ani* by Lartschneider (152*a*).

The above list, however formidable it may appear, in reality only indicates material enough to serve as an introduction to the myology of the species. The first necessity in the meantime is a thorough dissection and description of one animal to serve as a basis for further work, so that in detailing the dissection of any other individual one would have to record only the points wherein it differed from the 'type' description. Gratiolet's is the only description that could serve as a 'type,' and even it could be considerably improved upon. The lists that have been drawn up of muscular characters or peculiarities of the chimpanzee, or of a species or sub-species of chimpanzee, are almost without exception merely lists of characters peculiar to the individual that has been dissected. It is extremely probable that future and more accurate work will show that the myological characteristics of the anthropoids, especially of sub-species, lie not in any one, or any set of constant peculiarities, but in the proportion or frequency with which these peculiarities occur in a large number of individuals. Besides such census-taking work, however, good descriptions of the muscles of the palate, of the tongue, of the pharynx, of the back, and of the penis are required. The arrangement of the involuntary muscle of the œsophagus, stomach, bladder, and rectum would also repay investigation.

The Joints and Ligaments.—There is no thorough description of the ligaments and joints of the chimpanzee. Gratiolet's (131) is the most complete. Concerning those of the foot and ankle, see Thomson (204), Humphry (142), and Aeby (88). Traill (206), Sutton (201), Macalister (154), Humphry (142), and Hartmann (39), treat cursorily of some of the ligaments and joints. The synovial bursæ and tendinous sheaths, the ligaments of the trunk and pelvis, have scarcely been touched upon.

The Skull.—It is always an easier and more pleasant matter, when one wants to consult any point in the skull or skeleton, to refer to the originals in the shelves of a museum than to the descriptions of them in a library. At first, when such specimens were rare and costly, descriptions were necessary, but now, when they have become numerous and common, descriptions, unless there is something uncommon to record, are superfluous. What is really wanted is a tabulation of the characters of a long series, say of one hundred, of skulls. As in the myology of the chimpanzee, so in the skulls, there is quite an enormous amount of individual variation, most of the features that have been assigned as characters of sub-species being in reality only individual peculiarities, although it is highly probable, especially in connection with the skulls of Central African chimpanzees, that if a large series of this supposed species were contrasted with a large series of the ordinary West African animal, a very distinct difference in mass would be noted between them. The collections in museums are rapidly becoming big enough for such an undertaking. In London museums, for instance, in the museums of South Kensington, Royal College of Surgeons, and of the various medical and scientific schools, there are over sixty chimpanzee skulls, most of them with the necessary history attached to them; and in the museums of Europe and America, there are, at a low estimate, over three hundred skulls, certainly material enough for working out a very full understanding of this part of the chimpanzee. Anyone who has tried to bring all the descriptions of skulls in periodical and academical literature together and fuse them into a concise and clear whole, must have felt the wish to start the whole subject afresh upon our greatly increased stock of material. At best the literature upon the skull will serve only as an introduction to anyone who wants to start work on fresh material; it is almost useless for the purpose of addition to his own research. It is rather a big literature, the smaller articles, dealing with some definite structure or variation, being the most satisfactory. Such are those, for instance, of Thomson (205), Regnault (182), and Bianchi (95), dealing with the lachrymo-ethmoidal suture; of Maggi (156) dealing with the cranio-pharyngeal canal; Zuckerkandl's (216) with the turbinate bones; Morselli's (169) with the vermian fossa; of Chudzinski (113) and Manouvrier (156*a*) with the nasal bones; of Hamy (35) with the nasal spine; of Sutton (201) on certain foramin of the skull; of Bischoff (8) on the cranial indices; and of Flower (128) on an acrocephalic skull. Partial records or figures of skulls are given by Barkow (90), Lenz (53), Meyer (58, 59), Hartmann (40), Gratiolet (131), Dwight (123), Bolau (10), Bischoff (96), Beddard (93), Traill (206), and Vrolik (210). Keith (146) treats of the cranial capacity. The literature upon the skull of the Central African chimpanzee is by Giglioli (31), Hartmann (138), Issel (144), and Noack (171). Owen (175), Huxley (49*b*), Duvernoy (22), Bischoff (3), and Hartmann (138, 38) describe the characters of the chimpanzee skull in a general way, pointing out its generic, specific, and sexual characters, and the changes it undergoes with age.

The Skeleton.—One may say of the other bones as of the skull: it is an easier and more satisfactory matter to refer to specimens than to literature. For articles dealing with the chimpanzee skeleton as a whole one may consult Owen (175), Mivart (61, 61*a*), Duvernoy (22), Hartmann (138, 38), Bouvier (102), and Gratiolet (131). Records or figures of one or more skeletons are given by Bolau (10), Dwight (123), Barkow (90), Lenz (53), Meyer (58), Tyson (208), Vrolik (210), and Traill (206). Cunningham (118, 119), deals with the curve and cartilage of the lumbar region of the vertebral column; Broca (104), Chudzinski (112), and Paterson (179) with the sacral and coccygeal vertebræ; Keith (149) with the *manubrium sterni*; Rosenberg (187*a*) and Wyman (215) with the regional series of vertebræ; Sutton (201), Rosenberg (187*a*), Lucae (54), and Vrolik (210) with the bones of the hand; Lazarus (153), Lucae (54), Humphry (142), and Thomson (204) with the bones of the foot. Records of measurements of bones are given more especially by Rollet (186*a*), Meyer (58), Issel (144), Lucae (54), Slack (73), and Wyman (87*b*).

The Teeth.—Great weight has been placed upon the form and structure of the teeth of the chimpanzee for classificatory purposes, especially for establishing its generic value, and upon the cusps of the last molar teeth for establishing the specific value of certain groups of chimpanzees. It must be admitted that the enamel on the cusps of the gorilla's teeth assumes, as a rule, a sharp crystalline form never found on the teeth of the chimpanzee, and gives support to those that separate the gorillas from the chimpanzees as two well-marked and separated genera; but the last molar teeth, being of the nature of degenerating structures in the chimpanzee, and therefore very variable, are quite unreliable characters for splitting the group into species or sub-species. Very probably a fifth cusp appears much more frequently on the last lower molar of the individuals of one variety of chimpanzee than on the last lower molar of another variety; but its presence or absence can never be accepted as diagnostic. It will be some time before such points can be settled, because the skulls only have the teeth in a fit condition for study from a little time before until a little time after the animals have reached maturity, and it must take time to accumulate such a series. Irregularities in the dental series have been recorded by Bateson (92) and Bischoff (96). Descriptions and figures are given by Duvernoy (22), Ehlers (23), Beddard (93), Giglioli (31), Gratiolet (131) and Barkow (90). Practically nothing is known of the dates of irruption, although some data in connection with this matter may be picked from Beddard (93), Broderip (105), and Magitot (56). Topinard (82) treats of the variations of the cusps. Huxley, Tomes, and Owen (174) deal with the teeth in their well-known general treatises.

The Alimentary System.—Figures or descriptions of the tongue, dealing mostly with its papillæ, are given by Bischoff (7), Cunningham (118), Duvernoy (22), Dwight (123), Ehlers (23), Flower (28), Gratiolet (131), Humphry (142), Cavanna (109), Mayer (162), Symington (202), Traill (206), and Tyson (208). It is very noticeable in the literature of the anthropoids, as exemplified by the literature on the tongue, how subsequent observers pay particular attention to, and discuss, the points raised by their predecessors, so that one may safely assume that any point or question, once raised, is sure in time to gather a very full literature round it. It has been so also with the rugæ of the hard palate. Bischoff (7), Beddard (93), Ehlers (23), Gratiolet (131), Symington (202), and Waldeyer (211) figure or describe them. Ehlers (23) describes the buccal folds of mucous membrane that occur between the gums and cheeks, and Tyson (208) and Symington (202) also have made observations on the cavity of the mouth. Tyson (208) and Gratiolet (131) have made some observations on the salivary glands. Barkow (90) gives a very fine drawing of the stomach and its blood vessels; Bischoff (99), Cavanna (109), Gratiolet (131), Traill (206), and Tyson (208) give descriptions of the stomach; certain points concerning the length and form of the intestine have been recorded by Bischoff (99), Cavanna (109), Chapman (111), Dwight (123), Ehlers (23), Flower (28), Gratiolet (131), Huxley (49*b*), Barkow (90), Symington (202), Traill (206), and Tyson (208), while Embleton (126), Mayer (160), Owen (172, 173), and Vrolik (210) make minor contributions to the same subject. Cunningham (118) gives a very fine figure of a section, showing the topographical relationships of the abdominal viscera. Figures or descriptions of the liver are given by Bischoff (99), Flower (28), Gratiolet (131), Barkow (90), Cavanna (109), Symington (202), Traill (206), and Tyson (208); of the pancreas by Bischoff, Flower, Gratiolet, Cavanna, and Tyson (*opp. citt.*)

The Respiratory System.—The air sacs of the larynx have got quite an extensive literature of their own, and although their morphology and development may be said to be fairly well known, we are as far from knowing their functional meaning as ever. There have been nearly as many theories regarding their nature as there have been observers. Records of them may be found written by Bischoff (99), Chapman (111), Cunningham (118), Deniker and Boulart (19), Duvernoy (22), Ehlers (23), Mayer (161), Traill (206), Tyson (208), and Vrolik (210). The best work on the structure of the larynx and its muscles has been done by Gratiolet (131) and Mayer (161); but Bischoff (99), Cunningham (118), Ehlers (23), Humphry (142), Barkow (90), Symington (202), Traill (206), Tyson (208), and Vrolik (210) give descriptions of many points worth referring to. The trachea and bronchi have partial records by Aeby (88*a*), Ehlers (23), and Gratiolet (131). The lungs have been examined by Mayer (161), Ehlers (23), Gratiolet (131), Cavanna (109), Traill, Tyson, and Vrolik (*opp. citt.*) The limits of the pleura and its variations have been very accurately described and figured by Ruge (189) and Tanja (203). Cunningham's section (118) shows very well the relationships of the lungs, trachea and larynx.

The Circulatory System.—The heart of the chimpanzee is so similar to that of man, that there is little left to observe or describe. Its position and relationships have been investigated by Ruge (189), and can be well seen in Cunningham's section (118). Bischoff (99), Dwight (123), Ehlers (23), Gratiolet (131), Cavanna (109), Traill (206), Tyson (208), and Vrolik (210) give some details concerning it. The arch of the aorta and its branches are described or figured by nearly all the above writers, their observations being brought together by Keith (147). The arterial and venous systems have been recorded in a very fragmentary way. Barkow's figures (90) give much better information as to their distribution than any other record; but a good deal concerning the arteries may be obtained from Bischoff (99), Chapman (111), Dwight (123), Ehlers (23), Gratiolet (131), Humphry (142), and Sutton (201). Ruge (189) described the relationships of the pericardium, while Gulliver (135) has made a study of the size of the red blood corpuscles.

The Lymphatic System and Ductless Glands.—There has as yet been no proper investigation of this system. The spleen has scarcely been more than mentioned—Bischoff (99), Gratiolet (131), Symington (202), and Tyson (208). The thyroid has been remarked upon only by Bischoff (99), and Ehlers (23), and, so far as I know, no work has been done upon the lymphatic system or upon the thymus.

The Genito-Urinary System.—The external genitals of young female animals have been figured or described by Bischoff (6, 99), Chapman (111), Gratiolet (131), Hartmann (42), Barkow (90), Hoffmann (141), Symington (202), and Traill (206); the external genitals of the male by Duvernoy (22), Barkow (90), and Tyson (208); Crisp (114) has made observations on the *os penis*. The external genitals are of surprisingly small development; but it must be kept in mind that they have been studied upon animals, for the greater part, quite immature, or, if adult, upon subjects contracted by long immersion in alcohol. The uterus and internal organs of the female are described by Hoffmann (141), Symington (202), Gratiolet (131), Bischoff (6, 99), and Traill (208). So far as I know, Bolau (23) is the only one who has observed menstruation in the chimpanzee. The prostate, *vesiculæ seminales*, and bladder are figured by Barkow (90), Tyson (208), and Humphry (142), while in the section given by Cunningham (118) the situation and relationships of the pelvic organs of the male are very well brought out. There has been no good examination of the kidney made, most of the authors already mentioned in this section merely remarking casually upon it.

The Organs of Sense.—The eye of "Mafuca" was examined with some minuteness by Hirschberg (58); Gratiolet (131) and Traill (206) also give some details concerning it. Zuckerkandl (216) has described the turbinate region of the nasal cavities (*see* also references under tongue, p. 12, for the organ of *taste*, and under references 170, 150, and 89, for organs of *touch*).

External Characters, Configuration, and Proportions.—Many contributions to this part of the literature on the chimpanzee have been accompanied by very fine illustrations, such as those with the papers by Beddard (93), Bartlett (91), Nissle (170*a*), Hermes (139*a*), Hartmann (138*a*), Meyer (58), and Geoffroy St. Hilaire (72); in fact, almost every paper is accompanied by a figure, of greater or less merit, of the animal dealt with by the numerous observers. The hair is black, often mixed with a slight rufous tinge, and tending to become colourless in the vicinity of the openings of the body, where the skin becomes continuous with the mucous membrane. The hair of the face especially, but also of the other parts of the body, although it has always the same arrangement, varies much in length and shade of colour with the sex, the individual, the age, and probably, also, with the variety. Upon the hair, its arrangement and colour, see Bartlett (91), Beddard (93), Bolau (10), Broderip (105), Deniker (121), Du Chaillu (122, 21), Duvernoy (22), Ehlers (23), Embleton (126), Franquet (30), Fick (127), Friedel (129), Geoffroy St. Hilaire (72), Giglioli (31), Gratiolet (131), Hartmann (43, 139), Issel (144), Lenz (53), Martin (159), Meyer (58), Noack (171), Schlegel (193), Traill (206), and Tyson (208). Pigment appears early in life in patches, which gradually fuse together, until all the skin becomes of a slate or melanoid tint. Remarks concerning the deposition and distribution of the pigment may be picked up from most of the writers cited above, especially from Du Chaillu; but very few of them seem to appreciate the fact that it is more a character of age than an indication of species. Its appearance at an early stage of life may turn out to be a character of only one variety. Meijere (163) has shown that the hairs are grouped together in small colonies. The external configuration of the hands and feet has received a great deal of attention: *see* Alix (89), Barkow (90), Duvernoy (22), Dwight (123), Embleton (126), Gratiolet (131), Hepburn (46), Kollmann (150), Nissle (170*a*), Tyson (208), and Meyer (58). Figures of the ear are given by Beddard (93), Barkow (90), Du Chaillu (21), Dwight (123), Hartmann (40), and Schmidt (194). Of the four anthropoids, the chimpanzee retains its ear in its most pristine and fully-developed form, having none of the marks of degeneration that characterise the ear of man, gorilla, orang, and gibbon. It varies very considerably with the individual, and on the sides of the same individual; but it is quite probable that it may turn out to be of value in assisting to characterise sub-species, although it can never be of value for absolute diagnosis. Measurements of the limbs and trunk have been given by the following authors: Ehlers (23), Rollet (186*a*), Meyer (58), Slack (73), Wyman (87*b*), Owen (173), Noack (171), Marshall (158), Lucae (54), Issel (144), Broderip (105), Gratiolet (131), Fick (127), Embleton (126), Dwight (123), and Chapman (111).

Psychology.—With the exception of Darwin (120) and Romanes (187), scarcely anyone has attempted to analyse the mental status of the chimpanzee. Mitchell (164) has also made a contribution to the subject, but most of the other references apply to articles containing merely passing notices of the habits and manners of the chimpanzee in confinement. Du Chaillu's (21) and Reichart's (183) observations, however, were made in the jungle. Broderip (105), Deniker (121), Eismann (124), Fick (127), Friedel (129), Hartmann (43), Hermes (139*a*), Laborde (152), Martin (159), Nissle (170*a*), and Sayers (192) made their observation upon animals in confinement.

Pathology.—Nothing is known of the diseases to which the chimpanzee is subject in its native surroundings; in Europe it commonly falls a prey to diseases of the respiratory system. *See* Owen (172, 173), Schmidt (195), Rollet (186), and Meyer (58).

Distribution.—The chimpanzee occurs over a much wider area than any of the other anthropoids. Noack (171) and Reichart (183) report specimens occurring in the country along the western shores of Lake Tanganika; Schweinfurth (197) and Emin Pasha (125) found it in Niam Niam, and it has been seen in the region lying between Niam Niam and Tanganika. In fact, its distribution may roughly be said to be the areas drained by the Congo and Niger, and it also occurs along the banks of the smaller rivers on the west coast as far north as lat. 16°, and as far south as lat. 14°. *See* Du Chaillu (21), Franquet (30), Giglioli (31), Hartmann (137, 139), and Issel (144).

Classification.—Mr. Sclater (NATURAL SCIENCE, vol. ix., p. 143, August), has very courteously given his reasons for assigning the generic name of *Anthropopithecus* to the gorilla and chimpanzee. I was aware that Gmelin had given the name and that Fischer had adopted it; also that Flower and Lydekker had accepted it because *Troglodytes* had already been applied to another genus. But there is one very strong reason, it seems to me, why the generic term *Troglodytes* should be retained; it had come to be recognised all the world over as the scientific name of this genus, at any rate, of the chimpanzee. Universality of usage is such a difficult matter to obtain and so absolutely necessary, that it seems to me almost a scientific sin to disturb it once the fixation process has fairly set in. Italian, German, American, French and English anatomists, excepting always those that received their material from the Gardens of the Zoological Society of London, have for the last fifty years used the name *Troglodytes niger* for the ordinary chimpanzee. What I fear most is a state of matters arising in the nomenclature of the anthropoids, such as has already arisen among the names of the macaques, where one cannot with any certainty recognise, from the name, the material with which the author has been dealing. But in ordinary morphological work there is not much danger of any difficulty arising in connection with the nomenclature of a limited group like the anthropoids, because one can always fall back upon the terms gorilla, chimpanzee, orang, and gibbon, names of definite signification for civilised nations.

A great deal of work has been done to show the position of the chimpanzee in relation to the other anthropoids and also its position in descent as regards man. Geoffroy St. Hilaire held the opinion very strongly that the gorilla and chimpanzee should not be included in one genus, but ought to be separated into two well-marked genera, and this opinion has been accepted in France, while all other countries have followed Savage, Wyman, and Owen, and retained them in one genus. There is no absolute standard of generic value; but this much is certain, that the chimpanzee and gorilla are much more nearly correlated in structure than is either of these to the orang or gibbon, or the gibbon to the orang. (*See* Huxley, 59*a*, 59*b*; Geoffroy St. Hilaire, 72; Broca, 104*a*; Duvernoy, 22; Hartmann, 139, 43; Gray, 133, 134; and Peters, 180.)

There may be well-marked species, sub-species, or varieties of the chimpanzee, but as yet the material at home and notes of habits from the jungle are totally insufficient for their determination. A very considerable literature has sprung up round the chimpanzee of Central Africa, but as already said, our material and information are not enough to afford us any certain grounds for separating the chimpanzee of this region from that of the West Coast. (*See* Giglioli, 31; Issel, 144; Hartmann, 138*a*, 139; Peters, 180; and Noack, 171.)

As regards the number of species or well-marked varieties of chimpanzees on the West Coast of Africa, it is a very hard matter to decide in the present state of our information how far characters that have been assigned as of specific value are really so or are only individual peculiarities. Du Chaillu appears to me to be our safest guide in determining this question, and if he is right, and he can hardly have made a mistake, in saying that the voice and cry of *T. Kooloo-Kamba* is perfectly distinct in character from that of the other forms of chimpanzee, then I do not think he could have adduced any other feature or features so indicative of its being a certain and distinct species. Unfortunately he shot only one specimen, and its external configuration, so far as he describes it, agrees well enough with that of *T. niger*. He found it living also in a country inhabited by another form of chimpanzee, Nshiego-Mbouvé (*T. calvus*). Bartlett (91) and Beddard (93) assigned "Sally" to the latter species. Unfortunately, Du Chaillu on his own statement had rarely seen *T. niger* in his travels, his acquaintance with it being almost restricted to a few young specimens in confinement, and he was therefore unaware of the amount of variation that might occur among the members of that species.

In my last article on the gorilla I made a very stupid blunder, which I now wish to remedy, and confounded the name *Troglodytes tschego* of Duvernoy with *Gorilla gina* of Geoffroy St. Hilaire. *T. tschego* is certainly a name applied to a chimpanzee, but the specific characters assigned by Franquet (30), Slack (73), and Duvernoy (22) are, every one of them, variable. The degree of prognathism, the last molar teeth, the pigmentation of the skin, the colour of hair, the external ear, and proportions of limbs to trunk are subject to considerable fluctuation in different individuals. "Mafuca" (170*a*, 58), *T. aubryi* (130), *T. vellerosus* (132) may or may not be representatives of distinct species; probability is all in favour of their being only peculiarly marked individuals of the more common form.

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ARTHUR KEITH.

IV.

The Organisation of Local Science.

[To judge from enquiries that have been received, so much interest has been aroused among members of our local natural history societies by Mr. Boulger's article on "What shall we do with our Local Societies?" in the last number, that we have much pleasure in furnishing them with the following answer to the questions, which was read by Mr. G. Abbott, General Secretary of the South-Eastern Union of Scientific Societies, before the conference of delegates from local societies, held during the recent meeting of the British Association.—Ed. Nat. Sci.]

MANY begin to recognise, and some, like Professors Meldola and Boulger, have called public attention to, the need of improvement in our local natural history societies—their disappointing result, and too frequent unnecessary decay.

Societies for the cultivation of science, or, as they are more often named, natural history societies, scattered freely over the country have done much good work; some have reached high positions and gained reputations for usefulness, but too many others are weak, irregular, their efforts desultory, and so they fail to take their due position and secure the influence that otherwise might be theirs. Their work too often begins and ends with lectures that are mere stale *résumés* of what others have done; while the real scientific and useful work done by their members, if any, is hid under a bushel.

It is impossible to say accurately how many members are attached to these societies. Professor Meldola estimates them at 24,000. But this, no doubt, is reckoning only those societies which at present send representatives to the British Association. The total number must be at least twice as great, and I think this a low estimate, judging, as I do, by the twenty-five societies which were represented at the Tunbridge Wells Congress of the South-Eastern Union, societies belonging to three counties only. Of these, only four societies are included in the British Association list, viz.: Croydon, Rochester, East Kent, and Holmesdale, and they contain 556 members.

Probably a fair average would be 100 members to each society, and we should thus have in one corner of England alone 21,000 who are not in direct association with the British Association, but who belong to the City of London, North London, City of London College, Ealing, North Kent, West Kent, Bromley, Sidcup, Maidstone, New Brompton, Horsham, Brighton, Eastbourne, Hastings, Folkestone, Dover, Tunbridge Wells, Southborough, Guildford, Sutton, and Haslemere Natural History Societies.

We must have at least an army of 50,000 members, and from these grand work might be expected. Such a body of men, occupying such an important educational position, should be able to point to better work than any already done. Their immense power might be used to make the study of plants, animals, physical forces still more efficient factors in man's culture and mental development.

Failure to accomplish more than has already been done must be put down to many causes. The present results are, perhaps, not surprising without more direct attempts to guide and develop their latent powers and capabilities. *The chief cause of failure is want of organisation.*

When things are left to chance we must not look for the best results. Should we expect much if our army, navy, and volunteers were left to themselves, to the individual inclinations and humours of the members?

To effect a genuine advance, improved organisation is urgently needed, and will be eagerly welcomed by those who are anxious to see the "best possible" achieved by these scientific centres.

A step in the right direction has been taken by the Unions of Scientific Societies which already exist in England and Scotland.

Many of you are intimately aware of their advantages, their stability, and pleasant associations.

The Yorkshire and East of Scotland are striking instances of good work resulting from co-operation and energy skilfully used.

The present British Association regulations relating to affiliated societies do not sufficiently foster such unions, and they apply in some cases to conditions and aims which have passed away, or have already been realised. For instance, the publication of Transactions as a condition of affiliation leads now to the unnecessary accumulation of pamphlets, often of small value, when it is already difficult, among such a mass of printing, to find what has previously been written on any particular subject.

The time seems opportune for asking, without being charged with undue haste, whether some alterations might not bring benefits and improvements all round. Is it not time that some step forward should be taken, after a careful survey of past failures and successes? Time that some plan should be proposed that would tend to organise these scattered units of energy—the local societies—under the guiding care of the British Association?

Fully believing that further improvement through organisation is possible, I look to the extension of unions of societies in districts under the auspices of the British Association as the most feasible method.

The British Association only can do what is required. It must act as the guiding brain, and, through an organising secretary, help to bring these needed unions into being. The societies must all be brought into touch with it, and not remain, as so many are, unconscious of its aims and work. The societies in many cases are like an army waiting for a leader to guide them further along the pleasant paths of science to fresh fields for work.

The following is the plan I would submit for your consideration:

Districts.—The United Kingdom should be divided into fifteen or twenty districts, in each of which all natural history societies should be affiliated for mutual aid, counsel, and work. Existing unions should perhaps be imitated, at any rate not disturbed.

Geographical lines should decide their size, which might vary in extent and be dependent, in some measure, on railway facilities. From time to time these areas might be subject to review, and necessary changes made.

Congress.—Each of such unions would have its annual congress, attended by delegates and members from its affiliated societies. This would be held in a fresh town every year, with a new president, somewhat after the manner of the British Association itself. The congresses would probably take place in spring, but two should never be held on the same day.

These unions would render important help to local societies, would bring isolated workers together, assist schools, colleges, and technical institutes and museums, start new societies, and revive waning ones. Through these annual meetings local and petty jealousies would lessen or turn to friendly rivalries—each society trying to excel in real work, activity, and good science teaching.

Further, economy of labour would be accomplished by a precise demarcation of area for each local society. This would be understood as its sphere of work and influence; in this portion of country it would have a certain amount of responsibility in such matters as observation, research, and vigilance against encroachments on footpaths, commons, and wayside wastes.

These unions might also, through their Central Committees, bring about desirable improvements in publication, but it would certainly not be desirable, in all cases, to go in for joint publication. In this, as in other matters connected with the unions, *co-operation and not uniformity* must be our aim.

Union Committees.—Each union will need a general secretary and a committee, all of whom should be intimately acquainted with methods of work and the best ambitions of local societies.

Corresponding Members.—This is another necessary development. Each local society should appoint, in every village in its district, a corresponding member with some distinctive title, and certain privileges and advantages.

The work asked of him would be to—

1. Forward surplus Natural History specimens to their Society's Museum.

2. Supply prompt information on the following subjects :—

(*a*) New geological sections.

(*b*) Details of wells, borings, springs, etc.

(*c*) Finds of geological and antiquarian interest.

3. Answer such questions as the British Association or the local society may require.

4. Keep an eye on historic buildings.

5. Assist the Selborne Society in carrying out its objects.

No mean occupation — certainly a useful, attractive, and honourable post—worthy of any man's acceptance.

In return he should be offered—

1. Assistance in naming specimens, and with the formation of school museums.

2. Free admission to lectures and excursions.

3. Copies of transactions.

4. Free use of the societies' library.

Every village would soon, under this scheme, possess an agent, registrar, or whatever you like to call him, who would be more and more able, as he gained experience, to further the aims of this association.

Expenses or Ways and Means.—This cannot be ignored, but would not form a sufficient barrier to prevent the adoption of the scheme.

The unions would be self-supporting, by means of small contributions from the affiliated societies. Money is only wanting for the expenses of *an organising secretary.* I don't attempt to estimate the cost of this, but with objects so desirable and far-reaching in view, the money cannot be considered ill-spent, and the British Association would soon be repaid by obtaining prompt and direct communication with all the towns and villages in Great Britain, by greater assistance in its research work, and in all other branches which the British Association was established sixty-five years ago to promote.

Tunbridge Wells, GEORGE ABBOTT.
September, 1896.

SOME NEW BOOKS.

HERTWIG *versus* WEISMANN.

THE BIOLOGICAL PROBLEM OF TO-DAY. By Dr. Oscar Hertwig; translated by P. Chalmers Mitchell. Crown 8vo. Pp. xix., 148. London: Heinemann, 1896. Price 3s. 6d.

THIS work will be greeted with satisfaction by all who are interested in the problem of heredity. In translating Professor Hertwig's book, Mr. Chalmers Mitchell has rendered a service to the ordinary reader who may not have the power or inclination to read it in the original. As most people are aware, Hertwig has long been the foremost opponent of Weismannism; indeed, the present work is largely devoted to refuting the doctrine of the Freiburg zoologist. The translator has prefixed a clear and concise statement of the case as it now stands between the two chief schools of thought. He has, however, carefully refrained from giving any opinion of his own. This is, perhaps, a matter for regret. Mr. Mitchell is known as a student and expounder of Weismann's views, and an opinion from him as to the merits of an opponent doctrine would not have been out of place. There is, at the end of the book, a glossary of technical terms which will commend itself to the non-scientific reader.

The book itself is, like all the works of its distinguished author, a model of clearness and simplicity; and the doctrine of epigenesis as opposed to that of evolution is forcibly stated. The opening pages introduce the subject of heredity, and state the position occupied by Weismann. Further on, the fundamental point is dealt with as to whether, in a dividing cell, there is a quantitative or qualitative division of the nucleus; with a decision in favour of the former. That is, each chromosome splits into two exactly equal and like halves, and in no case is there any dissimilarity of structure or properties between them. To prove his case, the author deduces arguments from several groups of facts, especially those dealing with the reproduction of unicellular organisms, and the phenomena of regeneration and heteromorphosis. He next attacks Weismann's doctrine of "Determinants," and points out the logical fallacy in assuming that all the characters present in the adult organisms should necessarily be predetermined in the germ plasm. Such a view results from a failure to distinguish between the causes contained in the egg at the beginning of development, and the causes entering it during the course of development from the taking up of outside material. Thus Hertwig combats the one view of Weismann's that his supporters have found most hard to accept, viz., the almost total indifference of the germ plasm to external surroundings or stimuli.

The latter half of the book gives a plain statement of the author's own views as regards the causes which determine the development of organisms. Quoting from botanists and zoologists, he seeks to show that development is due to external influences acting on a highly complex germ plasm, capable of almost infinite alterations in form and properties in certain directions. Although, to begin with, each cell has the same nuclear composition, yet the interrelations it holds with its fellows ("centrifugal causes"), and the motive forces due to the action of environment ("centripedal causes"), determine the nature of the cells themselves and the tissues they make up. This idea has been strongly advocated in a later work, "Eine Theorie der Organischen Entwicklung," by Driesch, whose experiments in the mechanics of development led him to similar conclusions. He extends it even further, seeming to hint that all protoplasm is fundamentally the same, and that whether a fertilised egg develops into a man or a medusa is decided by external conditions alone.

Finally, although the importance of the cell as a morphological unit may to some minds be unduly insisted upon, the comparison in the concluding pages between the development of an egg-cell into a man, and of a man into a member of a state, both depending on epigenetic principles, is a suggestive thought, and contrasts favourably with the cumbersome, if ingenious, comparisons and similes resorted to by the author of "the germ plasm."

Taken as a whole, Hertwig's doctrine is easier of understanding and application than Weismann's, but what seems to render it infinitely superior to the latter is its capability of being tested by experiment and observation, towards which object much may be done by such work in the department of experimental research as has recently been published by the author, Roux, Driesch, Chabry, Morgan, and others. A word of praise is due to the translator for having effectively rendered the sense of the original with a minimal departure from the text. M. D. H.

Snakes.

Catalogue of the Snakes in the British Museum (Natural History). Vol. III. By George Albert Boulenger, F.R.S. Pp. xiv., 727, with 25 plates, and figures in the text. Published by order of the Trustees. London, 1896.

This volume contains the Viperidæ, the Amblycephalidæ, and five sub-families of the Colubridæ; the Elapinæ, Hydrophiinæ, Elachistodontinæ, Dipsadomorphinæ, and Homalopsinæ. In bulk it is much the largest of the three, which in part is due to addenda and corrigenda, forty-one pages of which apply to vol. i., and twenty-three to vol. ii. The high degree of merit apparent heretofore is maintained throughout, and the author is to be warmly congratulated for the admirable manner in which he has completed the series. His contribution is certainly one of the best that has appeared on the subject, and is sure to result in great advancement of our knowledge of the order. The classification adopted is a decided improvement on previous attempts. Whether ophidiologists generally accept a scheme placing Hydrophidæ and Elapidæ with the ordinary Colubridæ, or which throws together Crotalidæ and Viperidæ as a single family, will make little difference in the utility of the work. In the midst of so much that is of the best, however, there are points which render it liable to attack, and which will lead to modification in the hands of others, if not in those of the author. Much interference with the names of his genera might have been prevented by rulings somewhat less arbitrary; generic names applied by early writers have been arbitrarily dropped for later ones, and genera have been subdivided out of existence, newer names being given to all the parts. Numerous cases have been ruled out as naked names which are not really such, since with each generic or subgeneric name its author had specified a characteristic known species and had cited the authority for it. In the publications of Laurenti and of Fitzinger occasions for more than a score of changes may be seen. The rulings also work injustice in the synonymy; because of omissions subsequent authors are credited with discoveries actually made and published by others long before, which can not fail to mislead any one not well versed in the literature. Thus, for instance, *Dasypeltis scaber* and *Pseudechis porphyricus* of Wagler, 1830, are omitted, and credit for the specific assignment of the former is given to Smith (1842) [1849], while the latter is passed along to Günther, 1858. Instances like these are many. The incompleteness of the synonymy will be most productive of fault finding. The literature of anatomy, etc., so useful in other catalogues, is ignored; authors like Nilsson, Malm, Jones, Rochebrune, and Duvernoy, the last presenting fine illustrations of seventeen of the species, receive no attention; and among scattered references ignored are species such as *Crotalus cumanensis*, *Crotalus lœflingii*, *Platurus vulcanicus*, *Pituophis heermani*, *Alsophis fuscicauda*, *Dipsas dieperinkii*, *Coluber* (*Natrix*) *subcarinata*, *Boa ambleocephala*, and *Dendrophis aurata*. Criticism will be provoked also, to become more accented in future research, by a tendency to extend the limits of species and of varieties too far, and thus to bury and lose in the synonymy too much of what is known. The case of *Crotalus confluentus*, a rattlesnake common west of the Mississippi river, is an illustration: the synonyms given for this species include ? *viridis*, *oregonus*, *lucifer*, *lecontei*, *atrox*, *sonorensis*, *durissus* (Wied.), *exsul*, and *ruber*, and the author remarks "This species may be divided into two principal varieties, which are not definable by any structural characters that I know of, viz.: the typical form, with a dark temporal band extending to the commissure of the mouth; and the Texan *C. atrox*, in which a dark band descends obliquely from the eye to the mouth far in advance of the commissure." *C. atrox* and *C. exsul*, however, represent a group distinguished from *C. confluentus* by the presence of but two scales in contact with the rostral between the nasals and by the band from the eye in front of the commissure, a group of varieties having closer affinities with *C. durissus*, Linn. (*C. adamanteus*, Beauv.), of which species *C. atrox* is the southwestern representative. *C. exsul* is a dwarf, individuals bearing a dozen rings or more in the rattle being hardly larger than the young *C. atrox* before acquiring its first ring. *C. confluentus*, of several varieties, is distinguished from *C. atrox* and its closer allies by the presence of three or more scales in contact with the top of the rostral between the nasals and by the band from the eye to or behind the commissure. Without space for further comment, we may add that the points criticised seem the more prominent because of the general excellence of the work in which they appear.

A Jenner Celebration.

WHAT IT COSTS TO BE VACCINATED: The Pains and Penalties of an Unjust Law. By Joseph Collinson. Pp. 46. London: William Reeves, 1896.

THIS nicely got up little work is published for the Humanitarian League; it is excellently printed on good paper, and is singularly free from printers' errors. There is a short preface by a Mr. Ernest Bell, who candidly admits that the subject of vaccination is not one of which he can pretend to any knowledge, but who is nevertheless able to adduce two capital arguments against the practice: the first is the unanimity of the medical profession in its favour, and the second the "eager advocacy of the *British Medical Journal*."

We do not gather from a perusal of Mr. Collinson's pamphlet that he possesses any pathological knowledge, statistical ability, logical faculty, or other special qualification for the discussion of the subject. It is indeed a very typical instance of the ordinary anti-vaccinationist propaganda, and it is a curious thing that the writers of this kind of literature spend their strength in the vain endeavour to discredit the value of the practice they are attacking, instead of basing their argument on the liberty of the subject to run any particular risk he may choose. This liberty, as opposed to the right of the State to prevent his being at the same time a risk to the community, affords a legitimate subject for discussion, and involves a pretty ethical question. But of such argument there is little trace in Mr. Collinson's pamphlet, which consists mainly of hysterical invective and well-worn exaggerations, with the usual highly-coloured illustrative cases. This journal is not the place for the discussion of the merits of vaccination, nor indeed is there any immediate need to discuss the matter in view of the recent publication of the Report of the Vaccination Commission, and while the lesson of Gloucester is still fresh in the public mind. We can only deplore the perversion of mind which leads to the production of a work of this character, and the credulity and ignorance upon which it is only too likely to impose.

The Honey Bee.

The Honey Bee: a Manual of Instruction in Apiculture. By Frank Benton. Pp. 118, xi. pls., 76 woodcuts. Bulletin No. I.—New Series (Revised Edition). United States Department of Agriculture. Washington: Government Printing Office, 1896.

The publication of such works as the present treatise by a Government Department is deserving of high praise, and the practice might with advantage be imitated by our own Board of Agriculture. The work includes a most detailed and copiously illustrated account of the anatomy, economy, races, manipulation, and entire treatment of the honey bee, together with all the appliances incidental to apiculture. The directions and advice are given in plain language, such that the veriest tyro can with but a small amount of study and labour make himself fairly successful in the art. It would be out of place here to follow the author through the minutiæ of this interesting and commercially valuable pursuit. We wish, however, to call the attention of agriculturists, and particularly of the fruit growers, to the importance here insisted on of combining bee-keeping with fruit-farming. The presence of an apiary in the midst of the orchard entails a comparatively small additional cost, and cannot fail to largely increase the number of fertilised blossoms, and thus the value and weight of the resulting crop; at the same time, the fertilising agents pay their own way by the return of wax and honey.

Our own Board of Agriculture might do worse than circulate the kind of information given by Mr. Benton. County Councils have already done good work in providing lecturers and demonstrations by means of travelling bee-vans to many rural districts. We doubt, however, if it has been sufficiently brought home to the minds of the English country-people that the annual yield of fruit bears a very direct relation to the abundance of insects, and particularly of bees during the season of blossom. The reader of the book now under notice will gain much useful information on the subject, and also on the plants which may be profitably grown in this connection at other seasons of the year. The book itself is well printed, and the majority of the illustrations are clear and of practical value. There is a short list of the leading books and journals relating to apiculture, and to many of these, especially to Cheshire's well-known work, the author acknowledges his indebtedness. O. H. L.

THE SHADE-TREE INSECT PROBLEM. By L. O. Howard. Pp 24. From Year Book of the United States Department of Agriculture. Washington, 1896.

A SHORT but most excellently illustrated pamphlet on the "Shade-Tree Insects" of the eastern United States, by Mr. L. O. Howard, contains descriptions of the insects which have been found most injurious to trees in the streets, parks, and gardens of certain American cities. These are three native moths—a psychid (*Thyridopteryx ephemæriformis*), a tussock (*Orgyia leucostigma*), and an "ermine" (*Hyphantria cunea*) and an imported European beetle (*Galerucella luteola*). After pointing out the various remedies to be applied, the writer suggests that, where the city authorities are slow to move in attacking the insect devastators, the citizens should form a tree-protection league, and each inhabitant undertake to clear the insects from the trees in front of his own residence.

SOME SERIALS.

IN the *Boletim de la Sociedad Geographia de Lima* for the concluding period of 1895, just to hand, the valuable "Contributions to the Study of the Flora of the Peruvian Corvillices," by John Ball, deals with the composites, asclepias, gentians, heliotropes, etc. Manuel Garcia y Merino publishes a paper on the common names of Peruvian plants, which should be of much value to travellers. The other portions of the *Boletim* are taken up by geographical papers and an important discussion on the languages of the central Andean region by Dr. Leonardo Villar. The Aymara, Cauqui, Yunca, and Puquina dialects are dealt with, and the paper concludes with an examination into the antiquity of the Keshna, and the question whether this may be a primitive language, as Dr. Villar supposes.

We have often occasion to refer to the *Photogram*, that bright monthly published by Dawbarn & Ward. The issue for September is more than usually attractive, as it contains an appreciation of Mr. Hay Cameron, with specimens of his work, and a paper on photography in natural colours, in which Mr. Anderson, of Albany, N.Y., claims to be the original inventor and improver of the method we described in August (NATURAL SCIENCE, vol. ix., p. 87). The *pièce de résistance*, however, is the article "Beauty Spots of London," illustrated by charming and artistic views of St. Paul's, the Thames Embankment, the Bluecoat School, the Thames at Lambeth, Epping Forest, and others, especially a still moonlight scene "Westminster by Night."

The *Scottish Geographical Magazine* for August contains a valuable article on the Island of Formosa, by the Rev. W. Campbell, of Tainanfu, with a map on a scale of about twenty miles to the inch.

The *Westminster Review* occasionally contains articles which come within our province. In the August number there is such a one, by Walter Nathan, on the influence of the Stomach upon the Mind. The writer sensibly remarks that he would place no restrictions, beyond keeping to the one essential, that of taking food in such quantities and at such times as will best maintain mental and bodily capacity. He advocates a substantial breakfast, a very light lunch, just a "snack" in fact, and a good dinner, eaten leisurely, but always of fresh meat, *rechauffés* being simply "poison."

The *Nineteenth Century* for August quotes some interesting reminiscences of Huxley by Mr. Wilfred Ward, a neighbour and friend.

Knowledge for September contains, besides much interesting matter, a fine full-page reproduction of a photograph of sooty albatrosses taken on Laysan Island, by Mr. Palmer, the collector for the Hon. Walter Rothschild.

The *Literary Digest* for August 22 contains a translation from *La Nature* of an article on the decimal division of time, with figures of watch-dials divided in this way. The writer is hopeful that this reform may be introduced, and quotes a resolution passed by the London Geographical Society in 1896 inviting similar societies to study the application of the metric system to the measurement of time.

The *Irish Naturalist* for September is devoted to a description of the fauna and flora of Clonbrock, Co. Galway, which was investigated by a party of the Dublin Naturalists' Field Club last June. The results are very gratifying, and have been worked out as follows:—Land Planarians and Leeches, Land and Freshwater Mollusca, and Isopods, by R. F. Scharff; Earthworms, by Rev. H. Friend; Spiders, by G. H. Carpenter; Hemiptera and Coleoptera, by J. N. Halbert; Fungi, by E. J. McWeeney; Mosses and Hepatics, by David M'Ardle; and Flowering Plants and Vascular Cryptograms, by R. Lloyd Praeger.

We have received from the British Association the handy little guide to Liverpool and the neighbourhood, edited by Professor W. A. Herdman, who himself contributes an article on the marine fauna of the district. The archæology, geology, zoology, entomology, and botany are treated respectively by W. H. Picton, G. H. Morton, H. O. Forbes, W. E. Sharp, and Robert Brown. Instructive information is also given as to the tides, the climate, the trade, industries, etc., of Liverpool; and there are five maps, among which we may specially notice the biological chart of the Irish Sea, which forms quite a new departure.

It is announced that Cuvier's work, dated 1788, on the edible crabs of the French coast, as well as a number of his letters, are about to be published by the Leopoldinisch-Carolinische Akademie of Halle.

Literature Received.

Theory of National and International Bibliography, F. Campbell: Library Bureau. Revision of North American Slugs, H. E. Pilsbry and E. G. Vanatta; Synopsis of the Polar Hares of North America, S. N. Rhoads: *Proc. Ac. Nat. Sci. Philadelphia.* Some Plants worth Cultivating, J. H. Maiden: *Agric. Gazette N.S.W.* Presidential Address, H. D. Geldart; Contributions to the Flora of Russian Lapland; Contributions to the Flora of Kolguev, H. D. Geldart and H. W. Fielden: *Trans. Norfolk and Norwich Nat. Soc.* On the So-called Supra-Renal Bodies in Cyclostoma, W. E. Collinge and S. Vincent: *Anat. Anzeiger.* Geological Structure of the Extra-Australian Artesian Basins, A. G. Maitland: *Proc. Roy. Soc. Queensland.* Royal Natural History, pts. 33 and 34, R. Lydekker: Warne. History of Mankind, pts. 9 and 10, F. Rätzel: Macmillan.

Nature, August 20, 27, September 3, 10. Literary Digest, August 15, 22, 29, September 5. Revue scientifique, August 22, 29, September 5, 12 Irish Naturalist, September. Feuille des jeunes Naturalistes, September. Amer. Journ. Sci., September. Naturæ Novitates, August (15 and 16). Victorian Naturalist, June, July. Science, August 14, 21, 28, September 4. Scott. Geogr. Mag., September. Science Gossip, September. The Naturalist, September. Westminster Review, September. Amer. Geologist, August, September. Botanical Gazette, July, August. Review of Reviews, September. Pop. Science News, September. Knowledge, September. Photogram, September. Psychological Review, September. Journal Marine Biol. Assoc., August.

OBITUARY.

ALEXANDER HENRY GREEN.

Born 1832. Died August 19, 1896.

THE late Professor of Geology at Oxford was born in 1832, and was educated at Ashby de la Zouche Grammar School. He entered Gonville and Caius College, Cambridge, became Sixth Wrangler in 1855, and was elected a Fellow of his college the same year. He was appointed to the Geological Survey of England and Wales in 1861, and in 1875 was elected Professor of Geology at Yorkshire College. On the retirement of Professor Sir Joseph Prestwich from Oxford in 1888, Professor Green was chosen as his successor. He was an M.A. of Christ Church, Oxford, having been incorporated from Cambridge. His chief work while on the Geological Survey was done in the districts of Banbury, Woodstock, Bicester, Buckingham, Leeds, Tadcaster, and the Yorkshire Coalfield, Stockport, Macclesfield, Congleton, and Leek, but his best known and most enduring work is his "Geology for Students: Part I., Physical Geology." When Professor Green came to Oxford he found that geology had only just been made a subject of examination in the schools, and that no adequate provision for its teaching existed. He at once set to work to start a proper geological laboratory, and among the improvements which he initiated was that of acquiring the services of each successive Burdett-Coutts scholar during the first year of his scholarship, a move which was a mutual benefit to the museum and to the scholar. Either the atmosphere of Oxford or the weight of a large but ill-arranged collection seemed to act as a check on his original investigations, and since his appointment to the professorship at that University science has owed but little to his researches, though as a mining expert he was much sought after. He succumbed to the effects of paralysis, and was buried at Wolvercote.

GEORGIANA ELIZABETH ORMEROD.

Born July 23, 1823. Died August 19, 1896.

THE elder sister and constant companion of Miss Eleanor A. Ormerod passed away at St. Albans, aged 73 years. Miss Ormerod was born in London, and early showed a bent towards botany and conchology; her collection of shells, containing upwards of 3,000 species, was given by her to the Huddersfield Museum. For many years she assisted her sister Eleanor in her work on economic entomology, her linguistic gifts being of invaluable assistance, while her skill with the pencil and brush have been practically applied in drawing a large number of entomological charts, for agricultural or other economic purposes. A short time before her death Miss Ormerod was elected an honorary member of the Bath and West of England Society for her services to agriculture. Her energy and perseverance were remarkable, and her sister writes that she mastered a language at the age of sixty in order to advance her entomological studies.

Apart from her scientific work, Miss Ormerod took great interest in the distribution of serviceable and healthy literature to the poorer classes, and rejoiced in furthering many benevolent and charitable objects. It is difficult to estimate the loss that has fallen on Miss Eleanor Ormerod in the death of this talented and devoted helpmate.

WE regret to record the death of MAURICE VERSUPUY, who had only just returned to France after his daring and rapid march across Africa, from Mombasa to the Congo. He left Mombasa in the summer of 1895, and marched along the Uganda road to Fort Smith in the Kikuyu country. Thence he proposed to visit Kenya, but although his caravan was powerful he was unable to overcome the opposition of the natives and reach that mountain, either through Kikuyu or across Laikipia. He had a hard fight with the Masai south of Lake Naivasha, during which Dick of Mombasa was slain. Versupuy had another conflict with natives further west, but reached the Congo in safety. He returned to Chantilly, where he died of fever a few days later.

DR. J. M. TONER, of Washington, died on July 30, aged 71. He founded the Toner lectures, and in 1882 gave his magnificent library of 28,000 books and 18,000 pamphlets to the Congressional Library. He was also a writer and researcher on medical science.

WE have also to record the deaths of:—SAMUEL H. PARKES, the astronomer, whose early writings on entomology are well known; Mr. CARRIÈRE, of the Jardin des Plantes in Paris, author of many works on plant variation, on August 18, aged 79; LUIGI PALMIERI, Director of the Vesuvius Observatory, aged 89; Professor EGLI, editor of the "Nomina Geographica," and a well-known geographer, aged 73; Professor K. GÜNTHER, anatomist, aged 74, in Wynne, on July 13; the well-known geologist and Alpine explorer, Dr. F. SIMONY, in St. Galle, on July 20, aged 83; the dipterologist, W. TIEF, Professor in Villach, Carinthia; JOSEPH DWIGHT WHITNEY, Professor of Geology and Metallurgy at Harvard University, on August 19, aged 76; ALBERT N. PRENTISS, for twenty-eight years Professor of Botany and Horticulture at Cornell University, at Ithaca, on August 14; F. A. A. SKUSE, entomologist at the Australian Museum, who had lately been working at Australasian Diptera; and GEORGE BROWN GOODE, Assistant-Secretary of the Smithsonian Institution, on September 6.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

We note among recent appointments:—G. F. Stout, of St. John's College, Cambridge, to be Anderson Lecturer on Comparative Psychology at Aberdeen; Professor W. Dames, to succeed the late Professor Beyrich in the Chair of Geology and Palæontology at Berlin, and to have charge of the geological and palæontological collections in the Museum für Naturkunde; Dr. Wilhelm Sandmeyer, to be Professor of Physiology in Marburg University; Dr. Benecke, to be Docent in Botany in Strasburg University; Professor F. Hofmeister, of Prague, to the Chair of Physiological Chemistry at Strasburg; Dr. J. E. Weiss, of Munich, to be Professor of Botany and Zoology in Freising; Dr. Staudenmaier, of Munich, to be Professor of Chemistry and Mineralogy in Freising; Dr. B. Hofer, of Munich University, to be Professor of Fish-Anatomy and Fish-Diseases at the Veterinary School in that town; Dr. F. W. K. Müller, of the Ethnological Museum in Berlin, to be Directorial Assistant; A. Zimmermann, Professor of Botany in Berlin University, to the Botanical Garden in Buitenzorg, Java; F. S. Earle, to be Professor of Biology at the Alabama Polytechnic Institute; B. M. Duggar, to be Assistant in Cryptogamic Botany in Cornell University; Dr. Colin A. Scott, to be Professor of Experimental Psychology at the Chicago Normal School; Dr. Bashford Dean, to be Adjunct-Professor of Zoology at Columbia College.

Mr. E. Gerrard, who for fifty-five years and a half has been an Attendant in the Zoological Department of the British Museum, and who for ten years before that was connected with the then Museum of the Zoological Society of London, quits the service of the Trustees at the end of September. Mr. Gerrard has been for many years a veritable encyclopædia of information as regards the history of specimens in the British Museum, and his loss will be keenly felt. In 1862 he contributed a catalogue of the bones of Mammalia in the Museum. We understand that he will still take an active interest in zoology in connection with his son, and we hope he will enjoy the best of health in his well-earned retirement.

The entomologist, G. A. Baer, of Paris, has gone to Peru to investigate the insect fauna.

Dorpat University and the Russian Geographical Society have requested Dr. N. Busch to undertake a botanical investigation of the Caucasus.

We deeply regret to learn, as we do from the *Daily Telegraph*, that in the great cyclone which passed over Paris on Thursday, September 10, damage to the extent of £3,000 was done at the Musée d'histoire naturelle. Not only did water enter the laboratory and damage many of the specimens there exposed, but several lithographic stones prepared for the illustration of forthcoming memoirs were irretrievably spoilt.

An attempt is being made by the inhabitants of Londonderry to found a museum. We learn from a correspondent, however, that the object is chiefly to get together a collection of relics illustrating the history of the town, though a provision for natural history objects might be made later. But as the present Town Council refuses to take any action, the matter is in abeyance till November, when it may be brought before the Council then to be elected.

MARSHALL FIELD, the founder of the Field Columbian Museum, has promised $2,000,000 to that institution in the event of the city agreeing to remove it from Jackson Park to the new Lake Front Park.

AMONG the specimens added to the Museum of the Royal College of Surgeons during the past year are the following :—The dissected legs and feet of a case of congenital absence of the tibia in man, presented by H. H. Chilton ; four groups of the barnacle, *Lepas fascicularis*, which forms for itself a float of cement bubbles around the minute floating body to which the stalk is at the outset attached, presented by Professor C. Stewart ; a skeleton and dissections of various organs of *Lepidosiren paradoxa* ; various organs of the chimpanzee, presented by J. Marshall ; three specimens of *Myxine glutinosa*, showing that the protandrous hermaphrodite condition of the reproductive organs ; skeletons and organs of *Epomophorus* ; and organs of *Tapirus americanus*.

A NATURAL History Society for the people has been established in Berlin, chiefly to provide lectures of a non-technical character. The first of the series, by Professor Förster, was on "Conditions and Beginnings of Life on the Earth."

THE scientific laboratories of the Imperial Institute have been enriched from two sources : firstly, the Goldsmiths' Company have given £1,000 for extension and equipment, and secondly, a Fellowship of £150 annually for the investigation of natural products has been established by the Salters' Company.

ON October 8 there will be opened at St. Andrews a new building for the Marine Biological Laboratory, containing a large tank-room and a workroom capable of seating six researchers. It will be known as the Gatty Laboratory, after the donor, Dr. C. H. Gatty.

AT the opening of the winter session at Charing Cross Medical School, the first Huxley lecture, on "Recent Advances in Science, and their bearing on Medicine and Surgery," will be delivered by Professor Michael Foster.

THE Antarctic expedition, headed by Mr. de Gerlache, has found its preparations too numerous, and has therefore put off its departure till next year, when it will start probably equipped the better for the delay. There have been rumours that Nansen has expressed a wish to join this expedition, and it is stated that if he will consent to be its leader, the Belgian Government will make itself immediately responsible for all the cost.

WE learn from the *Daily Chronicle* that Dr. Paul Topinard, the eminent French anthropologist, accompanied by Dr. Beddoe, a past president of the Anthropological Institute, is about to make a tour of observation through Wales for the purpose of obtaining statistics with reference to the inhabitants of the remoter districts of the principality, which Dr. Topinard believes will point to an identity of origin of the Welsh and Breton races.

CORRESPONDENCE.

THE DATING OF BOOKS.

WITH reference to this subject, so often referred to in your columns, allow me to bring to your notice "Memoranda of Books registered in the 'Catalogue of Books printed in the Straits Settlements,' under the provisions of Ordinance No. xv. of 1886, during the quarter ending June 30, 1896." This is a sheet published by the Registering Officer, under the direction of the Colonial Secretary for the Straits Settlements, and gives the following items relative to each publication:—(1) Title of Book; (2) Language in which the Book is written; (3) Name of Author, Translator, or Editor of the Book; (4) Subject; (5) Place of Printing; (6) Place of Publication; (7) Name of Firm of Printer; (8) Name of Firm of Publisher; (9) *Date of Issue from the Press;* (10) *Date of Publication;* (11) Number of Sheets, Leaves, or Pages; (12) Size; (13) Number of the Edition; (14) Number of copies of which the Edition consists; (15) Price at which the Book is sold to the Public; (16) Name and Residence of the Proprietor of the Copyright. The italics are mine.

Here we have at once every item of interest or importance connected with a book, certified by the authorities, and registered at a central bureau. I have received this exceedingly important publication, by the kindness of the Colonial Secretary, for some years, and have found it invaluable in verifying references to the literature of Singapore. It is curious that we have to go to one of our smallest colonies, and one yet in its infancy as regards printing and publishing, in order to find such information registered—information which, in older countries, is most difficult to obtain, from want of a system which prevents the false dates often placed upon books by authors and by publishers, and provides a record of value to every person concerned in a publication.

C. DAVIES SHERBORN.

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.*

TO OUR SUBSCRIBERS AND OTHERS.—*There are now published* EIGHT VOLUMES OF NATURAL SCIENCE. *Nos.* 1, 8, 11, 12, 13, 20, 23 *and* 24 *being* OUT OF PRINT, *can only be supplied in the set of first Four Volumes. All other Nos. can still be supplied at* ONE SHILLING *each.*

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It will shortly be necessary to RAISE *the price of Vols. I.–IV. still further.*

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 57. Vol. IX. NOVEMBER, 1896.

NOTES AND COMMENTS.

To Collectors of Fossils.

DR. ARTHUR ROWE'S collection of Chalk fossils has long been known to those interested in the palæontology of that formation, not only for its large size, but for the loving care with which the specimens have been worked out. We are, therefore, glad to have persuaded its owner to furnish us with the account of his methods of preparation which is published in this number. Like a wise man, he has confined himself strictly to his personal experience, but it is clear that many of his suggestions and many of the methods which he employs for the fossils of the Chalk are applicable, with or without modification, to fossils from other formations; indeed, we understand that more than one private worker in other rocks has used the dental-engine with much success.

We draw attention to this paper because it hardly seems to be recognised by many of those who describe fossils even at the present day how necessary it is that their specimens should be properly cleaned, while it is not an exaggeration to say that more than half of the descriptive palæontology published by the past generation has to be done over again in consequence of the new evidence that springs to light, not by the discovery of new specimens, but merely by the proper cleaning of the old ones. A modern worker who endeavours to make a geological specimen tell him all that it has to say is often appalled by the perfunctory manner in which the palæontologists of a former age seemed to think it sufficient to do their work. Dr. Rowe's paper may also be perused with profit by the curators of many of our public museums, even, as he hints, by the officials of our Government establishments; for it is an undoubted, though a lamentable, fact, that there are displayed for the delectation of the British public hundreds of specimens which in their present condition are almost useless to the scientific investigator, but whose obscuring matrix might often be removed by five minutes with the dental-engine.

Dr. Rowe further complains that in most of our public and private collections a very large number of the specimens are from unknown locality, while scarcely one has any indication of the zone from which it came. This has long been a complaint for the fossils from other formations besides the Chalk. We know well enough that foreign geologists are chary of exchanging specimens with British workers, because the collections they obtain lose more than half their value by being devoid of these details of locality and horizon. There has just been reappointed a Committee of the British Association for the purpose of determining the zones of the Carboniferous Limestone, and the first task that this committee will have to perform will be to persuade the numerous collectors up and down the country to pay a little more attention to these details, even should they be the rough-and-ready geologists of the old school who regard such minute modern methods as another sign of the degeneration of the times. But it seems to us that similar committees are just as much required for the other strata of our island. The Chalk itself, whose equivalents on the Continent are known by so many names and are split into so many subdivisions, is still in the minds of most of our collectors capable of no other division than into Upper and Lower Chalk. Any committee appointed for the purpose would naturally work through the medium of local societies, instructing them in the methods of zonal collecting by means of peripatetic lectures, and prevailing upon energetic local geologists to organise the collectors of their neighbourhood. Another line of action that ought not to be unprofitable would be to impress upon those in charge of our museums that at the present day it is of more importance to preserve imperfect specimens carefully localised than it is to go on acquiring magnificent show-specimens too precious to be of use to anyone.

What is Palæontology?

"Palæontography," we have said, "is not always palæontology." What, then, is palæontology? It is the fashion nowadays to say that it is merely a branch of zoology, thus carrying to the extreme the saying of Huxley that "the only difference between a collection of fossils and one of recent animals is that one set has been dead somewhat longer than the other." This is the morphological aspect of palæontology. Then there is the geological aspect, which confines itself to the use of fossils as "medals of creation," each being regarded as a token to tell the geologist the age of the rock in which it occurs. Important though both these aspects are, still palæontology has its independent and wider scope. It is important to trace the migrations of former races from one part of the world to the other, thus throwing light on problems of geographical distribution, not only now but in past ages. It is important that we should make comparative studies of the faunas found in various rocks, with a view to determining the conditions of life that occurred during their deposition. It is important to study the aggregations of species in the rocks, that we may perchance find bionomic connections between the species belonging to different genera, such as undoubtedly obtain in modern seas. These are lines of investigation that cannot be followed in the museum alone, but that demand for their study long days spent in the field, carefully collecting and comparing the fossils from one horizon with those from another, carefully noting the positions of the organisms in the rocks and the mutual relations of associated specimens, and combining with this research the petrological and chemical examination of the matrices that contain the remains. All this constitutes a division of palæontology which is undoubtedly recognised by some of our best workers, but which the pure zoologist and the pure geologist are too often tempted to overlook, since it requires for its prosecution a careful training in both zoology and geology.

Pavingstone Palæontology.

It is, however, not our object to emphasise the need for the study of any particular branch of palæontology, but to point out the distinctness of faunistic study from that zoological and morphological division of the science, with which it is too often confused. The task of describing species and of investigating the structure of fossils must be handed over to men who have had a thorough training in the principles of systematic zoology and of comparative anatomy. It is useless, many of us think it is worse than useless, for the collector or even the geologist to attempt the taxonomic description of his own specimens: even when he does not make egregious mistakes, he is apt to be satisfied with a diagnosis that may possibly be enough for his brother hammer in the same parish working at the same restricted horizon, but that is of no value for the systematist approaching the subject from a more universal standpoint, and that, when placed before the morphologist, only succeeds in leading him astray. Even the mere determination of fossils has nowadays become, like the determination of recent animals and plants, a task for the specialist in taxonomy, and the lists that we constantly see issued in connection with stratigraphical papers can be proved, as Natural Science has before now proved some of them, to be lengthy aggregations of error. Correct conclusions cannot follow from such inaccurate premises; inevitably the determination, no less than the description, of fossils must be left to systematists, who should have had a training in general morphology, and who must be specialists on particular groups.

If the preceding remarks are as true as experience has led us to believe, it follows that the attempts of various most well-meaning persons to describe from a zoological standpoint the whole fauna or flora of a particular group of rocks are foredoomed to failure. Long ago Huxley scornfully stigmatised such attempts as "pavingstone palæontology." It is the class of work that is turned out by these estimable and energetic people that has for so many years brought disrepute upon palæontology, with which, unfortunately, it became confused in the minds of zoologists. Sometimes, of course, these worthy folk have the wit to recognise their own ignorance, and by taking counsel with one friend after another have been able to produce compilations, the value of which, if not great, has at any rate been slightly increased. This, however, is unsatisfactory for science, and not altogether fair to the friends in question. Would it not be better if these would-be universal geniuses placed the whole work of zoological investigation in the hands of the zoological specialists? After they had done this, they need not complain that their occupation was gone, for there would still be much for them to do in the other division of palæontology to which we have alluded. They could still collect with care, still determine horizons and study associations of fossils, and, if they wished to compare the fauna existing at one horizon in one country with that existing at another horizon, or in another country, they would be able to do so with far better results, since the materials for discussion would no longer be incorrect determinations and imperfect descriptions, but the carefully elaborated conclusions of many highly-trained specialists.

A Plea for Detail in Stratigraphy.

The preceding notes had been written before Mr. J. E. Marr delivered his address to the Geological Section of the British Association, and we were delighted to find similar views forcibly urged by so recognised an authority. Mr. Marr occupied the main part of his address "with reasons for the need of conducting stratigraphical work with minute accuracy." He did well, for there are in this country many people, professing to speak as geologists and palæontologists, who still pooh-pooh the detailed investigation of fossils and the correlation of minute subdivisions of stratified systems with one another. They say that in such work we lose sight of broad generalisations, that correlation is absurd when species must have taken time to migrate, that the field-geologist really cannot map so trivial a thing as a "zone," much less a "hemera," that the poor student is getting so puzzled he cannot pass his examinations. The absurdity of such protests was temperately yet thoroughly exposed by Mr. Marr. It was the minute palæontological investigation of strata that unlocked the secret of the Highlands and inaugurated a new era in physical and dynamic geology; microscopic examination of sediments, coupled with accurate zoological knowledge, has thrown brighter light on the problem of the permanence of oceans than all the speculations of the physicist, whose "imposing superstructure of mathematical reasoning" is "often founded upon very imperfect data"; the history of volcanic action, the reconstruction of former geographies, the explanation of the present contours of the earth, all these are elucidated by, indeed are impossible without, the most careful work of the stratigrapher. As for the influence that this kind of work has on our knowledge of ancient life, we need not repeat what we have already said; but the following passage expresses so forcibly a truth for which we are always contending that we quote it as fully as our space permits:—

"The importance of detailed observation in the field is becoming every day more apparent, and the specialist who remains in his museum examining the collections amassed by the labours of others, and never notes the mode of occurrence of fossils in the strata, will perhaps soon be extinct himself . . . In the first place, such a worker can never grasp the true significance of the changes wrought on fossil relics after they have become entombed in the strata, especially amongst those rocks which have been subjected to profound earth-movements; and it is to be feared that many 'species' are still retained in our fossil lists whose supposed specific characters are due to distortion by pressure. But a point of greater importance is that one who confines his attention to museums cannot, unless the information supplied to him be very full, distinguish the differences between fossils which are variations from a contemporaneous dominant form, such as 'sports,' and those which have been termed 'mutations,' which existed at a later period than the forms which they resemble. The value of the latter, to those who are attempting to work out phylogenies is obvious, and their nature can only be determined as the result of very laborious and accurate field work; but such labour in such a cause is well worth performing. The student of phylogeny has had sufficient warning of the dangers which beset his path, from an inspection of the various phylogenetic trees, constructed mainly after study of existing beings only . . . but recent researches amongst various groups of fossil organisms have further illustrated the danger of theorising upon insufficient data, especially suggestive being the discovery of closely similar forms which were formerly considered to be much more nearly related than now proves to be the case. . . . As the result of careful work, dangers of the nature here suggested will be avoided, and our chances of indicating lines of descent correctly will be much increased. It must be remembered that however plausible the lines of descent indicated by students of recent forms may be, the actual links in the chains can only be discovered by examination of the rocks, and it is greatly to be desired that more of our geologists, who have had a thorough training in the field, should receive in addition one as thorough in the zoological laboratory. Shall I be forgiven if I venture on the opinion that a certain suspicion which some of my zoological fellow countrymen have of geological methods is due to their comparative ignorance of palæontology, and that it is as important for them to obtain some knowledge of the principles of geology as it is for the stratigraphical palæontologist to study the soft parts of creatures whose relatives he finds in the stratified rocks?"

For these and many other pointed remarks, all those who are endeavouring to do work of real value, however minute their share, owe the president of Section C a debt of gratitude, and they will join with us in the hope that his Address will find its way into many a dim recess that they know only too well.

The Organisation of Sections at the British Association.

We do not know whether it was its President's eloquent plea for minute detail that affected the work of the Geological Section at Liverpool, but certainly it was as detailed, and consequently as dry, as the most Precambrian of fossils could wish. The ordinary person does not feel strongly impelled to hear a disquisition on "Two Examples of Current Bedding in Clay," or on "Quartzite Lenticles in the Schists of S.E. Anglesey." Even certain papers that did attract us by their titles, such as "The Depths of the Sea in Past Epochs" and "The Conditions under which the Upper Chalk was deposited," proved when we heard them to be for the most part repetitions of matter that we had already seen in print many years ago, and that, if their authors escape injury, we do not despair of seeing in print again as many years hence. But we should not like it to be inferred that other Sections were much better. "Fever in Mice" did, it is true, attract the ladies to the Physiological Section, only to disappoint them with long statistics of temperature. No one, however, can have been drawn to hear of the Action of Pilocarpine on the Eosinophile Granules of the Leucocytes, in the same Section; or, except for the sake of securing a good place to hear Mr. Francis Darwin later in the day, can many have been induced to attend the Botanical Section at 10.30 to be told about the Arrangement of the Vascular Bundles in certain Nymphæaceæ.

Of course, the wise man does not go to hear these papers: he knows that many of them are read for the sake of self-advertisement, and that any which are of value will soon be accessible through the ordinary channels of publication. For all that, it seems well to protest, if only in the hope that our words may reach the Canadian cousins who are preparing so splendid a welcome for the Association next year. These papers not merely clog the work of the Sections, but they have an effect directly contrary to the main object of the Association. Some, perhaps, read by local naturalists, or descriptive of local phenomena to which the attention of visitors should be directed, are not to be discouraged, but the rest both frighten away the people whom the Association wishes to attract, and, what we feel to be of more importance, tend to split the scientific visitors themselves still further among sections. The Association should rise above the specialism of most of our learned societies; it should offer a field where the zoologist might confer with the botanist, where both might exchange experiences with the geologist, and where all three might pick up something of use to them from the physicist and chemist, who in their turn need not go the poorer away. Let there be more discussions on matters of general interest, and let them be thrown open to even more sections. Why, for instance, should the discussion on Neo-Lamarckism have been confined to zoologists? Surely some of the physical problems that were hinted at in the discussion on the cell might have been laid before the physicists.

There are some who decry these general discussions, who say that the good men will not speak, that no one keeps to the point, that they only appeal to the Association bore. In this there is much truth, but it only proves that better organisation is needed. The subjects of discussion should be more strictly limited, and speakers should be kept to the point. We mentioned a "Discussion on the Cell"; why, one might discuss the cell for a month. But, as our Note on it shows, the discussion was almost entirely confined to the mechanics of nuclear movement, and a speaker who discussed cell-division on broader lines was told he was straying from the point. The truth was that there was no point to stray from. Again, instead of a discussion on Neo-Lamarckism, which was crushed out by the very vastness of the subject, or one on early man in the Mediterranean, which elicited little besides a string of contradictory statements, why could we not have had some definite question clearly put before us, or some definite thesis maintained? The organisers should get people with knowledge to attack the proposed problem from definite sides, and should explain to them beforehand precisely what the subject of discussion was to be. Even the public need not be snubbed or misled, and an abstract of the opener's speech might be issued the day before.

Again, if we must have sections meeting separately, we should like to see the sections dealing with what we call the natural sciences housed a little nearer to one another. At Liverpool, geology was three-quarters of a mile away from zoology and from the temporary museum, where many specimens of great geological interest were exhibited. Of course, there are often mechanical difficulties, but we imagine that the divorce is occasionally due to misunderstanding quite as much as to incompatibility.

Modification and Variation.

It must be admitted, however, that the Zoological Section did its duty in the way of discussion of general principles, both by itself and in conjunction with other sections. The first discussion of importance was that which purported to be on Neo-Lamarckism, and which was opened by Professor Lloyd Morgan. In a lucid paper he brought forward his useful distinction between *variations*, which are of germinal origin and congenital, and *modifications*, which are impressed on the organism by its environment. The question at issue between the Neo-Darwinian and the Neo-Lamarckian has of course been whether modifications, which are admitted by all, can be transmitted from parent to offspring, and so come under the influence of natural selection in the same way as variations are transmitted and come under that influence. Professor Lloyd Morgan, while theoretically holding the strict Neo-Darwinian position, that modifications are non-transmissible, considers that they may not be without their effect upon the evolution of the race, since through them environment may act upon variation indirectly. In a word, he supposes that an existing modification opens a way for the occurrence of a similar variation. The modification is, *ex hypothesi*, in accord with the environment, and its existence in the parent permits of variation in a similar direction in the offspring. He illustrated this by comparing the tendency to variation to the swinging of a number of pendulums in all directions, while the action of the environment or the action of the existing structure of the parent acts as a check on the pendulum swing in a certain direction, though permitting it in those directions that are harmonious with the existing structure. Thus any further modification of parental structure opens a new plane for the swing of a new pendulum.

Unfortunately the subsequent speakers did not, for the most part, direct their remarks toward this thesis of Mr. Lloyd Morgan's. We shall therefore confine ourselves to urging the following difficulty. The modification induced by environment arises necessarily after the fertilisation of the ovum, and in most cases a considerable time after that event; variation, on the other hand, either is inherent in the ovum or spermatozoon, or is a result of the process of fertilisation. In the life of a single individual it is obvious that no modification can affect variation, since this is necessarily antecedent. Again, to suppose that a modification of either the male or the female parent affects potential variation in the spermatozoon or the ovum, is merely to re-state, in other words, that a change of environment which affects the parent likewise affects the generative products; and such a statement is nothing more or less than Cope's theory of Diplogenesis, which already holds the field as one of the main theories of the Neo-Lamarckian.

ARE WE DESCENDED FROM KING-CRABS?

THE next important discussion in which the zoologists took part was that which, by an innovation in the Association's procedure, was permitted to follow the Address of the President of the Physiological Section. Dr. Gaskell took this opportunity of forcing on the attention of biologists the theory which he has previously put forward more than once, that the Vertebrata are descended from Arthropoda, the points of connection being represented among recent animals by *Ammocœtes*, the larva of the lamprey, on the one side, and by *Limulus*, the king-crab, on the other. It is certain that during the two hours in which Dr. Gaskell delivered his very remarkable address he was able to adduce a quite astonishing number of coincidences in structure, as shown in the annexed table; and it is a striking fact that his hypothesis should have led him to the discovery of structures previously unsuspected, such as the sense-organs in the flabellum of *Limulus* and the camerostome of *Thelyphonus*, which he claims as corresponding to the auditory and olfactory organs of *Ammocœtes*.

Table of Coincidences between Limulus and its Allies, and Ammocœtes and Vertebrates (after Gaskell).

LIMULUS AND ITS ALLIES.	AMMOCŒTES AND VERTEBRATES.
Central Nervous System.	
Supra-œsophageal ganglia ..	Cerebral hemispheres.
Optic part	Optic thalami, ganglia habenulæ, &c.
Olfactory part	Olfactory lobes.
Œsophageal commissures ..	Crura cerebri.
Infra-œsophageal ganglia.. ..	Epichordal brain.
Prosomatic ganglia	Hind brain, cerebellum, post-corp.quadrig.
Mesosomatic ganglia.. ..	Medulla oblongata.
Ventral chain.	
Metasomatic ganglia.. ..	Spinal cord.
Alimentary Canal.	
Cephalic stomach	Ventricular cavities of brain.
Straight intestine	Central canal of spinal cord.
Terminal part..	Neurenteric canal.
Œsophagus..	Infundibular tube and saccus vasculosus.
Mouth tube..	Hypophysial tube, later nasal canal.
Liver	Part of subarachnoideal glandular tissue.
Appendages and Appendage Nerves.	
Prosomatic or locomotor appendages	Appendages of oral chamber or stomatodæum.
Foremost appendages ..	Upper lip and tentacles.
Last appendages	Velar appendage and median ventral tentacle.
Metastoma	Lower lip.
Nerves of prosomatic appendages	Various branches of Vth nerve.
Mesosomatic or branchial appendages	Appendages of branchial chamber.
Opercular appendages ..	Appendage innervated by VIIth nerve.
Genital part	Thyroid gland & pseudo-branchial groove.
Branch. part	Hyobranchial.
Basal part	Septum of stomatodæum.
Branchial appendages ..	Branchial appendages innervated by IXth and Xth nerves.
Special Sense Organs and Nerves.	
Lateral eyes and optic nerves ..	Lateral eyes and optic nerves.
Median eyes and nerves	Pineal eyes and nerves.
Camerostoma and olfactory nerves	Olfactory organ and Ist nerve.
Flabellum and nerve	Auditory organ and VIIIth nerve.
Epimeral nerves to surface of prosoma and mesosoma	Sensory part of Vth nerve.
Internal and External Skeleton.	
Internal skeleton.	
Branchial cartilages	Branchial cartilages.
Entapophysial cartilaginous ligaments	Subchordal cartilaginous ligaments.
Fibro-massive tissue (forerunner of cartilage or "Vorknorpel")	Muco-cartilage or "Vorknorpel."
External skeleton.	
Chitinous layer	Cuticular layer on surface of body and subepithelial laminated layer.
Excretory Organs and Cœlomic Cavities.	
Coxal gland..	Pituitary gland.
1st head cavity, præoral	1st head cavity, præoral.
2nd head cavity. Cavity of prosomatic segments	2nd head cavity, mandibular.
Cavities to each mesosomatic segment	Cavities of hyoid and branchial segments.
Heart and Vascular System.	
Dorsal heart	Column of fatty tissue dorsal to spinal cord.
Longitudinal venous sinuses ..	Heart and ventral aorta.
Lacunar blood spaces of appendages	Lacunar blood spaces in velar and branchial appendages.

Since, however, Dr. Gaskell's arguments have long been before the scientific public, and since his complete address can now be easily obtained and studied, we shall not recapitulate them here. It may, however, be interesting to record some of the objections that were raised in the discussion.

In the first place, it is interesting to note that, though one or two speakers, such as Dr. Gadow, seemed inclined to support Dr. Gaskell, or at least to demand for him a fair field, still no attempt was made by anyone, except Dr. Gaskell himself, to rebut the arguments brought forward by the other side.

As for the supposed difficulty in the tubular nature of the vertebrate central nerve-cord, and its lining by non-nervous tissue, Professor Weldon, comparing the development of the nervous system in worms, pointed out that the nervous tissue arose from the deeper layers of the derm, which were separated from the outside by a layer of non-nervous ectoderm, while, as Mr. Garstang also insisted, the conversion of the invertebrate system into a tubular system was to be traced in the collar of *Balanoglossus*, an animal which Dr. Gaskell ignored. Professor Minot, on the other hand, reminded us that the nervous system of Vertebrata was not embryonically a tube, but arose in each individual as a solid mass, which became hollowed afterwards; such a solid nervous system is also found in Invertebrata, and there are no grounds for denying the homology. As for the epithelial lining, the nervous system in Invertebrata has a different embryonic origin from the digestive tract, whereas in Vertebrata the lining of the nerve canal has the same embryonic origin as the central nervous system. The infundibulum, too, if it represented a mouth, should be at the end of this tube, whereas it occurs at the base of the ventral zone of the brain at some distance from the end of the supposed tube. The cerebral hemispheres, moreover, are a product of the dorsal zone of the brain, and therefore cannot be the simple homologues of the invertebrate supra-œsophageal ganglion.

Dr. Gaskell would explain the packing tissue of the *Ammocœtes* skull as derived from the liver of *Limulus*. But similar packing tissue is not so rare, for it occurs, as stated by Professor Weldon, surrounding the alimentary canal, ovaries, and liver of the crustacean *Nebalia*, and, as Professor Minot pointed out, round the supra-renal capsules of man, though not of rodents.

We believe that Professor Hickson was right in affirming the agreement of all morphologists that the alimentary canal of the Vertebrata is homologous with that of the Invertebrata. There may be dispute as to the precise ancestor, but as to this fundamental fact there is none. Dr. Gaskell, however, would have us believe that an entirely new alimentary canal was originated by the closing in of the *Limulus* appendages around a cavity on the ventral surface, portions of these appendages forming the vela of the proctodæum and stomodæum. These latter, unfortunately for the hypothesis, are structures that occur not only in vertebrates but in invertebrates, and even in *Limulus* itself. The gill-slits in the anterior region of the alimentary canal are supposed by Dr. Gaskell to be the original spaces between the concresced limbs; why then, asked Mr. Weldon, are they formed in a vertebrate as slits gradually appearing in a continuous wall, and why is there no trace of them in the post-branchial region? More fundamental was the objection so clearly stated by Mr. MacBride that in the simplest type of vertebrate development with which we are acquainted (that of *Amphioxus*) the alimentary canal is formed by invagination, precisely as it is in the arthropod *Lucifer*, whereas the nerve-cord is formed much later by a simple layer of cells, over which a sheath of non-nervous cells grows as a protection.

Out of all these difficulties Dr. Gaskell extricates himself by denying the fundamental postulates of embryology, and by setting aside deep-seated homologies accepted by all comparative anatomists, whatever their peculiar heresies may be, in order to set up for himself a new method of morphological investigation, or rather, as he complacently informed us, a very antiquated one revived. The coincidences of adult structure on which he lays such stress are coincidences of a character familiar to those who study more than one group of animals, and are often of very superficial nature. It is, for instance, not to be wondered at that a transverse section of the thyroid should resemble that of the genital duct of a scorpion, for as Professor Weldon remarked, similar glandular arrangements are not so rare among invertebrates. Nor can much stress be laid on the presence of a chitinous layer in the skin of *Ammocœtes*, when we observe that this is not outside the epidermis, as it is in Arthropoda. As for the limbs of *Pterichthys* being morphologically comparable with those of *Limulus* or the Merostomata, this was stoutly denied by our chief authority on the subject, Dr. Traquair; while Mr. Bather, besides dwelling on the difficulty of the transmutation of a highly specialised type of structure into another highly specialised type with totally different physiological relations, insisted that, if this were really so, the absence of the well-developed connecting links, with their presumed chitinous exo-skeletons, from the record of the rocks was almost inconceivable in face of the fact that the broken ends of the supposed chain were so fully preserved to us in the Silurian and Devonian periods.

Finally, Mr. Hoyle summarised what evidently was the view of most zoologists present, in his parable of the medical student who, chancing on a cuttle-fish, wrote a learned and elaborate paper clearly demonstrating that every one of its structures was homologous with, and the immediate precursor of, the organs of a typical vertebrate.

Cell Facts and Cell Theories.

Yet another discussion, this time between zoologists and botanists (why not also physiologists?), was that on the Cell, initiated by

Professor Farmer, whose kindness has permitted a full abstract of his paper to be inserted among our articles. The discussion itself afforded examples of that disagreement among biologists to which Mr. Farmer alludes. Professor Zacharias was one of those who held that the radiating fibres seen in a dividing cell were in no sense contractile, but the expression of lines of force, and who rejected the individuality of the chromosomes. Dr. Gustav Mann, on the other hand, maintained the permanence of the centrosomes and the definiteness of their structure, while, on the ground of physiological evidence, such as that the chromatin in a gland-cell might change from day to day, he denied definiteness to the chromatin of the cell. The disagreement of doctors, if not the opposing evidence of acknowledged facts, is enough to show that we are not yet in a position to base elaborate hypotheses on such inconclusive evidence. While, therefore, we may admit with Professor Yves Delage that Weismann's theory is the only one that explains how the special characters of the male and female parent are contained in the fertilised egg, we may also agree with him that the theory is contrary to the evidence at present before us. We may even go so far as to maintain with Dr. C. S. Minot that the interest in the celebrated theories of "The Germ-plasm" is now a historical one. However this may be, there is one point on which all speakers were agreed, namely, that future advance will be made chiefly by the investigation of the living cell, through methods which were not at the disposition of the older observers.

"Anatomical Characters" in Systematic Botany.

In the Botanical Section, the presidential address, by Dr. D. H. Scott, put the present position of morphological botany in a clear light. At the outset he deplored the want of a study of the comparative embryology of seed-plants. It is often assumed that the development of the embryo from the fertilised ovum will teach us but little in botany; an opinion which is largely based on ignorance. As regards the value to systematists of characters which those gentlemen are pleased to call "anatomical," there is no doubt, as Dr. Scott himself has shown, that certain well-marked peculiarities of internal structure are constant in more or less definite systematic groups. Such a character is the presence of bast on the inside, as well as on the outside, of the wood-bundles in several orders of dicotyledons, *e.g.*, Solanaceæ, Asclepiadaceæ, Apocynaceæ. Similarly, Masters has shown that in many conifers anatomical characters may be useful for diagnosing species. In the pines, for instance, the position of the large resin-canals as seen in the transverse section of the leaves, the arrangement of the stomata, the branching or not of the foliar bundle, are all of some value. In the most recent revision of the Acanthaceæ the sculpture of the pollen-grains is extensively used as a generic character by Lindau, while Hallier makes bristly-pollen the most important feature in his limitation of the genus *Ipomœa*.

Just as in zoology, there is a growing tendency among the younger systematists to make use of a far wider range of characters, the constancy of a character, and not its position, being the quality that gives it classificatory value. Where botany appears to differ from zoology is in the fact that so few changes are necessitated by the more rigorous tests; and this says much for the acumen of the older workers.

Alternation of Generations in Plants.

Where must one seek the origin of the second generation? In the mosses, ferns, and higher plants there is a regular alternation of a sexual and an asexual generation. In the Algæ and Fungi there is no such regularity; the same individual may bear reproductive organs of both kinds. Is the neutral or asexual generation (the sporophyte) something new which has been intercalated between two sexual stages (oophytes), the latter alone being comparable with the individual in the thallophyte? or is the sporophyte also comparable to such an individual, the two generations contrasting only in this—that in the one reproduction depends absolutely on a sexual process, in the other is purely asexual? In a word, is the alternation *antithetic* or *homologous*? Bower, the chief exponent of the former theory, conceives the sporophyte to have arisen as a mere group of spores in a fertilised ovum. Hence the origin of its vegetative portion, whether thallus or stem, leaf, and root, must be sought in the sterilisation of this sporogenous tissue, that is to say, in a conversion of spore-forming into vegetative cells. In the address we are discussing, Dr. Scott preferred Pringsheim's view, which, by regarding the two generations as homologous, obviates the necessity of a new birth. On this view, the sporophyte is simply an individual precisely comparable with the oophyte, but it has acquired the habit of producing only asexual spores, while the case of the oophyte is the converse. As is well known, many green Algæ, such as *Ulothrix* and *Œdogonium*, can form asexual spores (zoospores) at any stage of their development, but there is one stage, namely, on the germination of the fertilised ovum (oospore), at which they are always formed. There is no difference at all between the two sets of zoospores; there is no indication of anything new. In another green alga, *Sphæroplea*, zoospores are formed only on the germination of the oospore; that is to say, there is here as definite an alternation of a sexual generation (the *Sphæroplea* plant) and an asexual (the oospore with its zoospores) as in the mosses.

Mosses and Ferns.

Concerning the relations between mosses and ferns, Campbell's *Anthoceros*-like ancestor for the latter does not find favour with Dr.

Scott. "An unprejudiced comparison," says he, "seems to me to show nothing more here than a very remote parallelism, not suggestive of affinity." "There is no reason to believe that the Bryophyta, as we know them, were the precursors of the vascular Cryptogams at all." "Things seem to point to both Pteridophyta and Bryophyta having had their origin far back among some unknown tribes of Algæ." The utter hopelessness of attacking such a problem is very forcibly put. It is generally agreed that Gymnosperms arose somehow from the vascular Cryptogams. Yet in the far-off days of the Devonian we find both flourishing together. "Hence, in the Devonian epoch, there had already been time, not only for the Pteridophyta themselves to attain their full development, but for certain among them to become modified into complex Phanerogams. It would not be a rash assumption that the origin of the Pteridophyta took place as long before the period represented by the plant-bearing Devonian strata as that period is before our own day. Can we hope that a mystery buried so far back in the dumb past will be revealed?"

A Nesting Fish (*Amia calva*).

In his valuable account of the early development of *Amia calva* (*Quarterly Journal of Microscopical Science*, vol. xxxviii., p. 413), Dr. Bashford Dean describes the curious nesting habits of that archaic fish. In the beginning of spring the fish leave the deeper waters of the lake and sun themselves in the shallow, swampy ends, where Chara, Potamogeton, and bulrushes abound. Immediately before spawning the fish divide themselves into parties, each consisting of a female and several males. The nest is prepared some time before spawning. Its method of construction is doubtful: "fishermen state that the spawning party prepares it by constant circlings . . . . . the soft weeds and rootlets appear bent and brushed aside in a way that gives it somewhat the appearance of a crudely-finished bird's-nest." The spawning fish leaves the nest from time to time, returning in company, and the eggs and milt are shed simultaneously. The eggs, after being fertilised in the water, become instantly adhesive, sticking to the roots of the water-plants. The early stages of development are rapid, the larvæ all disappearing from the nest twenty-four hours after the eggs are laid.

A curious feature is that the male acts as guardian of the nest and caretaker of the young. Soon after all the eggs are laid, a single male takes his position on the nest, and his constant movements no doubt aid in keeping the eggs free from sediment, and duly supplied with oxygen. The larvæ leave the nest in a body, and presently appear as a dense swarm swimming under and around the male. The male remains with them for some time, gradually leading them away from the breeding ground, and during this period he is most zealous and courageous in their defence.

Bird Day.

A "Bird Day" for America, on the same lines as the "Arbor Day," was suggested some two years ago by Mr. C. A. Babcock, of Pennsylvania, and approved by the U.S. Department of Agriculture. Its observance has again been pressed upon the attention of the National Education Association, in a circular dated July 2, 1896, which points out that the object of the Government is "to diffuse knowledge concerning our native birds, and to arouse a more general interest in bird protection." It is also stated that "one of the greatest benefits of Arbor Day is the sentiment and interest aroused in the subject of trees and in the broader study of nature." As appeals to the humanity of woman are fruitless, and the ignorance of the farmer is still deplorable, perhaps the best means for the preservation of feathered beings is to interest the young in birds in general, stress being especially placed upon their more interesting habits, their foods, and uses. The circular fully recognises the harm done to agriculture by the "Scalp Act" of Pennsylvania, of 1885, and the uselessness of waging war against noxious animals, because it almost invariably leads to the wholesale destruction of life, and the destruction therefore of many animals of inestimable value to the agriculturalist.

Phosphatic Chalk.

A second locality for phosphatic chalk has been discovered by Mr. John Rhodes, fossil collector to the Geological Survey, and has been described by Mr. Aubrey Strahan in the *Quarterly Journal* of the Geological Society for August. The newly-discovered bed is from one to two feet thick, and is seen throughout the section in the Southerham Pit "on the south-western side of the high downs of Upper Chalk which overlook Lewes from the east." In composition the Southerham phosphatic chalk is almost identical with that of Taplow; the brown grains can easily be separated from the chalky matrix by a weak solution of acetic acid. Mr. Strahan refers the bed to the horizon of the Chalk Rock, and points out that in this respect alone it differs from the Taplow deposits, which occurred in the *Actinocamax quadratus* zone of the Upper Chalk. Fish-remains are abundant in the phosphatic band, and Mr. Chapman has given a list of forty-two Foraminifera and six Ostracoda in an appendix to the paper.

A very rich phosphate from Taplow, containing no less than 65 per cent. of phosphate of lime, was exhibited at the July meeting of the Geologists' Association by Mr. F. W. Rudler, on behalf of the discoverer, Mr. de Mercey.

English Cave Dwellers.

While the Irish Cave Fauna is being investigated by Messrs. G. H. Carpenter, H. Lyster Jameson and others, to whose work we have often alluded (Natural Science, vol. vi., p. 148, March, 1895, and vol. viii., p. 371, June, 1896), the modern inhabitants of the caves of England are receiving the attention of Professor Denny, of Firth College, Sheffield, who is engaged with the exploration of the caves of Derbyshire. Although Mr. Denny has not yet published anything on his researches, we understand that the famous Peak Cavern at Castleton has already yielded a varied fauna, comprising representatives of the following groups of Invertebrata:—Chætopoda, Crustacea, Myriopoda (Diplopoda), Insecta (Diptera, Coleoptera, Collembola), Arachnoidea (Araneidæ and Acarina). Among these Professor Denny has found several blind types, but only one appears to be a true troglodyte, and that, strange to say, is none other than the Collembolan—*Lipura Wrightii* (of Carpenter)—which was, we believe, the first true cave animal discovered in the Mitchelstown Cave, of which we have heard so much of late. Mr. Martel (President of the Société Spéléologique of Paris) was therefore not quite accurate, in his recently published account of Mitchelstown Cave, in stating that "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 delegates from local societies corresponding with the British Association unanimously resolved at the Liverpool meeting that Mr. G. Abbott's paper on District Unions of Natural History Societies, published in Natural Science for October, under the title of "The Organisation of Local Science," "be distributed by the Committee of Delegates amongst *all* the natural history societies in the United Kingdom," with the object of obtaining their opinions on the feasibility of the plan. Clearly, the delegates are more in favour of federation than they were when the proposal was first introduced at their meeting in Montreal, in 1884. It will be curious if Toronto proves the scene of its ultimate adoption.

Pressure on our space obliges us to hold over till December further notes with which our correspondents at the Liverpool meeting of the Association have favoured us. In our next number, too, we shall publish Mr. MacBride's paper on the position of Morphology, which gave rise to some discussion.

An error, as annoying as it was obvious, crept into the Note, "Natural Science at Cambridge," in our October number. We said that "over three hundred unnamed specimens of Bryozoa" had been given by Miss E. C. Jelly to the University Museum of Zoology. It should, of course, have been "named specimens." Mr. S. F. Harmer, whom we thus misquoted, kindly informs us that some of the specimens have, in fact, "almost the value of type-specimens, since they belong to the same lots as those from which the original descriptions of the species were drawn up." We offer sincere apologies to Miss Jelly and Mr. Harmer.

I.

The Influence of Mind in Evolution.

THAT Charles Darwin, intent on his own discovery, the influence of natural selection by the survival of the fittest, should have given less than their due to other causes that may have contributed to the evolution of the colours and forms of animals was natural enough. Perhaps it was equally natural that his more ardent followers should go further than himself, and see in natural selection the sufficient explanation of everything. The tendency towards sheer materialism, which is perhaps an inevitable first result of accepting Darwin's theory, has disinclined them even to allow to an animal's habits and actions any influence in modifying the form of the species. All animal life is to them a gambling-table, in which every number in turn comes up, but only those which chance to fall into the right hole, labelled "environment," count towards the winning of the game. This view reaches its climax in Weismann's doctrine that characters acquired by an individual after birth are not transmitted to its posterity. Weismann is a great name, but since Herbert Spencer has stood up against him as the champion of the opposite doctrine, that acquired characters are transmitted and that the use or disuse of any organ is one of the most potent among the influences that control its development, meaner men who have never been able to believe that natural selection does explain everything may take courage to admit their conviction. I am one of these. Natural selection alone has always seemed to me utterly inadequate to explain many of the phenomena which come under the notice of every naturalist. In fact, natural selection itself appears to require an antecedent cause. Look, for example, at the phenomenon known as protective resemblance or mimicry. If the likeness of an insect to a leaf, or a twig, or another insect, often procures its escape from its enemies, then it is easy to see how natural selection may operate in maintaining and perfecting that likeness, for those in which it is least exact will be soonest discovered and killed. But it is obvious that the resemblance must be initiated and carried a certain length before natural selection can begin to operate at all; for until the likeness of an insect to some other object is sufficient to cause it sometimes to be actually mistaken for that object, no step in the direction of that likeness can be of any advantage to the insect. Natural selection in this case must follow the same course as human selection, which first put Darwin on the track of it. A breeder does not create varieties of pigeons, or fowls, or dogs: the utmost he can do is to seize upon any natural tendency to vary in a certain way, and perpetuate and accumulate it. Fowls often have a small crest—that is, the feathers on the top of the head are elongated; by breeding from these for many generations, and carefully selecting the most pronounced examples, the breeder produces the magnificent crest of the houdan. He cannot do the same thing with pigeons, because they have no tendency to vary in that way; but they often have the feathers on the back of the head twisted upwards, and this has been made a normal feature in several distinct breeds.

What then initiates the likeness which natural selection perfects into mimicry? Of course many causes may combine, of which some may be merely accidental, or may result from the conditions of the creature's life. The first element of likeness in an insect which mimics a green leaf is greenness, and this may be merely the result of its feeding on leaves and absorbing the colouring matter from them. A very large proportion of the larvæ of moths and butterflies are green from no other cause. The direct action of light may be another agency. Again, in view of the enormous number and variety of forms that have come upon the stage since the first appearance of life on our planet, we must allow that the doctrine of chances alone is sufficient to account for a great many superficial, or even close, resemblances. The perfectly ludicrous likeness of the pupæ of butterflies of the genus *Spalgis* to the face of a baboon, or ape, can be explained in no other way. In that instance the likeness, being of no advantage to the insect itself, could not come under the operation of natural selection, but in other cases it may have been otherwise. When, however, one considers some of the more striking instances of mimicry, together with the manner in which they are associated with certain peculiarities of habit necessary to render them effective, all these explanations together fail to satisfy the mind: one is forced to the conviction that there must be some special influence at work conforming the pattern to its copy.

Take, for example, the leaf-butterfly, *Kallima*, one of the most familiar and certainly one of the most extraordinary cases of mimicry known to us. This butterfly is brilliantly coloured on the upper surface, being chiefly blue in one species, and purple and yellow in another; but the under surface is an almost absolutely perfect representation of a dead leaf. The colour is some shade of brown, not exactly the same in any two specimens; a dark, diagonal line traces the midrib, a network of finer lines represents the venation, and there are even stains and mouldy patches, and sometimes small transparencies which look like holes in the leaf. Even the shape of the wings is modified to carry out the deception, and the ends of the posterior pair are prolonged to form the stalk of the leaf. In connection with this extraordinary combination of form and colour, let us consider the habits of the insect. Though it inhabits shady forests and shuns strong sunlight, it flies by day, its brilliant hues of course making it a conspicuous object; but its flight is exceptionally powerful, and it has little to fear on the wing. When it requires to rest, however, it does not do so, like almost all other butterflies, on the under-side of a leaf, but on the bare trunk, or one of the larger boughs, of a tree. Another fact to be noted is that it does not feed on the nectar of flowers, but is greedily fond of the juices that exude from the wounded bark of certain trees. These habits, of course, expose it in a special degree to those tree-lizards which are by far the worst of all the enemies that butterflies have in tropical forests. The ease with which a butterfly may often be caught with the finger and thumb proves how little their imperfect eyesight secures them against an enemy approaching cautiously from behind. They see a little better in front of them, and I have noticed that the leaf-butterfly always alights head downwards, so as to face anything coming up the tree, which is much the most likely direction of assault from a lizard. [In pictures generally, and in the showcase at the British Museum (Natural History), the butterfly is turned the opposite way, facing upwards, which is, no doubt, more appropriate to its character as a leaf; but that is a detail rather above the intelligence of a lizard: at any rate, I never saw a *Kallima* sit in that position.] It also abstains entirely from opening its wings and displaying its glories to the sun, as almost all brightly coloured butterflies are so fond of doing: it sits rigidly motionless. But all these precautions would not save it without its wonderful disguise. How effectual that may be was vividly brought home to me once by another deceiver of the same character, a kind of slow cricket which exactly resembles a small patch of grey lichen. I was sitting high up in a tree, rifle in hand, waiting for a tiger, when my attention was caught by one of these crickets scurrying round the trunk of a neighbouring tree, with a lizard in full pursuit. Just as the lizard came up with it, the cricket, falling in with a slight depression in the bark, stopped dead and flattened itself out, and the lizard was utterly confounded. There it stood, looking ludicrously puzzled at the mysterious disappearance of its prey, which was just under its nose.

In both these examples we find a most extraordinary disguise associated with peculiar habits not shared by undisguised members of the same family, and these are not merely passive habits, or habitual attitudes, but active habits. That the tendency to act so under such circumstances was evolved by natural selection side by side with the disguise, even granting that there existed an initial likeness from some other cause, is not easily conceivable, at least to my mind. Moreover, there is in the behaviour of the insect something that distinctly indicates the play of at least a dim kind of intelligence. The cricket at first yielded to a primary and almost universal instinct and ran from the lizard, but when that way of escape was clearly closed it *acted* its disguise. If we could find any reason to believe that the consciousness, or volitions, of an animal may be among the influences which have worked towards the evolution of its colour and form, then that is the direction in which I should look with most hope for the wanting explanation of these phenomena of mimicry and some others. And though, as Mr. Beddard well says in his book on Animal Coloration: "At every step in animal coloration we are met with closed doors which can only be unlocked by keys furnished by an intimate chemical and physiological knowledge such as we do not at present possess," there are not wanting facts that appear to point in the direction I have indicated. Darwin's explanation of the phenomenon of blushing is founded on the fact that "attention, or consciousness, concentrated on almost any part of the body produces some direct physical effect on it." From this he goes on to argue that "whenever we believe that others are censuring, or even considering, our personal appearance, our attention is vividly directed to the outer and visible parts of our bodies, and of all such parts we are most sensitive about our faces, as no doubt has been the case during many past generations. Through force of association the same effects will tend to follow whenever we think that others are considering, or censuring, our actions or character." "By frequent reiteration during numberless generations the process will have become so habitual, in association with the belief that others are thinking of us, that even a suspicion of their depreciation will suffice to relax the capillaries, without any conscious thought about our faces." We have Darwin on our side, then, if we believe that some effect may be produced on the skin of an animal's body, not only by its attention being directed to its own appearance, but by anything which has become associated in its consciousness with its own appearance.

Now let us turn to the chameleon. I once kept a reptile of that genus in a birdcage for six months, and grew pretty intimate with it. Its ordinary colour in the daytime, if there were no green leaves in the cage, was a dark smoky brown, sometimes with numerous, small, whitish spots; but at times, when the sun shone on it, it would indulge in a display of rich green, beautifully dappled with large, irregular marks of a lighter shade. If I approached it at such a time, it would fix one of its grotesque, rotating eyes on me, and, remaining perfectly motionless, change in a few seconds to a tint in harmony with the objects surrounding it. Absolutely ignorant as we may be of the way in which this change was brought about, two things are quite clear. The first is that the change resulted from the chameleon's becoming conscious that it was observed. It may have been quite involuntary, in which case Darwin's explanation of blushing fits exactly. Conspicuousness in its appearance being associated in the chameleon's mind with danger, the presence of danger affected its whole skin just as if its attention had been concentrated on its own appearance. The second fact goes beyond the phenomenon of blushing altogether, and introduces an entirely new element. It is this, that the kind of change effected in the chameleon's skin was decided by the colour of the objects immediately surrounding it at that time. There appears to be little room for doubt that this effect is produced through the eyes. As to the way in which it is produced we are yet without a satisfactory explanation, but there the fact is. The physical effect produced on the chameleon's skin by the consciousness of danger is modified in some way, mysterious to us, by the colour that happens to be before its eyes at that time, so that its skin assumes that colour. It is worth noting too that its attention was concentrated on me, the source of danger; and the colour of my coat, which might be bright red, was probably at that moment irritating its optic nerve more than any other; but this had no influence. The inference seems to be that a sense of the colours of surrounding objects is blended with the consciousness of conspicuousness which affects the skin, and operates through it. The conspicuousness results of course from the contrast between its own colour and that of the things about it, and it may be this contrast which is present to the consciousness of the chameleon. A curious point that ought not to be lost sight of is that the chameleon's eyes work quite independently, so that, while one was fixed on me, the other was directed on the objects surrounding it. To what extent its mind is capable of dividing its attention we have no means of knowing.

The chameleon is not the only animal which changes colour to suit its surroundings. Many tree-frogs do so, but they change more slowly, and I cannot say from personal observation whether consciousness of danger ever has any effect in causing the change. The pupæ of many butterflies also, especially those of the genus *Papilio*, take the colour of the surface to which they are attached. They are green if suspended among foliage, but brown if attached to the trunk of a tree; and in artificial circumstances they can assume other tints within certain limits. It is not certain, however, that this effect is produced through the eyes of the larva. It may be a result of the direct action of light on the moist and sensitive surface immediately after the larva has shed its skin. It matters little, for a single case like the chameleon is quite sufficient for my argument.

Now let us try to enter into the consciousness of a leaf-butterfly sitting motionless among withered leaves, or, if that is too difficult, of a quail feeding in a stubble field. A quail's one resource in danger is concealment, to hide itself and be still. This instinct, strong at first by inheritance, has been fostered and strengthened in it by its whole life from the time when it first ran under its mother for safety. But it ventures out into the field to feed. A hawk appears in sight. If there is a bush or a tuft of grass at hand it will rush into it; failing that, it squats and remains motionless. Its state of mind as the enemy sails overhead may, I think, be assumed to be precisely that of the chameleon with its eye fixed on me. Can it be doubted that some physical influence is being exerted by its consciousness on its skin, and if on the skin, then on the feathers growing out of it? It may be objected that the feathers are mere dead matter, beyond the reach of any vital influence, but that is not true of them while they are growing. That it is true after they are matured suggests a reason why any effect produced on the quail by its own consciousness should be permanent, and not merely temporary, as in the chameleon. Bird fanciers redden the colour of canaries by feeding them with cayenne pepper while their feathers are growing. When the feathers are mature the effect will become permanent, but further treatment of the same kind will cease to produce any result. So there is nothing in the present state of our knowledge to forbid the idea that the colour of a quail may be permanently affected by the condition of mind in which it passes so much of its time when young, viz., lying close and wishing not to be seen. And is there anything to forbid us inferring from the case of the chameleon that the change may consist in assimilation to the colours of surrounding objects, which in the case of the quail are pretty much the same always? The change may be so slight as to be quite imperceptible, but "by frequent reiteration during numberless generations" (the words are Darwin's) it may bring about that characteristic disposition of browns and yellows which makes most ground birds so difficult to see upon the ground. And it may be one of the principal influences that have been operative in bringing about many protective resemblances and mimicries. I referred to the tendency of Darwinism to lead its devotees into a very materialistic way of regarding animals. It will be difficult for those who have succumbed to that influence to allow so much significance to the consciousness of a mere insect, or even a bird, as my suggestions imply; but is it not possible that we have been all along underrating the degree of intelligence exercised by even the lowest animals in the direction of their lives, and so turning away our attention from a factor which is certainly there and may have had an unsuspected share in the evolution of animal forms? There are two faculties which broadly distinguish animal from vegetable life, namely, perception and action consequent on perception, in other words, the exercise of *mind*; and it seems to me that it is to these that we should first look for an explanation of any phenomenon which, like mimicry, prevails widely in the animal, but scarcely, if at all, in the vegetable kingdom.

EHA.

II.

The Preparation and Mounting of Chalk Fossils.

WHILE, doubtless, every collector looks upon one particular formation as the one of supreme interest, it will readily be conceded that the English Chalk occupies a warm corner in the heart of most palæontologists. Nor is the reason far to seek; for the fauna of the Chalk is so rich and so varied, the beauty of the fossils so great, the state of preservation so perfect, and the matrix lends itself so readily to skilful manipulation. Indeed, if one excepts certain intractable beds, such as the Melbourn Rock and the Chalk Rock, it is the collector's own fault if he fail to obtain an artistic result, and that with no better implements than a knife and a tooth-brush. But, unfortunately, slovenly specimens are the rule, and skilful manipulation the exception, and most private collections consist of partially cleaned specimens in shabby cardboard boxes, with loose labels, some of which may providentially be in the right tray. Even in the Government Museums one sees such imperfect work in developing and preserving fossils that one need make no excuse for touching upon apparently elementary points.

In the first place, with the exception of certain beds to be noted below, all Chalk fossils that come from sea-shore sections must be soaked in fresh water for periods varying with the size of the specimen. Having roughly trimmed the blocks, it will be found sufficient, as a general rule, to soak them for fourteen days, changing the water every day. If this be not done, the salt effloresces on the surface of the specimen as soon as the block dries, and not only disfigures the fossil but often destroys it. The softer the chalk is, the more necessary is it to remove all the salt. And in this, as in all other simple processes, attention to trivial detail is necessary, in order that a satisfactory result may be obtained. Chalk is very porous, and holds a large amount of water. For instance, a pound of dry Margate chalk will take up four ounces of water by weight, and this fact carries with it the conclusion that it is best to immerse the blocks while they still retain some of the moisture of the cliff. The reason for this is made obvious if one drops a piece of dry chalk into water: the imprisoned air is displaced by the water, and seeks the surface with a hissing noise from the liberation of the air bubbles. Should there be any crack in the chalk the sudden expulsion of the air will cause the block to split. The best way, then, is either to moisten the blocks before immersion, or to let them stand in a shallow layer of water before filling up the bowl. Blocks which are cracked, or in which there are obvious marly veins traversing the chalk, should be wrapped in muslin lightly tied round with string before being immersed, and very damaged or precious specimens had better be moistened by means of a spray-producer before they receive their bath. Another good plan is to build a strengthening wall of plaster of Paris around the broken parts of a block. If one collects Bryozoa, and has some five hundred specimens as the result of a tour, it will be found that a daily changing of water becomes a weariness to the flesh. This may be readily and cheaply obviated by making a platform by means of half-inch wire-netting strained over a stout wire ring; and the apparatus is made more perfect by the addition of a couple of stout wire handles and four short wire supports to act as feet. The platform is made of such a size that it closely fits the sides of a large pan, near to the bottom, on which the feet alone rest. All debris then falls clear of the blocks, and settles at the bottom of the vessel. In this way fifty small blocks can be changed in as many seconds. These suggestions for soaking the blocks apply to all beds in the Upper and Middle Chalk. But with the Grey Chalk and Chalk-marl it is different, as, in the first place, the salt does not show up so plainly when the specimen is dry, and in the second, the combination of clay and lime does not readily lend itself to permeation by water. The Chalk-marl is the worse of the two, and with the exception of the large echinoderms, it is better to avoid the process, as in many instances the matrix melts away in the water. And the same, in varying degree, applies to the Grey Chalk, though the *Belemnitella plena* marl, and certain bands in the zone of *Ammonites rhotomagensis* stand the immersion well. Specimens of *Salenia* and *Pseudodiadema*, if spineless, can readily be taken out of the matrix, and they then offer a good resistance to the water.

In passing, one may mention that Gault fossils are best worked with a knife when they are slightly moist, and that beautiful results may be obtained by using a badger-hair brush. Fossils from the Thanet Sands, if tide-washed, are very difficult to preserve, as the salt simply splits them to pieces. If the block of friable sandstone is trimmed, and the edges and base well dabbed with a strong solution of silicate of potash, one can sometimes successfully soak them; but to do this one must spray them first, and then lower them into shallow water on a glass plate fitted with wire handles. These Tertiary sands are so friable that it is often impossible to carry home a specimen of any size, and in such cases it is a good plan to trench out the specimen with a knife, coat the sides of the square or oblong with silicate, *in situ*, come back in an hour's time, and remove it from the cliff.

Should Chalk fossils be worked with a wet or with a dry brush? Clearly, with the exception of the large echinoids and the more robust brachiopods, there is nothing to be gained by the use of water, as both matrix and fossil are much more fragile when wet. An indispensable article in every workshop is an irrigator, and the thing is both cheap and simple. All that is wanted is a pail with a short half-inch leaden pipe soldered into it near the bottom. To this is attached a rubber tube, armed with a glass irrigator-point, and controlled by a spring clip. Any surgical instrument-maker will supply the two last for a few pence. If the pail is placed on a shelf, three or four feet above the level of the bench, a good stream is secured. By means of this simple contrivance one can use a fine and powerful jet of water, which will effectually wash away all the fine dust left behind by the dry brush. This plan is vastly better than treating the fossil with dilute hydrochloric acid, the use of which should be limited to the Flamborough Head sponges, the oxide of iron sponges of the Upper and Middle Chalk, and the bulky lithistids and hexactinellids of the Chalk-marl. Even in the case of these it should be employed with great caution, and then only in a very weak form.

Now, a few words as to the choice of knives. The ordinary dissecting scalpel is the best type of knife for most of the work, and in the field there is nothing better than the Swedish knife. But anyone who has cut up much chalk will have a lively recollection of the soreness of the middle joint of the index finger, due to the pressure by the back of the knife. This led me to devise the round-ended knives with a cutting surface extending from the front edge to half an inch down the back. The ease and rapidity with which one can with such a knife work off masses of chalk has to be seen to be believed, for by pushing the broad, round, cutting point one obtains all the power of the action of a chisel, with all the delicacy of finger manipulation. Further, one can be sure of not puncturing or scratching the fossil as one does with a sharp pointed knife, which as often as not breaks off as soon as any pressure is employed. One of the chief uses of these round-ended knives is to be found in working out the Plocoscyphiæ of the white Chalk, for the matrix can be scooped out of the chambers without damage to knife or specimen.

That beautiful work can be done with an ordinary knife and tooth-brush a visit to the Natural History Museum or School of Mines will abundantly prove. Even in private collections one sometimes sees beautiful results, and in none is this better shown than in the cabinets of Mr. James Fox, of Stamford Hill. But excellent as are these results, one cannot but deplore the great amount of time expended, especially when far more accurate and complicated work can be done in a tenth part of the time. It is the American dental-engine which has worked this revolution.

The engine has been employed by me for more than three years, and as fresh ideas have been evolved, so has the degree of mechanical perfection in the work increased. The use of the dental-engine was suggested while working at a fine *Cidaris sceptrifera*, for it was easy enough to clear with a tooth-brush the top of the test and the first row of spines; but, after that, no real headway could be made, as the knife could only dig the chalk off the test, and no brush could work between the lower rows of spines. The dental-engine, with its revolving brush no more than $\frac{4}{20}$ inch in diameter, soon solved the difficulty, and cleaned the specimen so thoroughly that the little spatulate spines were left *in situ*, and not a fragment was broken off.

It may not be out of place to give the measurement of the brushes which have proved to be most generally useful. The brushes are made of hard and soft bristle, and of badger-hair, and they can be made of any length and thickness so as to suit the taste of the worker.

Small bristle brushes	i.	length $\frac{7}{20}$ in.	diameter $\frac{4}{20}$ in.
	ii.	,, $\frac{5}{20}$,,	,, $\frac{3}{20}$,,
	iii.	,, $\frac{4}{20}$,,	,, $\frac{2}{20}$,,
Small badger-hair brushes	...	,, $\frac{7}{20}$,,	,, $\frac{3}{20}$,,
Large and hard bristle brushes		,, $\frac{9}{20}$,,	,, $\frac{4}{20}$,,
Large badger-hair brushes	...	,, $\frac{10}{20}$,,	,, $\frac{8}{20}$,,

With brushes like these one can do most things. *Cidaris sceptrifera* was cited as an example of what the engine can do, but this is coarse work compared to much that can be achieved by this instrument. The delicate *Plocoscyphia convoluta* of the soft Margate Chalk can be cleaned out so that chamber opens into chamber, and a bristle may be passed from one cavity to another, the hexactinellid mesh being left intact, and the walls of the convolutions standing out unbroken, though no thicker than a stout visiting card. This sponge, to the best of my knowledge, has never been worked out before, and, but for the round-pointed knife and the dental-engine, it would probably still be undeveloped.

But even more striking than this is the result obtained with the Bryozoa, especially with the delicate branching Cyclostomata. Here, instead of being content with tediously hand-brushing a fallen fragment, one can take a colony, with its intertwining branches, and clear all the matrix away, leaving the beautiful structure supported by only a few points on the block, with every cell sharp and clear. In my collection there is a colony of *Pustulipora pustulosa*, two inches square, with branches under $\frac{2}{20}$ of an inch in diameter, cleared in this way, and so delicate is the work of the engine that not a particle of the branches was broken off in the process. *Reticulipora obliqua* can be taken out of the matrix, and all the mesh-work cleared out, so that not an atom of chalk remains. Such delicate Bryozoa as *Entalophora proboscidea*, *Vincularia regularis*, *Heteropora francquana*, and the like can be displayed on the matrix with a badger-hair brush, without the least damage to the specimen.

The student of Foraminifera, Entomostraca, and Bryozoa, who has the good fortune to work in a district where spongiform flints abound, has his task made easy, for the flint-meal will yield him countless treasures, which only require to be washed in water to be ready for mounting. It is very different for those who work in districts where the flint is compact, for there every specimen must be laboriously worked out of the chalky matrix.

Every collector of Bryozoa must have been struck with the number of beautiful forms to be found in a cliff section, which are useless, by reason of the weathering of the exposed surface. The dental-engine offers a very simple solution of this difficulty. The process is as follows. Thoroughly clean the exposed surface with the badger-hair brush, and work it so finely that the specimen is nearly undercut. With a sharp pointed knife free the specimen from the block, taking away the smallest possible amount of matrix with it. Cement it, worn surface downwards, on some suitable rough surface, and when dry work the unweathered surface with the badger-hair brush. It is important to apply the gum only to the fossil itself, and to leave the matrix untouched by the cement. Soak off the specimen in hot water, and mount on a slip of black cardboard. An excellent thing to fix the specimen upon is a glass slip that has been roughened in the centre with hydrofluoric acid. Kay's cement has proved very useful in my hands. Bryozoa as thin and fragile as *Entalophora proboscidea* and *Vincularia regularis* can be treated in this fashion. In a like manner all small fossils, such as macroscopic Foraminifera, little brachiopods, and small Serpulæ can be removed from their matrix, and mounted in any position on black cardboard.

These instances are quoted as examples of the delicate work which one can get out of the engine; but it must not be supposed that practice and deft fingers have nothing to do with the process. Those who are engaged with the zonal distribution of the Bryozoa will find the engine most helpful in obtaining a rapid determination for making a list. If one has to handle several hundred Bryozoa from one zone, it is manifestly impossible to clean them all perfectly, and a few touches of the brush will put the determination beyond doubt, and at the same time tell one if the specimen is worth working. Bryozoa like *Truncatula*, *Semicytis*, *Homœosolen*, and *Idmonea* require to be worked on both sides to establish a determination, and in these cases the rapid work of the engine is simply invaluable.

But the dental-engine can do hard work equally well, and perhaps no better chance of testing its powers could be found than the effectual cleaning of large masses of Chalk-marl sponges, such as *Plocoscyphia labrosa*, *Craticularia fittoni*, and all the host of intractable lithistids. In this case the bristle-brush is replaced by the cutting rose-headed bur, and the steel and brass brush, and it is astonishing to see the way in which the hard matrix melts away before the business-like little tools, and the manner in which the sponge structure is revealed, but not destroyed. In fact, so much can be got out of the engine, both in power and delicacy, that the results leave little to be desired. Given a reasonably workable chalk, the specimen should be so thoroughly cleared by the brush that it should successfully stand the scrutiny of a strong hand lens. Indeed, no specimen can be considered clean until it will pass this ordeal.

The bristle brush can be used for working fossils in a damp state, and if the Grey Chalk and Chalk-marl specimens are worked in a moist condition (not soaking wet) beautiful results may be obtained, even in such awkward cases as clearing the long spines of *Ostrea carinata.* The Grey Chalk Salenias and Pseudodiademas are often quite impossible to clean in a dry state, and if care be taken to avoid using too much water, the urchins may be freely handled.

Anyone who has attempted to clean echinoderms of the nodular chalk of Dover, of the Melbourn Rock, or of the Chalk-marl, will have been reduced to despair by the way in which portions of the matrix decline to be removed. A very good plan is to reserve the stumps of the half-worn bristle brushes for these obdurate specimens, or in the case of the Holasters and Hemiasters of the Grey Chalk and Chalk-marl, to use the fine brass brush. This brush is of the same size as No. i. bristle brush, and is made of crinkled brass wire, as fine as silk, and it does no harm. Some patches, however, are so grown into the surface of the shell that nothing will remove them, and the dry brush will even polish them.

If one may judge from the grimy state of many Chalk fossils in public museums, not one of the least useful functions of the engine will be found in the case of the large badger-hair brush, which takes a thin film of matrix off flat surfaces without cutting into the specimen. Thus a fresh surface can in a few seconds be given to a block, without laboriously paring away the chalk with a knife, with the certainty of reducing the specimen to the vanishing point in course of time.

While on the subject of touching up old specimens, it may be well to mention that all hard fossils can be safely cleaned by dabbing them with cotton wool soaked in methylated ether. Many specimens would split if water were brought in contact with them, but the ether evaporates so rapidly that no harm is done.

The variety of instruments which can be fitted into the hand-piece of the engine varies only with the ingenuity of the worker, and special burs can be used for smoothing down the surface of Chalk-marl blocks, or drills can be made for piercing them.

As a lubricant for the engine nothing excels a white odourless hydrocarbon oil, which goes under the name of oleum deelinæ, or paroleine. Moreover, one can keep the steel burs, brushes, and drills in the same excellent fluid; and if a wide-mouthed bottle is filled with river-sand soaked in the oil, the scalpels can be stuck into the sand, and left with impunity even in a damp workshop.

The choice of an engine is a matter of no small moment, both from the point of view of cost and efficiency. What is wanted is a short, second-hand instrument, which is easy to work sitting down. Never mind if the engine is not a thing of beauty, so long as it goes well, and do not be induced to buy one of those tall silver-plated erections which cost from £10 upwards. What is known in the trade as a "S.S.White Engine," with flexible coil and short stem has served me for three years without breaking down, and one wants nothing better than that. If the machine does not work easily while one is sitting down, discard it at once, as a proper instrument will enable one to work for hours without causing fatigue. Indeed, when one gets used to the movement, it becomes almost a reflex action. Above all things, in choosing the engine, fit a brush or bur into the hand-piece, and see if it travels true. If the hand-piece 'wobbles,' the brush will deviate from the straight line and describe a small circle, and it will inevitably smash every specimen with which it comes in contact. This engine should not be a costly affair, and should be within the reach of most large collectors; indeed, I venture to say that no workshop will be complete without it. An excellent engine can be bought for £2 10s., and the small bristle brushes cost a penny each, and the steel burs about 10s. a dozen. The latter can be recut for a trifling cost when they are blunted. The softer bristle brushes, and those made of badger-hair, should be made at home, so that they can be made to suit the specimen in hand. The hand-piece of the engine is the only part likely to get out of order, and occasionally that gets clogged with dust, and has to be detached and sent to the dental depôt.

It is impossible, in a short communication like this, to describe the actual working of the various little tools, or to describe the tools themselves, or the manufacture of the brushes. The makers will be pleased to show them to anyone who is interested, and it will be a pleasure to me to give a short demonstration on the process to those who care to call upon me. The knives and steel brushes can be obtained only of Down Brothers, St. Thomas' Street, Borough, and the large bristle brushes only from Claudius Ash & Sons, Broad Street, Golden Square. The burs and small bristle brushes are supplied by Rutterford & Son, 11 Poland Street, Oxford Street. A dental-engine can be got from Rutterford or Ash, and it is worth while to get a friendly dentist to help you to chose one.

No claim is made for any special originality in this application of the dental-engine, but it is asked that the method should have a fair trial, as it is reasonable to think that it is destined to revolutionise the cleaning of fossils in soft rocks, and to enable the palæontologist to develop specimens which have hitherto been severely left alone. Nobody who has once experienced the satisfaction of working with this simple mechanical assistance will ever revert to the tedious and clumsy method of knife and tooth-brush, and the mere time saved will alone repay the worker for the small outlay. This method of cleaning fossils has recently been introduced into the Natural History Museum, Cromwell Road, and into the Woodwardian Museum, Cambridge.

A few suggestions as to mounting fossils when they are cleaned might not be out of place, although, no doubt, every collector has his own method.

Cardboard trays and loose labels are an abomination: delicate specimens can be put in boxes with glass tops, and, in any case, every specimen should have its own label fixed to it in some way. My plan is to mount each specimen or series of specimens on a wooden tablet, upon which is written the name, zone, exact locality, and a reference to some accessible figure of the species. The tablets may be in multiples of each other. The best wood for making them is that of the American poplar, known as American white-wood. This is soft enough to allow thin pins to be driven in without bending, and firm enough to prevent a heavy specimen from pushing the pins out of place. The wood is covered with paper such as "Hieratica" or "Silurian," with the aid of a spirit-gum known as "parlour paste" and a copying-press. The edges of the paper should be trimmed off neatly with a round-pointed knife. The specimens are attached to the mount by pins: headless pins of any length or thickness may be obtained from D. F. Tayler & Co., New Hall Works, George Street Parade, Birmingham. Specimens that have to be examined with a lens, such as Bryozoa, Foraminifera, and Entomostraca, should be kept under glass, since they will rarely stand a second cleaning. Many collectors of Bryozoa mount their specimens on wooden microscope slides with a circular aperture backed by black paper. The plan has its advantages, but the specimens get dirty, and their size is necessarily limited. I mount Bryozoa on black cardboard slips, and enclose them in a glass tube which is fixed with pins to a wooden mount on which the label is written. The tubes that I use all have a length of 1¼ ins. (about 31 mm.), with a diameter of ⅛ in. (3·5 mm.), ½ in. (12·5 mm.), and ¾ in. (19 mm.) Tubes of this or other sizes may be bought by the gross from Maw, Son & Thompson. If the surface of the cardboard used is too greasy to take the gum, this can be remedied by rubbing it with methylated ether.

A cement is necessary for fixing small specimens to the tablets, and for mounting broken ones. Fish-glue sometimes sinks into the chalk, and, if the museum is at all damp, often causes mould to form and the specimen to be detached. Gum and plaster of Paris is an excellent cement, clean and strong, but the desideratum is something which will set instantly, and will enable the specimen to be as readily detached in case of need. Such a material is found in "dental model cement," which is probably a compound of shellac and white wax, and is procurable at any dental depôt at a cost of twopence a stick. A spirit lamp is the only accessory. The value of the cement lies in the fact that it is white and clean, always ready, and reasonably strong; and that anything as thin as a sixpenny-piece can be stuck up on end on the mount, and very thin surfaces, such as the fragments of an echinoderm, can be instantly fixed together. Moreover, large masses of chalk may be at once cemented together, and the cement has this advantage, that the chalk can be afterwards treated with water or hydrochloric acid without in any way impairing its strength. The cement is soluble in benzol, and any bead of it which exudes between joined surfaces can be rubbed away with cottonwool soaked in that fluid, or flaked off with the point of a knife, or pared away with a blade which has been heated in the spirit lamp. To detach a specimen from its mount, it is only necessary to heat it, or to pass under it an old flexible table-knife which has been heated. When the chalk is soft, it is better to soak the bottom of the block with silicate of potash, as otherwise the cement may adhere to the mount, and drag away with it a layer of the chalk. A very useful aid to heating awkward corners and angles of a specimen is to be found in the spirit lighter, called a promethean, which is used to light incandescent gas burners.

Let me conclude by a plea for the more exact localisation of fossils. For this one usually looks in vain, and "South of England" seems to be considered near enough for all practical purposes. As to zonal localisation, there is so little evidence of such a custom in high places that it would be wonderful if it were commonly found in private collections. But if a collector cannot name a fossil, or determine the zone from which it comes, he can at least fix the exact locality; and this it is his clear duty to do, since many notable fossils lose half their value from indiscriminate collecting. On this head Mr. A. J. Jukes-Browne, in his paper on "The Subdivision of the Chalk," gives good advice. He says: "Much, however, still remains to be done in completing our knowledge of faunas of the different zones, and everyone who makes a collection of fossils from any part of the Chalk, and is careful to record the exact zone and quarry where each specimen was obtained, will be rendering valuable assistance."

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III.

Zoology since Darwin.[1]

Part II.

ZOOLOGY profited much by the countless researches which consciously or unconsciously led towards the solution of the problem of heredity and variation.

Darwin accepted heredity as a fact proved by the specific resemblance between parent and child, without seeking after its material carriers.[2] Since all living beings consist of cells, and even the most complicated organism has in the first beginnings of its development the form of a simple cell, these carriers could only be portions of cells. To find them was left to a deeper insight into the build of the cell and into the meaning of its parts. As the structure of the cell-substance and the nucleus contained therein was investigated with new methods, the surprising fact was discovered that movement and irritability as well as respiration were functions exercised by the cell-substance independently of the nucleus, and that on the other hand assimilation and secretion followed only under the influence of the nucleus, and that this was the only organising form-building factor of the cell. Further research showed the nucleus to consist of two substances, chromatin and achromatin, easily distinguished by their re-action to colouring agents; the first of these plays an important rôle in cell-division, since its changes introduce the process of multiplication, and lead, through regularly successive typical forms (mitosis), to division first of the nucleus, and then of the extra-nuclear cell-substance.

The conclusion that chromatin was the true heredity-substance could only be deduced with convincing clearness after duo-parental (amphigonic) reproduction had been studied. Here, where two cells, usually of different form, combine to form an egg capable of develop-

[1] Lecture delivered by Professor Ludwig von Graff on his installation as Rector Magnificus of the K. K. Karl-Franzens University in Graz, November 4, 1895. The profits from the sale of the original go to the Freitisch-Stiftung of the University. (*Continued from p.* 198.)

[2] Darwin's Pangenesis hypothesis, which assumed the germ to be influenced by the body in which it was buried, as well as by the prevailing external conditions, in such a way that minute particles were continually added to it from all parts of the body, has no actual foundation, and is, as Weismann says in his "Keimplasma," p. 7, "more a statement, than an explanation, of the problem of heredity."

ment, the conclusion was confirmed that the chromatin of the egg arose in equal parts from the chromatin of both parent-cells.

Thus was solved the problem of centuries—the problem of fertilisation, whose story shows, in the most instructive and, at the same time, most amusing manner, how preconceived ideas can dim observation, and how ingenious the human mind becomes when it is a question of supplying want of fact by dialectics.

Next to phylogenetic research, investigations on cell-division and fertilisation stamp the post-Darwinian period of zoology. They are among the most brilliant achievements in the domain of natural science. The zoologists who took chief part in them, W. Flemming, O. and R. Hertwig, Ed. van Beneden, were the first[1] to render possible the exposition of a theory of heredity. For, weighty as may be the most modern discovery that all movements of chromatin are accomplished passively, guided and directed by a source of energy placed in the newly-found centrosome, it effected no change in the interpretation of the chromatin as the substance that transmits the parental characters.

Since all cell-nuclei come from the nucleus of the ovum, there is in all body-cells a part of the parental chromatin, and thereby an inheritance of the parental characteristics is insured. On this foundation rests Weismann's theory of heredity,[2] to which we cannot deny the one merit of having at last clearly formulated the question of inheritance.

Are the ways of evolution exactly determined beforehand by the constitution of the germ, or is the germ a mass of formative substance, indifferent up to a certain point, and governed in its further development solely by the conditions to which it is exposed?

The descent of modern organisms from ancestors of different form on the one hand, and the facts of heredity, which teach us that parent and child (or, broadly put, the successive generations of the same species) always pass through specifically similar stages of form on the other hand, give the answer to this question. As the orthodox Darwinian expresses it: Every organism is the result of heredity and adaptation; what the parent inherits it transmits in its entirety to the child, but adds thereto what it has itself acquired.

Weismann's Neo-Darwinism, in opposition to this, denies the inheritance of acquired characters; and there exists neither a single undoubted fact to disprove his teaching, nor any theory that can

[1] *Note added by Author, October,* 1896: When writing this part of my address, I was fully aware that the name of O. Bütschli should have figured in *the front rank* of researchers on cell-division and fertilisation. Its omission was due to a *lapsus calami* which I deeply regret, but which I cannot understand; indeed, I only became aware of it through reading Bütschli's review of my address in *Zool. Centralblatt*, iii., p. 421. I am glad that this publication in NATURAL SCIENCE enables me in a measure to repair the omission.

[2] A. Weismann, "Das Keimplasma: Eine Theorie der Vererbung." Jena, 1892. This author has also dealt with the question in "Die Allmacht der Naturzüchtung: Eine Erwiderung an Herbert Spencer." Jena, 1893. "Aussere Einflüsse als Entwickelungsreize." Jena, 1894. "Neue Gedanken zur Vererbungsfrage." Jena, 1895.

render plausible the idea that new characters appearing in the organs of the body are transferred to the germ-cells. If we accepted this, or —what comes to the same thing—a direct action of the environment producing heritable modifications, we should have to admit that from the eggs of any single species new forms of the most varied description, capable of life and reproduction, could be obtained by simply changing the conditions of existence. This—which is contrary to all experience—is the final consequence from the assumption that external conditions are the factors which decide form. O. Hertwig and Y. Delage[1] seek to escape these conclusions—which they too consider absurd—by attributing the essential similarity of child and parent to the specific chemico-physical composition of the germ-plasm derived from the parent. The production of one species from the germ of another would always be prevented, because every germ must die which does not find the life-conditions adequate to its specific composition. But this means nothing else than that the causes of form lie in the internal composition of the germ.

In the face of these true causes of form inherent in the germ itself, to attribute equal causal influence to external conditions is obviously arbitrary, and, moreover, implies—as F. von Wagner[2] has shown—a confusion of "cause" and "condition" contrary to the customary use of the ideas.

The System and the comparative anatomy of organisms show us that a seemingly infinite number of developmental possibilities lie open to the germs, and therefore if certain germs always pursue the same path as did their countless generations of ancestors, this can be due only to internal causes; the path, however, in order to be followed, must lie open—that is, there must exist certain external circumstances ("conditions"), in order that the causes may result in visible action.

[1] Y. Delage, "La Structure du Protoplasma et les théories sur l'hérédité et les grands problèmes de la biologie générale." Paris, 1895. Delage's views on heredity are the exact antithesis to Weismann's. Characteristic is his contention that in order to explain the morphological and physiological agreement between parent and child, the idea of a hereditary substance inherent in the germ is no more required than it is to make us understand why the corpse of a worm, of an insect, of a frog or of a mammal, under the same external conditions, always undergoes decomposition in its own peculiar way, each creature having its own typical process.

O. Hertwig, "Präformation oder Epigenese? Grundzüge einer Entwicklungstheorie der Organismen." Jena, 1894. English translation by P. Chalmers Mitchell, reviewed in NATURAL SCIENCE, vol. ix., p. 270. Hertwig stands midway between Delage and Weismann, inasmuch as he does not put the causes of form exclusively in the germ, or exclusively or principally in external conditions, but thinks them both equal in their influence. Hertwig says himself of his theory (pp. 132–133):— "My theory may be called *evolutionary*, because it assumes the existence of a specific and highly-organised initial plasm as the basis of the process of development. It may be called *epigenetic*, because the rudiments grow and become elaborated, from stage to stage, only in the presence of numerous external conditions and stimuli, beginning with the metabolic processes preceding the first cleavage of the egg-cell, until the final product of the development is as different from the first rudiment as adult animals and plants differ from their constituent cells."

[2] F. v. Wagner, "Some Remarks on O. Hertwig's Entwickelungs-Theorie" (*Biologisches Centralblatt*, xv. Bd., pp. 777–815, Leipzig, 1895), and "Das Problem der Vererbung" (*Aula*, i. Jahrg., nos. 24 and 25, Munich, 1895).

E. Haeckel has asserted[1] that the whole theory of descent stands or falls with the inheritance of acquired characters. This would be so only if there were no other explanation for the variability of the organism. However, even Weismann does not deny that the conditions of existence exercise an influence over the constitution of the germ-plasm, and may, during long periods, strengthen many components in the combination of forces of the latter, weaken others, and even introduce new sources of energy. But these influences will only act directly, and not through the medium of other organs of the body.

In order to accept this direct influence of the germ-plasm by external agents, we are specially directed to those organisms with monogonic reproduction. In amphigonic organisms, the simple mixture of the inheritance substance of two parent-individuals produces an extraordinary number of possible combinations in the composition of the germ-plasm—so many that the extrusion (observable before the beginning of development) of a part of the nucleus of the ovum (the so-called polar body) was believed to indicate an arrangement for the elimination of the superfluous inheritance-tendencies.[2]

The cause of variation lies then in the individually changing composition of the germ-plasm, and what we call "adaptation" is no active and direct performance of the individual, but is the result of a more or less complicated selective process working through generations of individuals. The external conditions, to whose influence animals respond in exact, regulated ways, peculiar to each species, are therefore in no wise the real causes of such reaction, but release a formative energy, latent in the germ, and brought into action only under these definite conditions.

If we accept the view here set forth, there results a noteworthy contrast between the germ-cells and the "soma"—that multiform and often extraordinarily complicated combination of the remaining organs of the body. Principally in this, that in the segmentation that takes place during the development of the egg, those cells which in the perfected organism will play the rôle of germ-cells, receive a portion of all those parts of the egg which are necessary for the re-formation of a complete individual; while, in the soma-cells, only those substances necessary to the formation of a particular organ or organ-complex are transmitted. At the same time, however, the soma becomes a kind of organ of the reproductive cells, which accomplishes the work of assimilation, moves, feels, and thinks—but thereby serves in some respects only the development of the germ-cells, and so ensures the continuity of life.

(To be continued.)

[1] E. Haeckel, "Zur Phylogenie der australischen Fauna. Systematische Einleitung." In R. Semon, "Zoologische Forschungsreisen in Australien und dem malayischen Archipel," i. Bd., Jena, 1893.

[2] A. Weismann, "Uber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung." Jena, 1887.

IV.

An Introduction to the Study of Anthropoid Apes.—III. The Orang-Outang.[1]

MATERIAL for the study of the orang has always been more plentiful than that for the study of the chimpanzee or gorilla. Consequently the literature on this animal is the more extensive, and founded upon a wider basis of observation. Some idea of the amount of material may be obtained from the fact that within the last fifty years about seven hundred skulls have been collected for purposes of exhibition and study in museums. Skeletons and stuffed specimens are not so plentiful as skulls, but yet common enough, especially in museums, such as those of Holland and India. Living animals, too, are not unfamiliar exhibits in Europe. In the zoological garden of Rotterdam there have been twenty specimens in the last forty years, and about an equal number in the gardens at London. In captivity they do not, as a rule, live long, five years, perhaps, being the longest, and two months being the average length of life (Schmidt, 274*a*). The supply of animals has been fairly abundant, yet descriptions of the soft parts of their anatomy are very few. Perhaps the most complete are those added quite recently by Milne Edwards (258), with the assistance of colleagues, and by Fick (235), although valuable contributions to the general anatomy of the animal had previously been made by Sandifort (271), Beddard (93), and Chapman (229). The four animals dissected by Milne Edwards and Fick were full grown and the first mature adults seen in confinement in Europe. Much that is known of the anatomy of the orang is included incidentally in descriptions of the anatomy of other animals—*see* Vrolik (210), Giglioli (31), and Bischoff (293).

The Nervous System.—As far as I am aware, the nerves of the head and trunk have never been investigated, but, on the other hand, the nerves of the extremities have been well described by Westling (287), Hoefer (140), Kollmann (150), Hepburn (45), and slightly by Fick (235, 127). The lumbar plexus has been figured by Utschneider (209), Jhering (143), and Westling (287). No description has been given of the visceral nerves. The microscopic structure and minute anatomy of the centres and tracts of the cerebro-spinal axis remain

[1] Temminck gives *Orang-Outan* as the correct spelling; Sal. Müller, who was familiar with the Malay language, rendered it *Orang-Oetan*, but *Orang-Outang* is the form in most common use.

untouched. It is quite different as regards the surface anatomy of the brain. The fissures, lobes, sulci, and convolutions of brains of individual orangs have been described and figured by Bischoff (222), Chapman (229), Fick (235, 127), Rolleston (266), Sandifort (271), Schroeder and Vrolik (275, 196), Tiedemann (281), and Barkow (90). The surface anatomy of the brain has been treated in a more general way, and from a greater number of specimens, by Cunningham (115, 116), Benham (94), Bischoff (221), Gratiolet (130*a*), Huxley (49*b*), Kükenthal and Ziehen (151), Pansch (176), and Eberstaller (298*a*). The Island of Reil and the third frontal convolution have been specially studied by Cunningham (115, 116, 117), Hervé (48), Marchand (157), and Rüdinger (188*a*). As to the relative development of the lobes to each other, the relationship of the cerebellum to the cerebrum, and of both to the cranial walls, one may consult Cunningham (118), Féré (234), Flower (237), Schroeder and Vrolik (196, 275), Hamy (136), and Rolleston (266). Beevor and Horsley (220) have investigated the motor areas of the cortex, and Hitzig (246*a*) has made some observations respecting the morphology of these areas. The weights of the several parts of the brain have been estimated by Moeller (166), and Keith (146) has dealt with the brain weight as a whole.

The Muscular System.—There is not to be found anywhere in literature one complete account of the muscular system of the orang. The fullest descriptions are those given by Beddard (92), Chapman (229), Church (231), Fick (235, 127), Huxley (49*b*), Owen (263, 261), Vrolik (210), and Sandifort (271). A great deal can be ascertained from drawings given by Cuvier (231*a*) and Barkow (90), and something from the writings of Camper (228), Mayer (160), and Westling (287). The muscles of the extremities have received most attention, having been fully described by Hepburn (45), Langer (252), and Barnard (219). Quite a number of anatomists have paid attention to certain muscles or groups of muscles: Lartschneider (152*a*) to the muscles of the pelvis; Ruge (70), Bischoff (7), and Rex (67*a*) to the muscles of the face; Bischoff (100) to the extensor indicis and flexor pollicis muscles; St. John Brooks (106, 107) to the short flexor muscles of the thumb and little finger; Keith (148) to the rectus abdominis thoracicis and flexor profundus digitorum; Ruge (190, 268, 269) to the rectus abdominis, muscles of the planta and extensors of the toes; Koerner (251) and Mayer (161) to the muscles of the larynx; Ottley (260*a*) to the muscles of the eye; Westling (287) to the muscles of the tongue and pharynx; Seydel (198, 199) to the serrati muscles of the back. Langer (252) and Fick (235) record the weights of most of the limb muscles, a labour which seems well worth the extra trouble, as weight is far the best index of degree of function. By adding together these various accounts, one may obtain a fairly complete picture of the muscular system of an orang. The involuntary muscles still require investigation.

Ligaments and Joints.—Very little attention has been given to the ligamentous or articular structures of the orang. Fick (235) gives many details concerning the articulations; Aeby (88) and Thomson (204) of the ankle joint and foot; Hartmann (39) of the hip joint, while Keith (250) gives a description of many of the ligamentous structures.

The Skull.—In the examination of a large collection of orang skulls, such as is available in London through the courtesy of the curators of the leading museums (British Museum (Natural History), Royal College of Surgeons, and Royal College of Science), including over eighty skulls, one is struck by the amount of variation they exhibit. This great diversity of form is due, for the most part, to the fact that at no time of life does the orang's skull cease from growing and changing, altering nearly as much in old age as in youth; but it is also due to the fact that there is a great amount of individual variation. It is owing, in a lesser degree, to the fact that skulls are impressed to a variable extent with sexual characters. It is commonly quite easy to tell the skull of an adult female from that of a male, but at times this is hardly possible, the skull of the female having assumed characters commonly found in the male or *vice versâ*. It is worthy of remark, however, that skulls coming from the same locality have a striking similarity of form, even to the minutest features. These observations will help to explain the vast literature that has arisen around the skull of the orang. The wide fluctuation in form and size was thought to be due to there being several species of orang, and an immense amount of labour was expended upon skulls to discover the cranial characters of each species by Blyth (224), Brühl (227), Fitzinger (236), Temminck (280), Schlegel and Müller (272), Giglioli (31), Lucae (252*a*), Wagner (285*a*), and many others. There can be no doubt that the crania in the Natural History Museum at South Kensington, assigned by Owen (262) and Wallace (284) to *Simia morio*, are the skulls of scarcely mature individuals, and all the characters assigned to them as specific are those which distinguish the skulls of young from fully adult animals. Lucas (253), on the other hand, concluded that the cranial characters of *Simia wurmbii*, Fischer, were simply marks of old age, a conclusion with which I agree. What is really wanted at present more than aught else is a thorough examination of a wide series of skulls, perhaps three hundred might be sufficient, including all ages, and a final determination of the characters due to age and sex changes and those due really to individual irregularity. Selenka (277) appears to possess ample material for such an enterprise, but as yet he has only published a very brief review of his collection. Age changes so far have been noted by Dumortier (232, 233), Heusinger (246), Mayer (257), Temminck (280), and Lucas (253), who had at his disposal the large collection brought home by Hornaday (247) from Borneo. The generic characters, which distinguish the skull of the orang from that of the gorilla or chimpanzee, have been dealt with by a very great number of writers—Bischoff (3), Brühl (227), Duvernoy (22), Huxley (49*b*), Geoffroy St. Hilaire (72), Owen (264, 175), and Hartmann (40). Figures or descriptions of one or more skulls are given by Abel (217), Barkow (90), Bolau (10), Anderson (218), Camper (228), Fick (235), Giebel (241), Hervé (245), Mayer (160), Meyer (58), and Schlegel (193). Concerning the craniology of the orang skull Bischoff (8) and Delisle (258) may be consulted. Certain special points of structure have been studied: the nasal bones by Chudzinski (113), Maggi (255), Mayer (257); the nasal cavities by Seydel (178) and Zuckerkandl (216); the anterior nasal spine by Hamy (35); the sutures of the premaxilla by Maggi (254); the posterior palatine spine by Waldeyer (211); the lachrymo-ethmoidal suture by Regnault (182); the orbito-maxillary-frontal suture by Thomson (205); the cranial capacity by Selenka (277) and Keith (146).

The Skeleton.—There has been no investigation made of a collection of skeletons, most descriptions being of a general nature only, and drawn from a single specimen—*see* Blainville (223), Owen (264, 175), Huxley (49*b*), Mivart (61*a*, 259), Hervé (245), Duvernoy (22), Vrolik (210), and Hartmann (43). Some information of value may be picked from the accounts or figures of Trinchese (283), Temminck (280), Schlegel (193), Meyer (58), Fick (235, 127), Camper (228), Bolau (10), Blyth (224), and Barkow (90). Certain parts have been specially studied, such as the sacrum by Broca (104) and Paterson (179); the vertebral column by Cunningham (118); the bones of the hands and feet by Lucae (54), Hartmann (138), Lazarus (153), Rosenberg (187*a*), Kehrer (249), Thomson (204), and Trinchese (283); the manubrium sterni by Keith (149). Measurements of the limb bones have been given especially by Rollet (186*a*), Delisle (258), and Temminck (280).

The Teeth.—Topinard's (82) description of the molar and premolar teeth is the most complete given as yet, but the general treatises of Owen, Huxley, Tomes, and the more particular descriptions of Magitot (56, 57), Giebel (240), and Duvernoy (22) are well worthy of reference. Abel (217), Barkow (90), and Fick (127) add minor accounts. No investigation has so far been made of the development of the teeth, but recently Selenka (277) has contributed some valuable data concerning the order of eruption of the dental series. Orangs' teeth are much subject to variation. A form of macrodontia, sometimes almost pathological, is common. Irregular and supernumerary teeth are of frequent occurrence—*see* Selenka (277), Bateson (91), Brühl (227), Lucas (253), Maggi (256), and Schmidt (195).

The Alimentary System.—The literature on this system is brief and incomplete. The arrangement of papillæ and the structure of the tongue have been subjects of investigation by Fick (235, 127), Mayer (162), Deniker and Boulart (258), Sandifort (271), and Westling (287). The rugæ of the hard palate are figured by Beddard (92) and Gegenbaur (238). Brief and general descriptions of the alimentary tract are contributed by Chapman (229), Fick (235), Flower (28), Huxley (49*b*), Mayer (160), Owen (261), Camper (228), Sandifort (271), and Barkow (90). Wittmann (288) gives very exact figures, showing the arrangement and distribution of the blood-vessels of the stomach and bowel. Figures or descriptions of the liver are given by Barkow, Chapman, Fick, Flower, Camper, and Sandifort (*opp. citt.*). Chapman also describes the arrangement of the peritoneum.

The Respiratory System.—The laryngeal sacs have frequently been subjected to examination, the result being to show that although at first there are two sacs, one from each ventricle, they may ultimately become one by the absorption of the separating wall—*see* Fick (235, 127), Deniker and Boulart (19, 258), Sandifort (271), Camper (228), Mayer (161), and Chapman (229). Descriptions of the larynx may be found in Koerner (251), Mayer (161), Sandifort (271), Camper (228), Westling (287), Cunningham (118), and Fick (235). Aeby (88*a*) and Chudzinski (230) have given descriptions of the lungs, while nearly all the writers cited in this section have made some observations upon the pulmonary apparatus. Ruge (189) and Tanja (203) have mapped out the limits of the pleural cavity.

The Circulatory System.—The only observations upon the form and size of the heart are those of Sandifort (271), Fick (235), and Chapman (228). The arteries and veins have been done in part only. Barkow (90) gives figures of the circle of Willis and of many vessels of the extremities. Popowsky (265) has described the arteries of the lower extremities; Wittmann (288) the vessels of the alimentary tract; Keith (147) the arrangement of the arterial trunks from the aortic arch; Fick (235), Westling (287), Camper (228), and Sandifort (271) record some observations on the arterial system. Gulliver (135) gives measurements of the red blood corpuscles, and Ruge (189) describes the position of the heart.

The Genito-Urinary System.—The best description of the male genital organs is given by Pousargues (258), less full accounts being those of Sandifort (271), Barkow (90), Chapman (229), Fick (127, 235), Mayer (160), Camper (228), and Crisp (114). Trinchese (283), Bischoff (6), Camper and Barkow (*opp. citt.*) describe very briefly the genitals of the female. Slight references to the urinary organs may be found in Sandifort (271), Huxley (49*b*), Chapman (229), and Barkow (90).

Psychology.—The motor centres have been localised by Beevor and Horsley (220). The habits of the orang have been studied in the jungle by Wallace (285), Müller (272), Hornaday (247, 248), St. John (270), Mohnike (260), and Wenckstern (286); in captivity by Darwin (120), Bolau (225), Deniker (121), Fick (127, 235), Delisle (231*b*), Friedel (129), Hermes (139*a*), Martin (159), Reuvens (184), Grant (242), Camper (228), Brehm (225*a*), and Sclater (276*a*).

Organs of Sense.—The circumvallate papillæ have been examined by Mayer (162); the olfactory organ by Zuckerkandl (216), and the touch papillæ of the hands and feet by Kollmann (150).

External Characters, Configuration, and Measurements.—There are quite a large number of very fine drawings of the orang, such as those of Fick (235), Milne Edwards (258), Hermes (244), Beddard (93), Schlegel and Müller (272), and a photograph of a fœtus by Trinchese (283). Among those that have given particular attention to the characters of the hands and feet are, Abel (217), Alix (89), Barkow (90), Beddard (93), Fick (235), Harwood (243) Hepburn (46), Kollmann (150), Lucae (54), Trinchese (283), Temminck (280), and Camper (228). The curious cheek-pads that stand out as stiff flaps from the cheeks of some orangs have been specially dealt with by Fick (235), Deniker and Boulart (258), Temminck (280), Brooke (226), Selenka (277), and Möbius (259*a*). Numerous other writers give the cheek-pads a passing notice, but even yet their use, constancy, and significance are unknown. The hair, its colour and arrangement, has been described by most of the observers just cited, and to make the list more complete one must add Bolau (225), Chapman (229), Delisle (231*b*), Deniker (121), Fitzinger (236), Friedel (129), Hartmann (40, 43), Geoffroy St. Hilaire (239), Hornaday (247, 248), Meyer (58), Martin (159), Meijere (163), Reuvens (184), Schlegel (193), Wallace (284, 285), Grant (142), Möbius (259*a*), and Wenckstern (286). The peculiar arrangement of the hair is due to the fact, that when the animal lies on its side, as it does in sleep, the hair acts the part of a natural thatch. The external ear, which is in a more degenerate condition than the ear of any other primate, man included, has been described or figured by Schwalbe (275*a*), Barkow (90), Beddard (93), and Trinchese (283). Most of the authors I have cited in this section give measurements of the length of limbs and trunk, but Rollet (186*a*), Wallace (284, 285), and Blyth (224) enter most fully into this matter.

Distribution.—The orang, as is well known, is confined to the islands of Borneo and Sumatra, and to certain parts only of these islands. Its distribution is limited to the swampy mangrove forests along the coast, especially along the estuaries of rivers. It is most abundant in Borneo. Its exact distribution in that island has never been worked out, but the great majority of specimens come from the south-west corner, especially along the Kapuas River—*see* Selenka (277), Wallace (284, 285), Brooke (226), Hartmann (43), Hornaday (247), Mohnike (260), Schlegel and Müller (272), Rosenberg (267), and Trinchese (283). The orang is a much rarer animal in Sumatra, few specimens ever coming from there, and is confined chiefly to the north end of the island. Our information, however, is limited, what we have being due to Abel (217), Rosenberg (267), Veth (279), Wenckstern (286), and Schlegel and Müller (272).

Pathology.—Owen (261, 263) records the lesions found in two animals; Rollet (186) and Topinard (282) found cases of bone disease;

Schmidt (195) deals with their diseases in captivity. Of two young animals that I kept in captivity while in Siam, one died of ulcer of the stomach, the other of pneumonia, both lesions being exactly of the type found in corresponding human diseases. The subcutaneous tissue of these two animals contained a large number of thread-worms belonging to several species.

Classification.—It cannot be said even yet that the question as to the number of orang species is finally settled, but all the evidence at our disposal leads to the conclusion that there is but one species. This has been the opinion of Dutch naturalists all along. The great amount of structural variation—in the shape of the skull, presence or absence of temporal crests, of cheek-pads, or of great toe-nails, in the form of the teeth or colour of the hair, which was by some regarded as indicating a difference of species, is now generally looked upon as due to individual age or sex peculiarities. Brooke (226), Owen (262, 264), Blyth (224), and Wallace (284, 285) distinguished several species, but as pointed out in the section on the cranium, the specific differences were really age characters. Selenka (277), who more than anyone has had the advantage of studying abundance of material as well as the animal in its native haunts, regards the orang as forming one species, but distinguishes six local varieties in Borneo and two in Sumatra. From the characters he assigns to these, however, it may be doubted if these varieties could be distinguished from each other with any certainty. Lucas (253), who studied the material brought home by Hornaday, came to the conclusion there was but one species, and Temminck (280), Schlegel (193), Schlegel and Müller (273), Milne Edwards (258), Beddard (93), Brühl (227), Dumortier (232, 233), and Lucae (252) were of a similar opinion. Giglioli (31) distinguishes two species of Bornean orang, Fitzinger (236) distinguished four, while Gray (134) gives a full list of the species, with their characters, enumerated in his time. It is generally held that no line of demarcation can be drawn between the orang of Borneo and that of Sumatra, but our knowledge of the Sumatran animal is extremely scanty. I was able to find in London only five skulls of the Sumatran orang, and, working over these very minutely, could find no mark to distinguish them from Bornean skulls. Still, a further study of the anatomy of the whole animal might reveal permanent points of difference. Our knowledge of the Sumatran orang is due principally to Abel (217), Möbius (259*a*), Snelleman (279), Schlegel and Müller (273), and Wenckstern (286), who distinguishes two kinds of Sumatran orangs.

There is a concurrence of opinion in regarding the orang as much more closely allied to the gorilla and chimpanzee, than to the gibbon on the one hand or to man on the other. Meyer even proposed to place the three in one genus. There has been a great deal written upon the affinities of this genus, principally by Broca (104*a*), Duvernoy (22), Geoffroy St. Hilaire (239), Owen (264, 175), Huxley (49*b*), Mivart (61*a*), and Hartmann (138, 43).

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ARTHUR KEITH.

V.

The Cell, and some of its Supposed Structures.[1]

IN endeavouring to arrive at a correct appreciation of the status of the multitude of cell constituents that our improved methods of technique have revealed to us, we find ourselves in a position of no inconsiderable difficulty. A few years ago we believed we possessed a good deal more knowledge on these matters than we feel we can lay claim to at the present time. This change is to be attributed partly to the healthy attitude of criticism which cytologists have assumed towards the methods they employ, but still more to the conviction, which is ever being strengthened, that the earlier researches, classical though some of them have deservedly become, neither indicate the limits of the subject nor can be regarded as representing generalised type-forms.

Seldom has the need for caution been more effectively enforced than in the history of the so-called "quadrille of the centrosomes," first described by Fol, as occurring during the fertilisation of echinoderm eggs. Most biologists hailed this discovery with joy, which was greatly increased when the announcement was made by Guignard that he had observed a corresponding condition in the lily. Nevertheless, at any rate, so far as the animals are concerned, the foundations on which the whole observations were based have been destroyed; all recent competent investigators are agreed that Fol was mistaken in his conclusions, and that his mistake arose from the defective fixation of his material.

The centrosome question, on which so much has been written during the last decade, is in a very unsatisfactory condition. Few investigators are agreed as to the actual nature of this body, and perhaps fewer still as to the part which it plays in the cell. Some regard it as the active agent in bringing about nuclear division, while others believe it to be a transient structure, called into existence by

[1] Short abstract of a paper read before a combined meeting of Sections D and K at the meeting of the British Association at Liverpool. The full text will appear later in the *Annals of Botany*.

We beg to remind our readers that the terms used and the theories criticised in this article have already been explained fully in NATURAL SCIENCE: *see* M. D. HILL, "Cell-division," vol. iv., p. 38, Jan., 1894, and p. 417, June, 1894; and RUDOLF BEER, "The Nucleolus," vol. vii., p. 185, Sept., 1895.—ED. NAT. SCI.

the forces which are operating in the cell, and which finally produce the phenomena of karyokinesis; and the extreme advocates of these respective views only weaken their case, as well as cause a difficult subject to become still more obscure, by refusing to look at the other side of the question. For, while it is certain that in some cells the centrosome does possess a marked individuality of existence, it must be remembered that this fact is not one of *general* application; hence it is absurd to speak of it as a "necessary organ" of division. The recent studies of Hertwig, for example, on the behaviour of unfertilised echinoderm eggs, as well as the observations of botanists, have shown that nuclear division may be initiated and even completely gone through without the occurrence of a visible centrosome; and further, in certain other cases (*e.g.*, spore-mother-cells of liverworts), where these bodies are present there is absolutely no proof that they are anything but new and temporary formations in the cell.

In fact, there is but shadowy evidence, even in the most favourable instances, that the centrosomes act as principals in the process of karyokinesis; they may well only be aggregations which mark the centres of the forces operating within the protoplasm. They would occupy a similar *position* whether they were the active agents, or merely the passive insertion points of the radiations. We know that contractility is a property of protoplasm, and there is no *à priori* need for assuming a special organ to direct the procedure of that special kind of contractility which results in the partition of the nucleus. *Post hoc* does not always mean *propter hoc*.

But these considerations do not affect the further conclusion, that a certain structure may be produced by a definite interaction of forces upon matter, and that in the case of protoplasm this might lead to an aggregation of such a character as that to which we give the name of centrosome; and that, further, the same set of physical and mechanical conditions being periodically reproduced, would lead to as regular a reappearance of the structure—the centrosome. From what we know of protoplasm it would not be difficult to imagine that something like this does go on in cells, and possibly this may account for the periodical reappearance, and even permanence, of these bodies in some of the cases in which they have been observed. Still, it must be remembered that we actually *know* so little about protoplasm that any such line of thought is merely speculative, although it may serve for the present to link together the apparently irreconcilable results which have been reached by different investigators.

The present position of the question as to the origin and nature of the achromatic spindle is also in a very unsatisfactory state. Does the spindle arise as the result of an onward development of a pre-existing rudiment, or is it a new formation in the protoplasm? In the answer to this question, no less than in the conclusion to which we arrive respecting the nature of the centrosome, an important principle is involved. It is doubtless simpler to admit the existence of a variety of 'organs' in the cell; but does such an admission bring us any nearer to understanding the actual processes of cell-life? Looking the facts squarely in the face, it is very difficult to maintain the hypothesis of an independent autonomous development for the spindle. Most of the carefully worked out results of recent years seem to point to it as arising as a differentiation out of the normal protoplasmic structure, and not as the replacing of this by an intrusive centrifugal outgrowth of a special substance surrounding the centrosome. But, just as with this latter body, so also with the spindle, there are differences exhibited by different cells in the degree of mechanical complexity and completeness characterising their spindles. These differences may well be, and, indeed, fundamentally must be, due to physical differences existing between the different protoplasms; thus the ultimate extent of delicacy of adjustment adapted to meet the individual requirements in any given instance would come to depend on the constitution of the protoplasm itself. The same forces acting through different mechanisms will naturally produce dissimilar results.

Again, the chromosomes themselves present abundant difficulties, when one tries to form a rational conception which shall embrace the facts now known respecting them. If individuality and permanence be conceded to the chromosomes, how can this be reconciled with the facts of reduction and of fertilisation? It seems perfectly clear that the reduction, which, so far as is known, always occurs at some point before fertilisation, can be effected in various and radically different ways. And if this is so, how can one grant even the probability of the existence of that complex structure which has been ascribed to the chromosomes as the supposed bearers of the hereditary qualities of the organism?

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SOME NEW BOOKS.

Semon in the Australian Bush and on the Coasts of the Coral-Sea.

Im australischen Busch und an den Küsten des Korallenmeeres. Reiserlebnisse und Beobachtungen eines Naturforschers in Australien, Neu-Guinea und den Molukken. Von Richard Semon, Professor in Jena. 1 vol., 8vo, pp. 570. Leipzig: Engelman, 1896.

Books about Australia are numerous enough, but are mostly devoted to a monotonous record of journeys in a barren and thirsty land where no water is. Among the few that vary from this general character we can only call to mind Lumholtz's "Among Cannibals," which contains a most interesting narrative of the author's adventures with the native tribes of Northern Queensland and of the animals of that district. But the Swedish naturalist must now give way to the German professor, who has not only made remarkable discoveries in the course of his wanderings, but evidently knows well how to bring them before the public. Professor Semon, who dedicates his narrative to Professor Haeckel and Dr. Paul v. Ritter, two of his brother professors in Jena, left his university in June, 1891, with the principal object of investigating the three great wonders of the Australian fauna—the egg-laying mammals, the marsupials, and the lung-fishes. In all these objects he seems to have met with undoubted success. Proceeding straight to Australia, by Aden and Ceylon, he found himself in a few weeks at Brisbane, and after a short stay took up his quarters in the backwoods of the Burnett district of Queensland, traversed by the Burnett and Mary Rivers. In these streams alone the "living fossil," as our Professor calls the *Ceratodus*, has as yet been ascertained to exist, though in former days it was doubtless met with in other Australian rivers. Professor Semon, although, as will be seen from many passages in his narrative, a most enthusiastic supporter of the Fatherland and its interests all over the globe, appears to have much appreciated the good qualities of the English residents with whom he made friends in Queensland, and is unstinted in his thanks for their assistance and in his praises of their hospitality. Altogether he passed the greater part of two years in the wilds of this district, which is not only the home of *Ceratodus*, but also of the monotremes and marsupials of which he was especially in search. But Professor Semon by no means confined his attention to these subjects; he made huge collections in, apparently, every branch of natural history. Nor did he by any means neglect the wild man of Australia, without whose aid he would have had very little success in his investigations. Our author devotes his tenth chapter wholly to an elaborate account of the habits and manners of the Australian natives, and dilates upon every particular as regards their customs, history, and supposed alliances to other native races.

The second point in the Australian Continent investigated by Professor Semon, was in the coast-ranges of Northern Queensland, of which he gives a lively sketch. Here our traveller seems to have been attracted by the existence of a tree-kangaroo (*Dendrolagus* *lumholtzi*), which is only found in this part of Australia. As regards this animal, which appears to be both scarce and shy, our author was not so successful as on the former expeditions; still, he met with a different set of marsupials in this district and with many other novelties, including numerous crocodiles and so-called flying foxes (*Pteropus*).

Leaving Australia on his way northwards, Professor Semon proceeded to Thursday Island in Torres Strait, where he cruised about and inspected the pearl and trepang fisheries and investigated the marine fauna. Here, too, he made a most interesting excursion to the southern coast of New Guinea, and introduces a vivid account of the native Papuans, with some good illustrations of their faces and their dwelling-places. Proceeding up the Gara River he had the pleasure of shooting some paradise-birds (*Paradisea raggiana* and *Cicinnurus regius*), and of obtaining specimens of other products of this strange land. An excellent chapter is devoted to a disquisition on the Papuan race and its alliances.

From Thursday Island, after returning to Australia for five months in order to make his collection of the various stages of *Ceratodus* more complete, our traveller proceeded to Java, where, like all other visitors, he was enchanted with the beauty of the celebrated botanic garden at Buitenzorg and the luxuriant vegetation of the whole island. From Java Professor Semon made a long excursion to the northern Moluccas, travelling by Celebes to Amboina, where he secured considerable collections both of marine and terrestrial fauna. From here, after a short visit to the Banda group, Professor Semon returned to Europe by Calcutta, whence he did not omit to run up to Darjeeling and see the celebrated view of Kinchinjunga and the Himalayas. We must allow that he laid out his time well, and did not fail to take every opportunity of seeing all the sights that Nature could afford him.

In conclusion, we can truly say that Professor Semon's narrative is one of the best put together and most instructive volumes of travels that we have ever read, rivalling even the well-known "Naturalist on the Amazons," of Bates, and the "Malay Archipelago," of Wallace. Since we read "The Cruise of the 'Marcheesa,'" no journal of a natural history expedition has interested us more. Professor Semon's volume is, moreover, abundantly illustrated from well-executed photographs. Unfortunately for our countrymen, many of whom are still imperfectly educated, Professor Semon has chosen to write it in his mother-tongue, but we are sure that an English translation of this excellent piece of work would be much appreciated, and trust that measures will be taken to set it before the British public in their own language. P. L. S.

THE CAUSE OF MALARIA.

ROMAN FEVER: the results of an enquiry, during three years' residence on the spot, into the Origin, History, Distribution, and Nature of the Malarial Fevers of the Roman Campagna, with especial reference to their supposed connection with Pathogenic Organisms. By W. North. 8vo, pp. xx., 419. London: Sampson Low, Marston & Co., Ltd., 1896.

THE GOULSTONIAN LECTURES ON THE LIFE-HISTORY OF THE MALARIA GERM OUTSIDE THE HUMAN BODY. Delivered before the Royal College of Physicians of London, by P. Manson, March, 1896. Reprinted from *British Medical Journal*.

IN an article published in NATURAL SCIENCE in September, 1894, an account was given of the researches made up to that date as to the cause of malaria. The case was there stated for the belief that this malady is due to the presence of a parasite, which attacks the corpuscles of the blood; the life-history of this parasite was summarised so far as it was known, its biological affinities were indicated, and the action of quinine upon it was explained. Having given space for a definite exposition of the parasitic theory, we are bound to call attention to a new work, in which the case for the opposite view is stated in great detail.

The volume is the work of a man who has devoted much time and trouble to the study of this subject. As a research student for the Grocers' Company he went to Italy in 1883, and spent three years investigating the disease and the conditions under which it flourishes. He worked in the medical laboratories of Rome; he studied the geology, hydrology, and meteorology of the infected areas; he treated cases medically, and noted the effects of food and drugs on the course of the disease. He seems to have spared no pains, and with the courage of his profession never hesitated at serious personal risks.

His book is divided into three parts, dealing respectively with the distribution of malaria, with the meteorological and other factors which control it, and with the phenomena of the disease. The author first dwells on the great importance of the subject, illustrating his remarks by the facts that in India half the military forces are temporarily disabled by disease every year, and that the expense of the administration of that country is greatly increased by the lessened efficiency of individuals. The next two chapters state the distribution of malaria in the world, and especially in Italy. The author then treats of the Roman Campagna in detail, describing its physical geography, geology, and hydrology, and the history of malaria in the province from the earliest records downward. In the second part he gives the result of his investigation into the conditions under which malarial fevers exist, and the circumstances which modify them. He claims that "the only relation of malaria to altitude consists in the diminution of temperature which accompanies the latter" (p. 99), and points out the intimate relationship between malaria and wet soils (p. 109). He attaches great importance to the effect of subsoil water, and maintains that "the intensity of the disease increases as the subsoil water approaches the surface." He refers to localities such as the Amazon Valley, which he accepts as non-malarial, although, according to popular ideas, they ought to be infested with the disease.

Considerations such as these lead to the argument in the third part of the book. The author there contends that the disease is the direct effect of sudden changes of temperature; he claims that the parasitic theory is "utterly unsatisfactory," and that the "chill theory" is sufficient to explain all the facts. He ingeniously argues that there is a normal periodicity in the human temperature, and that in malarial fever there is simply an exaggeration of this, produced by chills upsetting the normal relations of the heat-producing and heat-dissipating processes of the body. The liability to a recurrence he explains as due, not to hæmatozoa persisting in the marrow-cells or in the spleen, but to the patient having acquired, "from some unknown cause, a periodicity of function."

This third part of the book is the least satisfactory; the author does not disturb our faith in the parasitic theory, nor does he bring the chill theory into harmony with all the known facts or render it capable of explaining the phenomena of the disease. To take, for example, one illustration of the effects of violent changes of temperature. The temperature of Zanzibar is one of the most uniform in the world; the annual range of temperature is about 70° Fahr., but the town reeks with malaria. On the other hand, on parts of the Masai plateaux the daily range of temperature may be 70°, but malaria, in some of these places, is unknown.

The author's criticisms of the organic theory are not always up to date. He shows a full knowledge of the literature of his subject up to 1885, but not for later years. His arguments are often fatal to the organic theory of 1886, while they do not shake that theory as we know it in 1896. It is within the last six years that the hæmatozoic theory has been proved. Pages are devoted to the refutation of the suggestions of Salisbury, Klebs, and Tommasi-Crudeli, which have now only an historic interest, whereas the discoveries of the last few years are not considered. The author is clearly a patient and conscientious worker, who mastered the whole subject as far as was possible at the time of his three years' research upon it. Had the book been published immediately after his return it would have been of great value; but since then the author does not seem to have had his former opportunities or access to medical literature. Hence the book is several years out of date, and its main value depends on its account of the past history and present distribution of the disease.

Dr. Manson's Goulstonian lectures treat malaria from an altogether different point of view. He accepts the parasitic theory as fully established. He tells us that "there cannot any longer be the slightest doubt that it [Laveran's parasite] is the germ of malaria; there cannot any longer be the slightest doubt that incidents connected with its multiplication in the human body are the causes of the clinical phenomena of malaria. These things are now abundantly proved, and are accepted by all who have taken the trouble to make themselves personally acquainted with the facts and the parasite." Starting from this premise, his faith in which we do not think at all excessive, Dr. Manson endeavours to trace the life-history of the malarial hæmatozoon during the stages which it must pass through outside the human body. It was known that when malarially-infected blood corpuscles were drawn from the body some of the malarial spherules broke up into free-swimming flagellated bodies. The explanation given of these flagellated bodies by most workers is that they are degenerate hæmatozoa (or plasmodia, as they are generally called in medical literature). This is the view adopted by Blanchard, Labbé, Marchiafava, and Begnàmé, but opposed by Laveran, Nannaberg, Danilewsky, and others. Dr. Manson now explains this flagellated stage as one adopted by the hæmatozoon when it escapes from a body in order to secure its proper distribution. He considers that it is the first extra-corporeal stage in development, and, as it cannot be produced in the host, he concludes that one part of the normal development of the hæmatozoon is outside the body of the host. He suggests that the mosquito is the agent which effects the liberation of the parasite. He shows that this is probable from the facts of the distribution of the disease, and from the interesting analogy between filaria and the malarial parasite. This evidence is not conclusive, but some experiments made in India by Surgeon-Major Ross at Dr. Manson's suggestion have certainly made one important step towards proving the theory, for it has been demonstrated that if a mosquito sucks in blood containing the malarial spherules, that these develop in the insect into the flagellated bodies.

Considering the enormous influence of malaria in all tropical countries, it is greatly to be hoped that Dr. Manson's theory will soon be further tested. For if it be proved that mosquitoes are essential to one stage of the life history of the parasite, sanitary engineers will know one method by which its ravages may be checked.

Jurassic Bryozoa.

Catalogue of the Fossil Bryozoa in the British Museum (Natural History). The Jurassic Bryozoa. By J. W. Gregory. Pp. 239, pls. xi. Printed by order of the Trustees. London, 1896. Price 10s.

In the catalogue before us the diagnosis is given of seventy-seven species of Cyclostomata, and of two Chilostomata. We are quite accustomed to authors prefacing descriptions of Cyclostomata by a note of despair as to the difficulty of classification: Dr. Gregory shows how many groups of invertebrates live in tubular shells, and admits that there are no diagnostic characters by which we can positively say whether a given fossil be bryozoan or not. The difficulty of this decision is greatest with the Paleozoic Bryozoa, but even Bryozoa from the Jurassic formation have been placed among corals, while Hydrozoa such as *Acanthopora*, *Neuropora*, and *Chrysoaro* have now had to be removed.

Zoarial characters are considered to be the only ones available for systematic work on the Cyclostomata, and Gregory accepts the divisions based upon them, but shows how one genus passes into another, and asks the question as to whether there are any genera in Cyclostomata; answering that there are only certain convenient, but artificial, groups of species. The groups called "genera," Gregory would, in the Cyclostomata, prefer to call "circuli." Another way of putting our difficulty would be to say that, although there must be groups of species having relationships, which in other orders we should call generic, yet here, on account of the simplicity of the calcareous structure and few characters available, we are often unable to trace the relationship.

The extremest pessimist may, however, hope for some increase of knowledge; for example, the ovicell, which was not formerly noticed, is now always keenly looked for, though the number of species on which it has not yet been found is very large. Out of the seventy-five species of Cyclostomata diagnosed by Gregory, he only mentions the ovicells in twelve cases. No doubt by the discovery of further specimens, and by making sections, this number will be somewhat increased.

Useful as the ovicells are specifically, caution is required; for a character may in some cases have generic value, in others specific, or the same character may have no importance, and, until a large number are known, it is unsafe to make generalisations. We see the danger in Gregory's attempt to use the position of the ovicell as a family character in the Chilostomata, for in his "British Palæogene Bryozoa," and in the present catalogue, he makes both the Membraniporidæ and the Microporidæ have "external oœcia," which in neither case is universal. In the subfamily Membraniporinæ it is certainly usual, though the best known of the Membraniporidæ, *M. pilosa*, has recently been removed to *Electra*; and Norman, describing the genus, writes "no oœcia known in recent species," and says that he thinks a fossil described by Waters as *M. Lacroixii*, var. *grandis*, from New Zealand, must, on account of its possessing an external ovicell, be removed to another genus. This is apparently going too far, as the writer has a specimen of *M. Lacroixii* from Naples with a small raised ovicell, and it seems that in Savigny's plate the ovicell is figured, though the artist has drawn it incorrectly, placing it below the zoœcium.

Jullien made a "tribus inovicellata" for the Aetidæ, but a paper is now in the hands of the Linnean Society figuring the ovicells.

In the Microporidæ there are a large number of species with external ovicells, while many are without; but is Gregory right in placing *Onychocella* in this family? The genus *Onychocella* is a very interesting one, occurring in great abundance in the Chalk, continuing abundant through the Tertiaries, with only one or two representatives now living. The form described by Gregory as *O. flabelliformis*, Lamx., very closely resembles several Chalk species, but revision of these is much wanted, as the number of synonyms is known to be very great. We may, however, hope to see this genus brought into order when the catalogue of the Cretaceous Bryozoa is published.

In *Micropora* the oral aperture corresponds with the operculum, but this is not the case in either *Membranipora* or *Onychocella*. In the living *Onychocella angulosa* the opesial opening is large, while the operculum is but small, and is entirely attached to the membranous wall. Further, there are no external ovicells, and the ova pass into a membranous chamber at the distal end of the zoœcium, near to the basal wall. In recent species of *Onychocella* there are trabeculæ bordering the operculum as in *Cellaria*, and an interesting Cretaceous fossil called *Escharella argus*, d'Orb., has teeth in the aperture like *Cellaria*, and has avicularia of the type known in *Onychocella*, while the ovicells are like those of *Cellaria*. In the fossil *Onychocella* an external ovicell is rare, though in *Onychocella lamarckii* there is a slight elevation where the "oberhöhle" of Hagenow occur; and Jullien speaks of the ovicell of the Onychocellidæ being raised, but in none of the species described by him is there any ovicell. In a number of forms such as *Eschara dichotoma*, Hagenow, it is very difficult to decide whether the opening is opesial, or was closed by the operculum.

To return to Dr. Gregory, he accepts Ulrich's order Treptostomata, which contains the families Ceramoporidæ, Heterotrypidæ, and Amplexoporidæ, represented in the Jurassic by *Ceriopora*, *Chilopora*, and *Heteropora*, but the *Heteropora* of Blainville is somewhat limited.

The Cyclostomata are divided into four suborders, the Articulata, Tubulata, Dactylethrata, and Cancellata. "Dactylethræ" is the name proposed for a form of "aborted zoœcia" consisting of short cæcal tubes closed externally, but whether this is, as Gregory considers, a structure of classificatory value, may at present be considered an open question; however, much of the usefulness of such a work is that questions are raised which lead to further investigation. The best critic of classification is time, but many groupings which have not stood this test have yet been useful in helping towards an orderly arrangement of our knowledge.

Since the genus *Melicervitites* included species with well developed avicularia, and others distinctly cyclostomatous, Gregory has placed the latter in a genus *Haploœcia*.

This catalogue, clearly placing before us what is known concerning the Bryozoa of the Jurassic period, will be warmly welcomed by those who are working at this or kindred subjects, and will be a standard work of reference. A. W. W.

The Literature of the Pleistocene in Ireland.

A Bibliography of Irish Glacial and Post-Glacial Geology. By R. Lloyd Praeger. Being an Appendix (no. 6 of vol. ii.) to the *Proceedings of the Belfast Naturalists' Field Club* for 1895–96. Pp. 239–316. 8vo.

The literature referring to the Glacial and Post-Glacial geology of Ireland is somewhat scattered, and many valuable papers occur in publications that are not in the hands of the ordinary geologist, such as the *Transactions* of the Kilkenny Archæological Society or the *Journal* of the Historical and Archæological Association of Ireland. In the absence of any bibliography, the work of the numerous energetic naturalists who are springing up all over Ireland in connection with the various field-clubs, to which we have often alluded, was necessarily hampered, and this careful compilation by Mr. Lloyd Praeger will be welcome specially to them and also to students of Glacial phenomena in other countries. The bibliography includes papers not only on the Pleistocene beds of Ireland, but also on the "manure" gravels of Wexford, which, though generally considered to be of Pleiocene age, possess a fauna related to that of the Glacial period. References are also included to the literature of the caves, on which so much valuable work has recently been done in Ireland. The bibliography appears to have been carefully compiled, and is clearly printed. It might perhaps have been improved from a technical point of view had some indication been given when the name of an author was carried over from one page to another. For instance, the reader seeing **90 Bell (Alfred)** at the top of page 252 might suppose that No. 90 was the first paper by Alfred Bell recorded in the book, whereas the papers ascribed to him really begin at No. 85 overleaf. The difficulty is easily got over by the insertion of "*cont.*"

The value of the list is increased by an index to the numbers under various geological, palæontological, and geographical heads, such as "raised beaches," "prehistoric implements," "Co. Cork." This index, as the author himself recognises, would have been of far greater value had it been compiled from the papers themselves, and not merely from their titles or from the brief indication of their contents that has occasionally been added by Mr. Praeger. Authors are too fond of giving to their papers titles that convey a totally wrong impression of the contents, and abstractors are too prone to pay attention to the points that interest themselves rather than others, for such a method of constructing an index ever to produce a reliable and final guide.

The copy sent to us for review is in printed wrappers with a separate title-page, but it does not appear whether the work can be purchased apart from the *Proceedings* of the Belfast Field Club. We hope it can.

TYNDALL'S GLACIERS.

THE GLACIERS OF THE ALPS: being a Narrative of Excursions and Ascents, an Account of the Origin and Phenomena of Glaciers, and an Exposition of the Physical Principles to which they are related. By John Tyndall. New Edition. 8vo. Pp. xxvii., 445, with 5 plates aud 57 figures. London: Longmans, Green and Co., 1896.

THE recent growth of the interest taken in Alpine gymnastics has in one way been a source of inconvenience to geologists. During the last few years there has been so great a demand for the earlier Alpine literature, that most of the best books have long since gone out of print, and risen to a fancy value that places them out of the reach of most naturalists. In the case of books of purely topographic interest, this is not a matter of much importance; but when fashion increases the cost of such an important work as Tyndall's "Glaciers of the Alps" to many times its published price, it is decidedly matter for regret. Glacial geologists will therefore be very grateful to Mrs. Tyndall for her republication of this book. Beyond welcoming its appearance we need say little: the book is too well known. It is a glacial classic, and no one interested in the long controversy on the nature of glaciers, and the cause of their movements, can afford to ignore it. It is true that most of the second part of the volume was re-issued in an abridged and somewhat more popular form, in Tyndall's "Forms of Water"; but for advanced students, the original and longer discussion of the subject is to be preferred. The accounts of Tyndall's Alpine ascents, given in the first part of the book, are of great interest, though, perhaps, not equal to the author's "Hours of Exercise in the Alps." The present edition has a greatly improved index, but otherwise Mrs. Tyndall has wisely left the text unaltered. A short introductory chapter on the advances made in the subject since the first edition would have been extremely useful, as the volume will, no doubt, find its way into the hands of many visitors to Switzerland who know nothing of later researches.

Plankton Pelecypods.

Die Acephalen der Plankton-Expedition (Ergebnisse der...Plankton-Expedition der Humboldt Stiftung, etc. Bd. ii., F.e.). Von Dr. H. Simroth. Pp. 44, 3 pls. Kiel and Leipzig, 1896.

We have on a previous occasion (vol. viii., p. 343) called attention to the section of this work by the same distinguished author, treating of the gastropod forms, mostly larval, met with on the Plankton Expedition; the present part, though much smaller, is conducted on the same lines and with the same care.

With one exception the Pelecypoda prove to be larval forms belonging to taxodont, desmodont, and probably other groups. Most of them had passed the velar stage, and were dimyarian and integropallial. The greater number were probably pelagic only by accident, and exhibited no special adaptation for the life. Nor did the only perfectly formed bivalve met with, *Planktomya henseni*, n.gen. et sp., though its foot was largely aborted. This truly pelagic little mollusc is only from ·5 to ·75 mm. in length, and occurs in the warmer regions of the Atlantic. Its shell appears to be destitute of lime.

Prefixed to the paper, which contains many points of great interest not limited to its subject matter, is a chapter, with a table, on the development of the different groups of Mollusca under different conditions of environment. Among other forms tabulated one is surprised to find that mythical monster, the 'hypothetical primitive mollusc,' and to learn that it dwelt between tide-marks and in the littoral zone, while its larval form was hemipelagic.

New Serials.

It is a genuine pleasure to observe how steadily the study of Ornithology is gaining ground in the United States. *The Osprey* is the youngest of American magazines, but it has left the eyrie under happy auspices. It is edited by Walter A. Johnson and Dr. A. C. Murchison, and published at 217 Main Street, Galesburg, Ill. The papers contributed to the first number, issued in September last, embrace a variety of subjects, including a paper on Terns, an admirable essay on the "Nesting of the Ferruginous Buzzard," and other reports of useful field-work. An interesting feature of this journal is to be found in the picturesque photographs which are reproduced in its pages. We are glad to observe that *The Osprey* "is not a money-making scheme, nor wholly dependent upon the first year's receipts." We congratulate the editors upon the plucky start which they have accomplished, and trust that their venture will receive wide support.

Western Field and Stream (St. Paul, Minn., U.S.A.) is another new journal that has been sent to us. It is copiously illustrated, and though devoted chiefly to sport, contains one or two articles of interest to naturalists. The subscription is one dollar a year.

A new quarterly, *Revista Trimestrial Micrografica*, is announced, under the editorship of Dr. Ramon y Cajal, Professor of Histology and Anatomy in Madrid University.

From October 1 *Science Progress* changed into a quarterly review of current scientific investigation, at an increase in price to 3s., and in size to an average of 110 pages. The solid value of its contents undoubtedly adapts them for the dignity of a quarterly.

The Nordoberfränkischer Verein für Natur- Geschichts- und Landeskunde, which was founded at Hof, Bavaria, in 1891, has now begun to publish a *Bericht*. No. I., which is an octavo of xiv. and 110 pages, with two folding plates, is said to have been delivered in July, but we saw no copy in this country before the end of September. One of the plates represents a section along the railway at Neuhof station near Hof, where fossiliferous beds of Tremadoc age have lately been exposed. The fossils are described by Dr. J. F. Pompeckj, who records the occurrence of eleven species already described by Barronde in his "Faune silurienne des environs de Hof," 1868, and of three new but still unnamed species belonging to *Lingula*, *Acrotreta*, and *Bellerophon*. To this number also Dr. Ernst Zimmermann contributes an article, "Ueber Wesen und Ziele der geologischen Landesaufnahmen," and another entitled "Einiges ueber die Loessfrage."

Varia.

Two parts of the eight large volumes to be issued by Gustav Fischer, under the title, *Handbuch der Anatomie des Menschen*, have appeared, edited by Professor von Bardeleben. The first part, by Professor J. Disse, deals mainly with the spinal column.

Science for September 4 contains an interesting article on Botanical Gardens, their origin and development, by N. L. Britton, with notes on the chief Gardens in Europe and in the United States. An appreciation of Dr. P. L. Sclater, by the late Dr. Brown Goode, is also to be found in this number.

The National Museum at Washington has been benefiting for some eight years by the addition of collections made in different parts of the world by Dr. W. L. Abbott. This explorer has sent material from East Africa, the Seychelles, Cashmere, Turkestan, and Ladak, which is being worked out by the staff of the Museum; two reports on birds have already been issued.

Further Literature Received.

Biology Lectures, Wood's Holl Lab.: Ginn & Co. How to study wild Flowers, G. Henslow: Religious Tract Soc. Handbook of Physiology, W. D. Halliburton: Murray. Testimony of Science to the Deluge, W. B. Galloway: Sampson Low. Die Morphologie und Physiologie der Pflanzlichen Zellkernes, A. Zimmermann; Die Bedingungen der Fortpflanzung bei einigen Algen und Pilzen, G. Klebs: Fischer. Certain Problems of Vertebrate Embryology, J. Beard: Fischer. The Priceless Gem, Balmokand: Mitra Vilasa Press, Lahore.

Voles and Lemmings, G. S. Miller: U.S. Dept. Agric. On Structure and Reproduction of Cystopus candidus, Lev., H. Wager: *Ann. Bot.* Reptilian Order Cotylosauria, On Pleistocene Mammalia from Petite Anse, 4th Contribution Marine Fauna of Miocene Period of U.S., 2nd Contribution to History of Cotylosauria, 6th Contribution to Marine Miocene Fauna of U.S.; E. D. Cope: *Trans. Amer. Phil. Soc.* Report, Jamaica Inst. Guide, Bristol Museum. The Yolk-Sac, etc., in Scyllium and Lepidosteus, J. Beard, *Anat. Anz.* *Trans. Norfolk and Norwich Soc.* vi., 2.

Nature, September 17, 24, October 1, 8, 15. Literary Digest, September 12, 19, 26, October 3, 10. Revue scientifique, September 19, 26, October 3, 10, 17. Irish Naturalist, October. Feuille des jeunes Naturalistes, October. Naturen, October. Nature Notes, October. Amer. Journ. Sci., October. Naturæ Novitates, 17 and 18. Science, September 11, 18, 25, October 2, 9. Scott. Geogr. Mag., October. Science Gossip, October. The Naturalist, October. Westminster Review, October. Botanical Gazette, September. Review of Reviews, October. Knowledge, October. Photogram, October. L'Anthropologie, September. Amer. Natural., October. Vict. Natural., August.

OBITUARY.

GEORGE BROWN GOODE.

Born in New Albany, Ind., February 13, 1851. Died at Washington, D.C., September 6, 1896.

On the 7th of September, fifty years ago, the Regents of the Smithsonian Institution met for the first time; on the same day of the present year they were to have met and commemorated the event, while in our October number we had hoped to publish a special account of the Institution and especially of the National Museum, by the assistant secretary, the director of the museum, Dr. Brown Goode. But he who should have summoned the Regents died on the day before, and the pen that should have written for us had been laid down for the last time. We allude to this kindly promise to ourselves, for it was typical of the man. Eminent though he was as a scientific investigator, it was chiefly by helping others that he advanced science. After graduating in 1870 at the Wesleyan University, Middletown, Conn., he was led by Professor Baird to help the United States Fish Commission as a volunteer, and subsequently became officially connected with it. He was United States Commissioner to the Fisheries Exhibitions in Berlin (1880) and London (1883). Among his chief works in this connection were "The Game Fishes of the United States," 1879, "The Fisheries and Fishing Industries of the United States," 1884, "American Fishes," 1887, and, in co-operation with Dr. T. H. Bean, the great work recently published on Ocean Ichthyology, a treatise on the deep-sea and pelagic fishes of the world. It was in 1873 that Brown Goode became attached to the Smithsonian Institution, and an opportunity of showing his mettle came three years later, when, owing to the illness of Professor Baird, the charge of the Smithsonian Exhibit at the Philadelphia Exhibition (1876) devolved largely on him. The experience thus gained led to his being placed in charge of the national exhibits at the exhibitions in New Orleans, Cincinnati, Louisville, Chicago, and, quite recently, Atalanta. Here, and in the National Museum, of which he was made assistant director in 1881 and director, along with the assistant secretaryship to the Smithsonian, in 1888, his remarkable genius for museum organisation and administration was displayed. He led the revolution against the old dry-as-dust, lumber-room practice of museum arrangement, and the principle that guided him was thus expressed: "The exhibition of the future will be an exhibition of ideas rather than of objects, and nothing will be deemed worthy of admission to its halls which has not some living, inspiring thought behind it, and which is not capable of teaching some valuable lesson." Fortunately for the world his enormous experience does not altogether die with him, for in their *Report* for 1895, the Museums Association printed his codification of "The Principles of Museum Administration," from which we cull a single aphorism. "A finished museum is a dead museum, and a dead museum is a useless museum." We wish that space permitted us to say more; but, after all, no further words could express our poignant regret at the loss of this man, snatched from us in the prime of life.

SIR FERDINAND VON MUELLER.

Born 1825. Died October 9, 1896.

THIS eminent botanist, one of the most distinguished men of science of the southern hemisphere, was born at Rostock in Germany in 1825, and as a boy showed great fondness for botany. At the age of twenty-one he was told that his only chance of life was emigration to a warm climate. He accordingly sailed for Australia, and has lived there for the last fifty years. In 1852 he was appointed Government botanist of the colony of Victoria, and in that capacity, following the lead of Robert Brown, has done more than anybody for the development of Australian botany. In the first ten years of his residence in Australia he made many important and arduous botanical expeditions to various parts of what was then a comparatively little-known continent. He acted as botanist to Mr. A. C. Gregory's expedition of exploration in tropical Australia in the years 1855 and 1856, and was one of the first to ascend the Australian Alps, and to explore their rich stores of botanical treasure. In these extensive land journeys, to which Dr. (now Sir Joseph) Hooker refers in some detail in his essay on the Flora of Australia, he covered upwards of 20,000 miles.

Baron von Mueller was a most voluminous writer, his works, which deal almost exclusively with Australian botany, forming a library in themselves on its systematic and economic aspect.

In his many books and papers he dealt with both the recent and the fossil botany of the continent; his chief contributions to science may be here recalled:—Fragmenta Phytographiæ Australiæ (11 vols., 1858–1881); Eucalyptographia (1879–84); Index perfectus ad Caroli Linnæi Species Plantarum . . . 1753 (1880); Iconography of Australian Species of Acacia (1887–88); New Vegetable Fossils from the Australian Drifts (1874, etc.); Select Plants eligible for industrial culture or naturalisation in Victoria (1876); and "Select Extra-Tropical Plants readily eligible for industrial culture," which went through many editions, of which the ninth appeared in 1895.

When a general "Flora of Australia" was contemplated, Mueller, in the hope that the work would be entrusted to him, devoted his utmost energies to collecting the necessary materials. But, situated in Melbourne, he was unable to do the very necessary work of comparison with the type-plants deposited in various European herbaria. The task was therefore allotted to George Bentham, who in his general preface to the work warmly recognises the invaluable assistance received from Mueller in the form both of notes and of dried specimens. This help is also acknowledged by the insertion of Mueller's name on the title-page.

One of his greatest services to economic botany was his indication of the value of the Australian gum-tree (*Eucalyptus*) in combating malarial fevers, and it was on his advice that the tree has been so extensively and efficaciously planted in many malaria-haunted districts of Southern Europe and America.

NICHOLAS RUEDINGER.

BORN MARCH 25, 1832. DIED AUGUST 24, 1896.

DR. RUEDINGER was born at Büdesheim, in Hesse, and studied medicine at Heidelberg and Giessen. He was appointed Prosector at the Anatomical Institute of Munich in 1855, and was presented to a professional chair at the University in 1880. He was successful in applying photography to the purpose of anatomical illustration, and invented a new method of preparing objects for use in anatomical and surgical instruction. Although best known as a human anatomist, he contributed to general anatomy a paper on the speech centre and on the brain of the apes. Ruedinger died at Tutzing, Bavaria, according to the *Daily Chronicle*, to which journal we are indebted for some of the above particulars.

THE August number of the *Alpine Journal* contains a sympathetic notice, by Dr. F. A. Forel, of the late Captain MARSHALL HALL, who was born in London, February 6, 1831, and died at Parkstone, Dorset, April 14, 1896. He was educated at Eton and Caius College, Cambridge, and served his apprenticeship in the Alps by making the first passage of the New Weissthor from Zermatt, in 1849. In 1867 he made the second traverse of the Aiguille de l'Eboulement, and from 1878 to 1884 he resided in Switzerland, making ascents of peaks and observations on the glaciers of the high Alps. He was one of the Alpine Club Committee for studying the oscillations of the glaciers in the British Empire and elsewhere, and in 1895 he initiated the formation of a committee of the International Geological Congress for the study of the variation of the glaciers of the world. On this latter subject Captain Marshall Hall contributed a paper to our pages in January, 1895. He was a frequent visitor to the meetings of the Geological Society and the Geologists' Association, and his keenness and insight will be much missed.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced :—Professor Allbutt, to the Downing Professorship of Pharmacology, in Cambridge; J. C. Willis, Botanical Assistant in Glasgow University, to be Director of the Ceylon Botanical Gardens; Charles Elcock, to be Curator of the Art Gallery and Museum at the Free Public Library in Belfast, in place of J. F. Johnson, mysteriously disappeared; Mr. Stanley Flower, son of the Director of the British Museum (Natural History), to be Curator of the King of Siam's Museum at Bangkok; Dr. C. Winkler, to be Professor of Nervous and Mental Diseases at Amsterdam; Dr. E. Lesser, to be Extraordinary Professor of Dermatology at Berlin; Dr. Chermak, to the Chair of Comparative Anatomy and Embryology at Jurieff (Dorpat); Dr. Andreas Obezut, to be Professor of Anatomy, and Dr. Prus, to be Professor of Pathology, at Lemberg; Dr. Gräff, to be Assistant Professor of Mineralogy and Petrography in Freiburg University, Breslau; Dr. A. V. Fomin, to be Assistant at the Botanical Garden of Dorpat University; Dr. L. Montemartini and Dr. G. Pollacci to be Assistants, and Dr. F. Tognini to be Curator, at Pavia University Botanical Gardens; T. S. Hart, of Victoria, to be Lecturer on Geology and Botany at the Ballarat School of Mines; F. B. Loomis, to be Assistant in Biology at Amherst College, U.S.A.; Miss A. M. Claypole, to be Instructor in Zoology, and Miss J. Evans, in Botany, at Wellesley College, U.S.A.; R. E. Dodge, to be Associate Professor of Natural Science at the Teacher's College, New York; T. A. Williams, Professor of Botany in South Dakota, to be Assistant in the Division of Cereals, U.S. Dept. Agriculture; Miss Parker, of Alabama, to be Professor of Natural Sciences in the Georgia Industrial College at Milledgeville, U.S.A.; Dr. C. Hart Merriam, to be head of the newly-established Biological Survey of the Department of Agriculture, U.S.A.; C. P. Nott, of the Brown University, to be Assistant in Botany in California University; Dr. Ludwig Reh, of Sao Paolo, Brazil, to be Permanent Assistant to the Concilium Bibliographicum, Zurich.

MR. WILLIAM WHITAKER retires from the Geological Survey on October 22. Mr. Whitaker, who is senior officer, was appointed on April 1, 1857, and has therefore held service for nearly forty years. The good wishes of all geologists go with him in his retirement. His address is now "Freda, Campden Road, Croydon."

MR. W. W. WATTS, of H.M. Geological Survey, is *not*, as many of his friends have supposed, the W. W. Watts who has been appointed Chief of the Circulation Department at the South Kensington Museum.

THE 70th birthday of Professor Bastian, of the Imperial University and Ethnological Museum in Berlin, was the occasion for the presentation of his bust to the latter institution. A memorial volume containing thirty-two papers by leading German anthropologists, such as Dr. Boas, Dr. Seler, and Professor Ehrenreich, was presented to him.

THE establishment at Palermo of an International Botanical Station, under Professor Borzi, is proposed, and the co-operation of botanists is asked.

Mrs. E. Roby, Mr. E. A. Shedd, and Mr. C. B. Shedd, have offered the University of Chicago a large tract of land around Wolf Lake for the purpose of a lake biological station, and it is understood, says *Science*, that they will erect the buildings for the purpose if the offer is accepted.

In the Anatomical Building now being added to Chicago University will be placed the psychological laboratory, and the department of neurology under Professor Donaldson.

Over half the amount required for a new science hall at Lake Erie Seminary, U.S.A., has been subscribed, as well as $10,000 for equipment.

The Johns Hopkins University *Circular* for May, which is devoted to a general report of the courses of instruction, states that the geological library contains most of the leading journals dealing with geology, and has been enriched by the addition of the libraries of Professor G. H. Williams and Professor H. C. Lewis. Moreover, the Peabody library is always available for the use of students. A capital practice is that of bi-weekly meetings, for the more advanced students, at which the leading geological journals are reviewed. In botany the students have the good fortune to be allowed the use of Captain Donnell Smith's private herbarium, which contains some 78,000 sheets of specimens.

It is proposed to erect, near Honolulu, a biological laboratory for the Hawaiian Isles. According to the *Revue scientifique*, the cost, some £160,000, would be defrayed by Mr. C. R. Bishop, one of the richest bankers resident there.

Part of the late Professor A. M. Butljero's collection of butterflies has been presented to Moscow University, and the late Julius Flohr's collection of Mexican insects has been left to the Berlin Museum of Natural History.

A museum of natural history, geology, archæology, and technology is proposed for Hertfordshire, and a site near St. Albans has been offered by Lord Spencer, upon certain conditions. A sum of at least £5,000 must be raised for building and endowment, and the museum is to be in the hands of the County Council. We are glad to see that a curator is thought of as much importance as a building. A provisional committee has been appointed, including Lord Cowper, Sir John Evans, and the Hon. Walter Rothschild.

The *Report* of the Manchester Museum for 1895–6, notes the importance of the recognition of the museum as a public institution by the Manchester City Council, in that a sum of £400 has been apportioned to the museum out of the Free Library Rate. The average Sunday attendance is 519, and may be considered highly satisfactory, seeing that the largest attendance ever recorded on a week day was 1,079. The increase in the collections and library is very marked. The arrangement of the minerals by Mr. Gilbert Rigg, under the supervision of Dr. Burghardt, has been completed as far as the end of the silicates, and it is hoped that a guide to this collection may shortly be published.

Whitechapel rises superior to the nation in that the following evening lectures, with lantern illustrations, are being delivered in its Museum free of charge: on October 13, "The Egyptian Workman, Past and Present," by W. Flinders Petrie; on November 10, "Extinct Monsters," by the Rev. H. N. Hutchinson; on December 8, "The Meadows of the Sea," by G. R. Murray.

An exhibition of the highest interest is being shown in the Muséum d'Histoire Naturelle, Paris. It comprises the collections of ethnography and natural history made by Mr. Pavie and his fellow-workers during their explorations in Indo-China.

THE Bradshaw Lecture at the Royal College of Surgeons will be delivered on November 5 by Dr. W. R. Gowers, and will be entitled "Subjective Sensations of Sound." Dr. Bastian and Dr. Luff are to be respectively Lumleian and Goulstonian lecturers for next year, while the Croonian Lecture of 1898 will be delivered by Professor Sidney Martin.

THE Tenth Congress of Russian Naturalists and Physicians will be held at Kiev, from August 21 to 30, 1897.

A SECOND national congress of the Mexican scientific societies will be held in Mexico City in July, 1897.

ON the South bank of the Lake of Sils, in the Engadine, an erratic block of granite has recently been erected, bearing the inscription, "In memory of the illustrious English writer and naturalist, Thomas Henry Huxley, who spent many summers at the Kursaal Hotel, Majola."

AN amount of nearly £2,000 (of which the Emperor of Russia contributed over £300) has now been raised by international subscription for the monument to Lavoiser proposed two years ago, and money is still coming in.

PROFESSOR SOLLAS, writing to the Royal Society, reports that the borings made in two places at Funafuti were unsuccessful, owing to a quicksand which was struck at a depth of about 70 feet and choked the borehole. But in the collection of fauna and flora good results were obtained, while a complete series of soundings was made by Captain Field.

AN expedition to Madagascar, under the auspices of the French Government, to be directed by Messrs. Milne Edwards and Grandidier, is being prepared at a cost of 600,000 francs. We wish them all success.

MESSRS. BARBIER intend to fit out a boat of 2,000 tons for an expedition to West Africa, to take back the negroes whom they brought to Paris and Rouen. The voyage there and back will occupy forty-five days: by way of Lisbon and Las Palmas, the boat will proceed to Dakar, Ste. Marie de Bathurst and Konakry. As *L'Anthropologie* points out, this is a splendid opportunity for anthropologists and naturalists.

THE plan elaborated by the amateur Arctic tripper, Mr. George J. Gould, of attacking the North Pole with the help of a cordon of depôts established a point further north from year to year, is thrown somewhat out of joint by the discovery of a deep Polar sea, with nothing more secure than floating masses of ice.

Julius von Payer's scheme for an Antarctic expedition seems to have met with some obstacles, and should these not be removed, the veteran explorer will start next summer for Franz Josef Land to meet Mr. Jackson. It is said that Mr. Harmsworth has offered his vessel to Von Payer for a new expedition.

The Peary Expedition has been unsuccessful in bringing back the large meteorite from Greenland, since the implements taken were not strong enough to lift the enormous weight of forty tons. Valuable collections and observations compensated for the disappointment, and another journey will probably be undertaken.

Some exceedingly valuable zoological results have been obtained by Commodore Wandel and his party in the Danish boat "Ingolf," which returned on August 27 from a two years' cruise in Icelandic waters.

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NOTES AND COMMENTS.

The Botanist of the Future.

"BOTANICAL OPPORTUNITY" is the title of Professor Wm. Trelease's presidential address delivered to the Botanical Society of America, and reported in full in the September number of the *Botanical Gazette*. As the president addresses himself to "the large and growing number of young botanists" who are seeking help and inspiration, and as his remarks will apply almost equally well to other branches of science, it may be worth while to call the attention of our readers to some of them. The present is a period of transition. A generation ago it was possible to accumulate wealth in commerce, and also to devote much time to the study of nature. "To-day the man who is not entirely a business man is better out of business, and, with a few exceptions, the man who is not entirely a student is little better than a dilettante in science."

Professor Trelease is sanguine; he predicts that even in the next decade, the money-makers will realise the tremendous advantages to be gained by the encouragement of pure science, and adequately endowed laboratories of research will "stand out quite alone, and justify their existence without reference to other ends." Take heart, Cinderella, the prince is coming!

The subject is considered under two heads,—the opportunity of institutions and of individuals. That of the former lies in equipment and the use thereof, and useful hints are given as to the proper limits of library, herbarium, garden, and apparatus. The great expense attached to a garden, and the impossibility of growing more than a very limited number of plants, and also of imitating successfully different climatic conditions, leads to the suggestion of establishing branch gardens, where plants characteristic of special sets of conditions, such as alpines, maritime plants, succulents, etc., can be studied in their native environment. Moreover, the institution of the future "will count as a part of its legitimate equipment the provision, as needed, of very liberal opportunities for the staff to visit even distant regions for the study in their native homes of plants which cannot be cultivated even in special gardens in such a manner as to be fully representative"; and some provision will be made for enabling students to utilize new centres of research "without encroaching too far on the limited savings from the small salaries which, as a rule, are drawn by the botanists of the country." And "it is quite certain that within a very few years opinion will have so changed that a considerable number of salaried positions for research work or applied botany will exist," which positions "will compete with the professorships in the best universities," &c. Utopia! And the scientific members of the Staff at Kew Gardens will be provided with suites of rooms at Hampton Court!

Turning to the individual, the speaker reminds us that it is to slow and persistent investigation, rather than to sudden inspiration, that we must look for the accomplishment of the greatest collective results. He points to the necessity of breadth of early training; powers of observation must be well developed, and more discipline in reasoning given than is now customary. After the selection of a subject nothing is so important as system in pursuing it. We can see in others, if not in ourselves, a great waste of energy, resulting from shiftless and ill-considered methods of procedure. "Order and method are absolutely necessary, and next to the clear idea of the end aimed at, I should place immediate making of full and exact notes as their most essential part." Finally, manner of publication is considered. Writers are warned against the habit, especially common in the earlier years of their work, of distributing their papers among a number of journals. Provided they are on kindred subjects, they should, of course, be kept as closely associated as possible when published, so that in seeking one a reader is likely to learn of another.

The Study of Variation.

In our September number, under the heading "A Registry Office for Snails," we ventured some remarks suggested by a Label List for variations in banded snail-shells, sent us for review by Mr. John T. Carrington. Mr. Carrington is very angry, so angry that, in a reply extending over five columns of his own magazine, he brands us as "closet naturalists" and "Superior Scientists," the latter expression being in his opinion particularly "objectionable." We cannot, however, regret our note, since it has drawn from Mr. Carrington an explanation that really is of interest. After all it seems that he really is trying to correlate the existence of these variations with the character of the localities in which they are respectively abundant, and he finds that he can "by change of food and other means alter the band formula of an individual, I think I may say, at will." He wishes to find out what occurs in a state of nature, and especially what does not occur, and his object in having the list printed was that he might send it round, for their local census, to the very few people in this country and on the Continent who collect these band forms. Mr. Carrington also points out that the study of variations has proved of great importance in the hands of Darwin and Bateson. This is admirable. This is precisely what we hinted was necessary. But of all this there was no suggestion in the preface that was attached to the "Label List." What we objected to was not the scientific study of variations, but their *meaningless* collection and record, and, above all, the misleading habit of attaching varietal names to variations which may, it is true, be constantly repeated, but which have not been proved to exist as separate and continuous races. On this question Mr. Carrington has a paragraph which is unintelligible to us; we regret our obtuseness the more since the paragraph appears to be of a sarcastic nature. We can only gather from it that the Editors of NATURAL SCIENCE and of *Science Gossip* use the word "variety" in different senses; which of them is right it would ill become us to decide.

THE USE AND ABUSE OF COLLECTING.

STILL addressing us as the "Superior Scientist," Mr. Carrington hints that we are casting wet blankets on young naturalists, deterring them "from pursuing lines of thought and investigation which are really unworked"; that, in short, we desire the extinction of the field-naturalist. Our regular readers, of whom Mr. Carrington is obviously not one, will recognise the absurd injustice of these aspersions. From the leading article on "Private Collections," on p. 161 of our first volume, down to the note headed "Natural History *versus* Systematic Work," on p. 4 of this volume, we have been perfectly consistent in urging the importance of observations in the field and the value of the collecting spirit when directed along proper channels; we have even, strange though it may seem to Mr. Carrington, insisted more than once on the necessity for the detailed and systematic collection of those minute variations which *Science Gossip* loves to call varieties. What we have protested against has been the restriction of a man's energies to mere collecting, often indiscriminate and harmful in its effects on the flora and fauna, covetous of rarities and show-specimens, and rarely paying attention to larval forms, food, or bionomic considerations. Why was it for thirty years "the custom of the 'superior entomologist' to sneer at British butterflies and their collection"? Simply because the ordinary "bug-hunter" did *not*, and did not even wish to, pay attention to their life-histories, to their comparative structure, or to the various points that made Mr. Scudder's work what Mr. Carrington calls it—"really scientific." Even now there are entomologists—we do not know whether they are too "superior" for Mr. Carrington—who think that "the wholesale formation of collections should be discouraged as much as possible" (*Nature Notes*, October, 1896). When we find such men as Professor Meldola, Mr. McLachlan, Mr. J. W. Tutt, and Mr. W. F. Kirby all in a tale together, we are not ashamed to be of the company. Let us not misunderstand one another! Let *Science Gossip* continue to inculcate the true principles of scientific collecting, let it above all things encourage observation, and discourage petty nomenclatorial propensities, and it will meet with not merely patronising approval, but all possible help, even from the Superior Scientist.

British Snails.

Yes! Mr. Carrington, even the variations of snails may be studied to good effect, as shown by a paper on an early neolithic kitchen-midden and tufaceous deposit at Blashenwell, near Corfe Castle, which Mr. Clement Reid has had published in the *Proceedings* of the Dorset Field Club, vol. xvii. Twenty species of snails are recorded by Mr. Reid from the tufaceous deposit; "all species still inhabiting Dorset," and the list is "more striking from the absence of so many of our commonest living species than for anything else." The chief interest is seen in the well marked distinction between *Helix nemoralis* and *Helix hortensis*, so marked indeed that Mr. Reid says "no naturalist seeing a large series from Blashenwell, and unacquainted with the variability of the living snails, would for a moment hesitate to say that they were good and well-marked species, belonging merely to the same section of the genus." The following diagnoses are given:—

H. nemoralis.—Shell large, depressedly globular, amber coloured or yellow, without bands, lip dark.

H. hortensis.—Shell smaller and more globular than *H. nemoralis*, whitish, bands five, two narrow above and three broader below, often widened till they become confluent, lip white.

The difference is not due to deficiency of colour, for, as Mr. Reid says, the dark tipped *nemoralis* is always amber-coloured or yellow, but entirely without bands, while the smaller white-lipped *hortensis* is whitish or grey and five banded, only a single specimen out of hundreds having one of the narrow bands missing. The banded *nemoralis* so common at the present day is wanting at Blashenwell, as are all intermediates or hybrids between the two forms.

Mr. Reid also calls attention to the fact that land shells are likely to be extremely valuable guides to the age of a deposit, and mentions that he has never seen in any deposit, satisfactorily shown to be older than the Roman invasion, any specimen of the common brown snail of our gardens, *Helix aspersa*, and he urges archæologists to collect land snails from the graves in the Downs.

N.Spp.?

We have for the greater part of this year been protesting, both in season and, as some of our readers think, out of season, against that irritating form of scientific vanity known as the preliminary notice. Our protest was originally drawn forth by a regrettable publication in the *Circular* of the Johns Hopkins University from the pen of an excellent American geologist. But his rival has now appeared in our own country, and a greater offender arises in the Geologists' Association. We should like very much to know what particular obliquity of judgment it was that led the well-known gentlemen who form the council of that thoroughly praiseworthy association to publish in the August number of their *Proceedings* (issued September 4, 1896) "A Preliminary Synopsis of the Fauna of the Pickwell Down, Baggy, and Pilton Beds: by the Rev. G. F. Whidborne, M.A., F.G.S." We do not propose on the present occasion to discuss the accuracy of this gentleman's work; we do not propose to repeat for his edification, or for the benefit of the Geologists' Association, the invectives that we have already launched at the heads of workers and societies of even greater reputation; but we confine ourselves to the most succinct statement possible of the facts of the case.

The paper occupies seven pages: it consists of a list of 187 names of fossils, most of them without added remarks, but many placed (no doubt wisely) between inverted commas or in front of a note of interrogation. Seventy-five of these names, however, are stated to belong to new species. Of these seventy-five new names, two are absolute *nomina nuda*. Five others are equally unprovided with any attempt at a diagnosis, but have references to figures in Phillips' "Figures and Descriptions of the Palæozoic Fossils of Cornwall, &c." The remaining sixty-eight are followed by sentences which only courtesy and convenience permit us to designate as diagnoses. No figures are given. We quote at random a few examples of the diagnoses:—

> "*Anatifopsis* (?) *Anglica*, n.sp., like *A. acuta*, Barr., but shorter.
>
> "*Ceratiocaris* (?) *subquadrata*, n.sp., large sub-oblong valves with ogee end.
>
> "*Orthoceras Barumense*, n.sp., very like *O. ibex*, Sow., but without longitudinal striæ.
>
> "*Scaldia* (?) *longa*, n.sp., small, smooth (?), transversely ovate, with sub-central umbo.
>
> "*Athyris rugulosa*, n.sp., large, with wide flattened fold and numerous imbricated foliaceous striæ.
>
> "*Camarella togata*, n.sp., with three large ribs on fold.
>
> "*Rhabdomeson* (?) *distans*, n.sp., dichotomizing witth (*sic*) fewer and more distant zoæcia (*sic*), with oval apertures.
>
> "*Cornulites devonianus*, n.sp., small, elongate, conical, slightly flexuous, with few step-like annuli.

"*Taxocrinus* (?) *stultus*, n.sp., with 3 B, 5 R, and intercalated anal, and with IBr. in three rows.

"*Prothyris recta*, n.sp., small, sub-oblong, coarsely striated."

It is stated on the wrapper of the *Proceedings* that this paper was first published in the Long Excursion Pamphlet. The date of this is not given, but we understand that a very limited number of copies was issued. A note at the end of the paper states that the author "is at present describing the above species in a Monograph of the Palæontographical Society." A portion of that Monograph has since appeared, and we are not surprised to find many of these so-called new species again figuring as "n.spp."—for such is the usual custom of the preliminary speciesmonger, who, having secured what he calls "priority" by his precious leaflet, carefully ignores it in all his subsequent writings. Casual comparison of the preliminary list with the Monograph reveals a strange discrepancy: "*Anatifopsis ? anglica*," is now said to differ from *A. acuta* "in being much more elongate." Moreover matters are not made much better by the publication of figures of some fifteen of these so-called new species without accompanying text. From some enquiries we have made, we gather that in the present case the author was not altogether responsible for the publication of what he wished to be regarded as a manuscript list. This may throw the blame on to other shoulders, but it does not make matters better for the working naturalist. And as for the Palæontographical Society, its fifty years should have taught it better.

THE REDUCTION OF PUBLICATION.

THOSE who sympathise with the remarks that we have had occasion to make on the preliminary publication of incomplete work, will read with interest the following sentences by Mr. Charles R. Keyes in a review, published in *Science*, of volume v. of the Iowa Geological Survey:—"As in the previous volumes of this survey there is carried out the highly commendable policy, established at the beginning, of eliminating all matter from the reports that is of a preliminary nature, and of publishing only material that has been carefully digested and classified. In this way the total amount of matter published is not nearly so great as it otherwise would be. With great advantage all work of preliminary character, which so often goes to make up the large bulk of geological publications, is omitted. Thus, only the work in its ultimate form is made public. The set of volumes becomes the 'final' series, and only a single class of publications is issued."

We also welcome the co-operation of the *Botanical Gazette* which, *à propos* of the duplication of publication, remarks:—"If we are not mistaken, the publication of one paper stating fully the nature and results of a research ought to end publication until further research has been made and new results reached. Some eminent botanists have in late years followed a different course, and have worked over the same studies into three or four different papers in different journals. But if results are of real value one adequate publication is all they need to receive recognition and all that ought to be unloaded upon already burdened bibliographers. We go so far as to say that the 'preliminary paper' with its half prepared diagnoses or ill-digested generalisations is an unmixed evil and ought to be suppressed by botanical opinion. We are glad to join *Natural Science* in its vigorous opposition to such makeshift methods."

"Drunken with Writing."

That was the picturesque phrase, descriptive of the present intellectual position of civilised man, with which Professor Flinders Petrie gained the hearty applause of those who heard his Liverpool lecture on "Man before Writing." The position and importance of writing, in contrast to the teaching through the senses, has been so much overvalued that it has deadened the growth of the mind. This mistake is like that which the Greeks made regarding language, in supposing that words could be used as an algebra to reach the reality of mind and of matter. Thought, however, is independent of words, as is most plainly shown by the difficulty of finding words to express thought exactly. As thus words have been formerly mistaken in their function, so writing has been until very lately also mistaken as the means of growth of the mind. The earliest writing, before the mind of man was deadened by convention and imitation of past literature, is the finest, as seen in the Homeric and other epics of each land. That expresses the mind of man before writing. And literature only lives by continual absorption of the unlettered man as material for new growth. Each stage of literature in Greece and in England has been a using up of a fresh stratum of man without writing. And as literature requires to grow on the facts and feelings unconventionalised, so history requires to grow on the facts as discovered, either with or without writing, but independent of any version of it written down. The tangible facts of man's art, life, constructions, follies, and magnificence, form the reality of history. Such history can be gathered as well from man before writing as from written accounts.

The nature and ability of man before writing can be seen as regards his mind in the earliest literature, which is confessedly the finest and most vivid. For his art, we see it in the magnificent vigour and ability of the Mycenæan art, as shown on the gold cups of Vapheio and the ornaments from Mycenæ, and on the architecture of Tiryns and Mycenæ. And the grand ability of these is akin to the spirited and natural carvings of animals done by the cave men of

France and England, and is therefore not by any means a solitary test of unlettered man.

The splendid figures of the Dacians, conquered by Trajan, give a view of the noble air and expression of man before writing in that region.

Egypt, as Professor Petrie has done so much to show, presents us with an epitome of the civilisation of unlettered man in the figures of various objects used as hieroglyphs, since they must have preceded the use of writing. These show that in that stage man had fully developed weapons, tools, boats, ornaments, and architecture.

Thus the civilisation, art, ability, and conceptions of man before writing are quite on a level with what he used afterwards. Writing is like railways and telegraphs, one of the tools which we must use to hold our place with others; but it is of no virtue to the mind in itself. And by relying on it too much we lose that education of the senses, and the growth of the mind through the senses, which is the most really important for us.

Was it, we wonder, this lecture, that suggested to Dr. W. Essex Wynter his recent address to the students at Middlesex Hospital, in which he advocated a study of concrete facts rather than of books? At any rate, we ourselves as we heard it were profoundly impressed with the truth of those remarks as applied to the study of science. The beginner, we fear, is often expected to know what Professor X., Dr. Y., and Mr. Z. think about, say, *Balanoglossus*, though his own practical acquaintance with the animal remain of the most meagre description. Even when practical work is insisted upon, it is accomplished with the aid of manuals, text-books, diagrams, and pretty pictures. Originality of observation, nay, the very power of independent observation, is thus checked. Give a man an object, whether a tea-plant or a tea-cup, and make him describe it; take him to a quarry, and make him measure, sketch, collect, note, and label; all this without books, without names, without the obscuring jargon of the "ologies," and you will have done more for his training as a scientific naturalist than by a month of lectures on the ancestry of the Chordata.

MYCENÆAN CULTURE.

IN his presidential address to Section H, entitled "'The Eastern Question' in Anthropology," Mr. Arthur Evans alluded to the continuity of race from Palæolithic times, as evidenced by the remains in the Baoussé Roussé Caves, through Neolithic skeletons of the same Ligurian coast, down to the historical Ligurian type. Thus the 'Mediterranean Race' finds its first record in the West, and may date from the time when the land bridges of Eurafrica were still unbroken. The continuity of cranial type has been emphasised by Professor Sergi, and Salomon Reinach has brilliantly advocated the indigenous nature of the early European civilisation. The earlier civilisation of the Bronze Age is that of the Swiss Lake settlements, the later is known under the general term of 'Ægean.' The latter roughly falls into two divisions, an earlier, represented by the cist graves of the island of Amorgos, and a later, the Mycenæan. The Amorgan period exhibits abundant proof of a widespread commerce from Spain and the Libyan coast to Chaldæa. Characteristic of the art of this period is the returning spiral, which undoubtedly was borrowed from Egypt and by the trade of this civilisation it spread into Scandinavia and as far as Ireland; but there was probably a southern route along the Mediterranean to the latter island, and it is on this line, rather than on the Danube and the Elbe, that we find in a continuous zone that Cyclopean tradition of domed chambers which is equally illustrated at Mycenæ and at New Grange. In the matter of the spiral motive, Crete may be said to be the missing link between prehistoric Ireland and Scandinavia and the Egypt of the Ancient Empire. The President announced his discovery of a prehistoric Cretan script excavated from the lowest level of a Mycenæan stratum, thus the great step in the history of writing implied by the evolution of symbols of phonetic value from primitive pictographs is shown to have effected itself on European soil. Mycenæan culture was permeated by Oriental elements but never subdued by them. It is difficult to exaggerate the influence of this widely ramifying Mycenæan culture on later European arts from prehistoric times onwards. Beyond the limits of its original seats, primitive Greece and its islands and the colonial plantations thrown out by it to the west coast of Asia Minor, to Cyprus, and in all probability to Egypt and the Syrian coast, we can trace the direct diffusion of Mycenæan products, notably the ceramic wares, across the Danube to Transylvania and Moldavia. The Mycenæan impress is very strong in Southern Italy and Sicily, isolated relics have been found in Spain and even in the Auvergne. In Bosnia and Herzegovina a sub-Mycenæan influence affected the Early Iron Age. These Mycenæan survivals and Illyrian forms engrafted on the "Hallstatt" stock were ultimately spread by the conquering Belgic tribes to our own islands, to remain the root element of the Late Celtic style in Britain, where the older spiral system had long since died a natural death, and in Ireland to live on to supply the earliest decorative motives of the Christian art of that country.

Geological Time.

Professor Poulton's interesting address to the Zoological Section discussed the possibility of evolution within the allowable limits of the earth's age. Biologists would probably have preferred a summary of recent work on the problems of insect coloration, which the zoological President could have discussed with unique authority; but in this age of specialisation it is seldom that the difficulties thrown in the way of zoological progress by sister sciences can be attacked by men who are authorities on more than one. Professor Poulton is a geologist as well as a zoologist; he was, therefore, doubtless wise in choosing a subject which depends on the evidence of both sciences. His text was one of the arguments used by Lord Salisbury at Oxford. It may be remembered that the Premier, in his Presidential Address, claimed that the limitations placed on the age of the earth by Kelvin and Tait were a proof that evolution had been physically impossible. Evolution demands many hundred million years; physics prove that no more than ten or a hundred million years can be allowed. This conclusion has recently been attacked by Professor Perry, who has shown that of the three arguments on which it once rested, the only one to which any weight was still attached is utterly valueless. He has shown that Lord Kelvin's case rests on a series of assumptions, which are not only unproved, but of which the truth is almost impossible. Professor Poulton quotes Darwin to the effect that "Thomson's views of the recent age of the world have been for some time one of my sorest troubles," and that to his mental vision their author was "an odious spectre." In this judgment Darwin was truer than he knew; for Perry's examination of Lord Kelvin's assumptions has shown that Darwin troubled himself needlessly; the argument, as mathematically stated, is at first sight as unintelligible and alarming as a spectre, but it is as harmless. Perry's position is based on mathematical reasoning, of which the principles are simple, but the language obscure to the non-mathematical mind. Professor Poulton has done a useful service by summarising the controversy in non-technical language which anybody can understand.

The second part of the address considers the biological evidence in support of the geological view of the immense antiquity of the earth. Professor Poulton's thesis is that the evolution of the ancestor of each of the higher animal phyla probably occupied a very long period, and that the time required for the evolution of the separate phyla from their original common ancestor can only be expressed as the period represented by all the fossiliferous rocks multiplied many times over. He points out that in the Cambrian period most of the hard bodied phyla were represented, and that in most cases, *e.g.*, the echinoderms, they were as distinct and separate as at present. He therefore demands a prodigious period of time before the Cambrian, during which life was slowly evolving. That he is right in his main contention no geologist is likely to deny, although when we come to his individual arguments we may doubt whether some of his estimates are not exaggerated. Even if we were to accept the exceeding slowness of evolution that finds favour with Professor Poulton, we might still maintain that it advanced far more rapidly in pre-Cambrian times, for groups in their youth vary more than in maturity, though perhaps less than when in decay. Brooks has suggested causes as likely to have accelerated the early development of the phyla, which, when once well established, remained remarkably stable. Hence, we may not hope for a reliable estimate of the length of the pre-Cambrian period from zoology any more than from physics. We may at least be grateful, when comparing Professor Poulton's cautious generalities with the statement of some physicists, that no attempt to hamper progress by impossible precision is likely to be made.

Palæontology and Geographical Distribution.

A further example of the greater importance now attached to palæontology is given by Mr. Lydekker's volume on the "Geographical Distribution of Mammals," on the issue of which we congratulate the editor of the Cambridge Geographical Textbooks. Mr. Lydekker's work, reviewed on p. 392, is unique among manuals on distribution in the attention paid to fossil forms. The works of Schmarda (1853), Sclater (1858), Huxley (1868), and Wallace (1876) established zoological provinces on the evidence of living animals alone. Neglect of palæontology was necessary when these authors wrote, since the available evidence was so imperfect. The methods they were therefore forced to employ were as little likely to yield final results, as an attempt to deduce the original distribution of human races from that of the present day without any reference to the historical records of changes and migrations. It is not surprising that Mr. Lydekker's broader range of view renders necessary alterations in the classification of the zoological regions. Mr. Lydekker finds the time-honoured six regions of Mr. Sclater inadequate, and prefers ten regions divided among three realms, which are those suggested by Dr. Blanford in 1890. The ten regions are prepared mainly on the evidence of mammals, except in the case of the Hawaiian, which in the absence of a mammalian fauna depends on birds. The striking differences between arrangements based on different classes of animals themselves illustrate the necessity for the consideration of palæontology; for the differences are due, at least in part, to the varying distribution of land and water in past ages. That Mr. Lydekker's divisions do not suit all classes of animals detracts from their convenience but not from their truth. It may be objected that palæontological evidence cannot be relied on owing to the imperfection of the geological record. But after the discoveries among the mammalian faunas of Patagonia and the Argentine Republic, of the Western States of America, of India, of Australia, of the Mediterranean islands, not to mention the many localities on the mainland of Europe, this objection may be regarded as equal in value to the cry for missing links. Mr. Lydekker's book shows that systems founded on neontological evidence only have had their day.

International Congresses.

It has been decided by the British Association that all fellows and members of the American Association, meeting next year at

Detroit, be admitted as members of the British Association during its Toronto meeting, on the same terms as old annual members. *Science* takes the opportunity to suggest that there should be established an International Congress for the Advancement of Science. "The co-operation between the British, French, and American Associations, the successful international congresses in the separate sciences and for scientific bibliography, the establishment of journals international in circulation, in contributions, and even in editorship, are steps in the forward movement leading directly to a world's congress of men of science." Our readers will remember a little note that we published on International Congresses a short time ago, and they will not expect us to support this proposal very warmly. The great fault of these gatherings is the want of organisation, and the more international the gathering, the worse, as a rule, is the organisation. We agree that most of the questions mentioned by our contemporary—"bibliography, nomenclature, the definition of units, libraries and museums, explorations, the teaching of science"—can only be settled by international co-operation. But they should be discussed, not by some general congress with a high-sounding title, but by special international committees appointed *ad unumquidque.*

THE ENCOURAGEMENT OF ZOOLOGICAL RESEARCH.

THE International Congress of Zoologists in 1898 will be held at Cambridge at the same time as the congress of Physiologists. A committee, with Professor Alfred Newton in the chair, will arrange the details. Two prizes will be awarded on this occasion, the first, of the Czar Alexander III. for research on the ruminants of Central Asia, zoologically and geographically considered; the second, the prize of the Czar Nicholas II. for an anatomical and zoological monograph on some group of marine invertebrates. Manuscripts should be sent in to the president of the permanent Committee, 7 Rue des Grands-Augustins, Paris, before May 1st. 1898. The *Revue Scientifique* hopes the second subject may be altered in order not to promote the continual publication of monographs, and remarks "Il n'y a pas que les faits; il y a encore et surtout les idées, et les zoologistes contemporains semblent l'oublier souvent." We cannot say that we altogether agree with our estimable contemporary; for in the first place we do not see why a monograph on marine invertebrates should necessarily be destitute of ideas; in the second place, highly as we value ideas, we still maintain that they must be checked by reference to facts, and we agree with our contributor, Mr. F. G. Parsons, that the more facts we have at our disposal, the surer will be our conclusions. This, as our last number sufficiently showed, is what geologists and palæontologists are feeling, and we are glad to find, as the papers by Drs. Parsons and Keith instance, that many pure anatomists share the same view.

Jamaica as a Tropical Marine Biological Station.

In America, at any rate, they appreciate the value of extended acquaintance with facts, and for some years Professor W. K. Brooks has realised the importance to his students of taking an extra course of laboratory work at some more tropical centre. For this object Professor Brooks has given the preference to Jamaica on account of the more typical and varied conditions of both its marine and terrestial life. According to his experience, the Bahamas may be superior for a study of the fascinating life of the coral-reef, but, for the requirements of a more general training, Jamaica is perhaps better adapted. In 1891, the first party of students, with Professor Brooks at their head, made a three months' stay at Port Henderson, close to Kingston; in 1893 a second party under Dr. Bigelow did the same; and only recently a third party, consisting of Messrs. Conant, Clark, and Sudler, accompanied by Professor Brooks, have spent three months at the same place. The visit of these students is not entirely confined to laboratory work, but exploration and collection from the more important places in the island has been systematically carried out. At the invitation of the Board of Governors of the Institute of Jamaica, a special meeting of the members of the institute was held in the lecture room, and the members of the Johns Hopkins University Marine Laboratory then stationed at Port Henderson gave an account of the work performed by them on the fauna of Jamaica. Mr. Conant discussed the chætognaths, or arrow worms; Mr. Clark, the holothurians, or sea cucumbers; and Mr. Sudler, the crustacean genus, *Lucifer*. The Institute of Jamaica has not been slow in recognising the value to the island of the work carried out by the Johns Hopkins students, and has placed itself in close communication with the university, and, in return for the assistance afforded, the institute obtains the valuable help of Professor Brooks and his students in naming specimens in the museum, and in receiving valuable duplicates of the treasures collected by the workers. The governors of the institute also realise that it would be of value to zoology generally if some scheme could be devised for holding vacation biological sessions at Kingston; anyone desirous of obtaining further information may apply to Mr. J. E. Duerden, the curator. At the close of the special meeting referred to above, Mr. Duerden commented on the extraordinarily complete course of instruction received by the Johns Hopkins students, and pointed out that after four years' general course at the university, the students usually gave from three to five years to research work, from which he hoped that Jamaica would receive a considerable and lasting benefit.

Teaching Physiography.

We are are glad to observe that the Science and Art Department has taken the subject "Physiography" in hand, and if it has not more fully justified the title of that hodge-podge of elementary science, it has made a more rational use of it by substituting experiments—or, at least, the suggestion of experiments—for what was originally a lecture syllabus only. It is perfectly true that lecturers of any standing have for years used apparatus in illustration of their remarks, but the syllabus as now drafted cannot fail to re-model the whole subject. Instead of a smattering of geology and astronomy with a little physics and chemistry thrown in, the students will now have placed before them enough of each of these sciences to whet their appetites, and to help them in making up their minds as to which branch they will in future pursue as a separate subject. That part of the new syllabus relating to physics (or so much of it as is intended to be taught in physiography classes) has been drawn up with especial care; but to our thinking too much astronomy is still apparent, whilst biology, in its relations to the distribution of animals and plants, is hardly insisted on at all. How different the subject as now drawn up by the Science and Art Department is from that originated by Huxley, must be very evident to those who have followed the fortunes of "physiography" from its commencement.

THE HINGE OF BIVALVE MOLLUSCS.

ON page 153 of volume viii. we referred to the researches of Dr. Felix Bernard upon the hinge of Pelecypoda. A further instalment of his results has appeared (*Bull. Soc. Géol. France*, 3^{e} ser., t. xxiv., pp. 54–82), and gives an account of the development of the hinge in the Taxodont group of that class, *i.e.*, those with a great number of teeth in a row, such as *Arca* and *Nucula*.

Dr. Bernard points out, by way of preface, that the prodissoconch stage is so similar in all the groups as to lead naturally to the conclusion that it recalls a non-differentiated ancestral form; and he considers that the completed prodissoconch corresponds to a period of rest in the growth of the animal and of its shell, during which the internal organs arrive at perfection and the various cells specialise. This completed, growth recommences brusquely, but always least actively in the region of the hinge.

In the Taxodonts, as in the Heterodonts and Desmodonts, Dr. Bernard finds that the ligament originates in an internal central pit. Along the upper margin of the hinge-line, however, there appears a row of small quadrangular crenulations, which in every respect act as do the teeth of the adult shell: with these last, however, they have nothing to do. These prodissoconchal teeth the author has, since his previous paper appeared, found in a few Heterodonts. The true teeth of the adult shell arise on the hinge-plate, on either side of the ligament, by the formation of shelly ridges more or less parallel to the dorsal shell margin, much as they do in the Heterodonts, but arching over afterwards as growth proceeds. Both sets of teeth are present in certain stages, except in the oyster, in which the true teeth never develop.

From the point of view of the morphology of the hinge the Taxodonts form a very natural and homogeneous group.

The author's general conclusions are held over till his studies of all the Pelecypod groups shall have been completed.

A Big Fungus.

The visitor attracted to the Botanical Department of the British Museum (Natural History) by the various additions and alterations to which we have recently called attention, will be faced on entering the gallery by a striking model of a huge specimen of the fungus *Hydnum erinaceus*, represented in the situation where it was found growing. It does not bear much resemblance to the familiar mushroom; nevertheless, the Hydneæ belong to the same group of fungi, namely, the Hymenomycetes; but whereas in the mushroom and its allies the spore-bearing layer (hymenium) is borne on gills on the under surface of the fungus, in *Hydnum* it covers projecting processes or teeth, which are well shown in this exhibit. The specimen, of which this is a model, was presented to the museum by the Hon. Mabel de Grey. It was found in the New Forest in the hollow trunk of an old beech tree, in which sheltered position it had grown to quite extraordinary dimensions, weighing 22 lb. 6 oz., though always retaining the long teeth and the characteristic heart shape of *H. erinaceus*. The exhibit reproduces very carefully the habitat and appearance of the plant.

Sexual Reproduction in Fungi.

Owing to the questionable fate of the numerous nuclei which are present in the sexual organs of the *Phycomycetes*, the exact nature of the processes of fertilisation in this group of Fungi is of the greatest interest. Our knowledge on this subject, however, has been in a very unsatisfactory condition, due to the contradictory results obtained by various observers. Mr. Wager has just worked out this point very fully and satisfactorily in *Cystopus candidus*. ("On the structure and reproduction of *Cystopus candidus*, Lév.," *Ann. of Bot.*, Sept., 1896.) The result of his investigations is somewhat as follows. The oogonia are formed by the passage of protoplasm with nuclei into expansions of hyphæ; when a certain quantity has passed, the oogonia become cut off by a transverse wall, and the nuclei can be distinctly made out. They have exactly the structure of those of higher plants, and consist of a nuclear membrane and network, and a nucleolus; the average number is about ninety.

The structure of the antheridia is very similar; they contain a small quantity of protoplasm with from six to twelve nuclei. The antheridia become closely pressed against the oogonia, and the latter then go through the process of maturation. Their protoplasm *with all* *the nuclei* contracts towards the centre, forming there a spherical mass. This central mass then becomes differentiated into an external very dense layer (periplasm) and a central vacuolate mass (gonoplasm). The nuclei at the same time undergo division, and their number becomes doubled; the division is the typical indirect division of higher plants. They then become almost completely restricted to the periplasm, and there appears in the central part of the gonoplasm a deeply staining granular mass, in which one of the nuclei becomes embedded. This proves to be the nucleus that fuses with the one brought by the fertilizing tube.

In the antheridium also the nuclei divide, and one of the daughter nuclei passes with a small quantity of protoplasm into the fertilizing tube, which is protruded from the antheridium. This tubes bores its way into the oogonium and through the periplasm and gonoplasm, till it comes in contact with the central mass of dense protoplasm. The antheridial nucleus is then expelled and is found in close contact with the nucleus of the oosphere. At this stage a delicate membrane becomes visible round the oosphere, and the two nuclei shortly fuse together and fertilisation is complete.

The cell-wall of the oospore is formed from the mass of the periplasm, and the nuclei, which were embedded in it, degenerate. Thus, of the numerous nuclei present in the oogonium and antheridium, only one from each organ takes an active part in fertilisation.

Botanical Crumbs.

At a recent meeting of the Manchester Philosophical Society a paper by the late Mr. Thomas Hick was read, in which the affinities of *Rachiopteris*, a fossil plant of doubtful position, are discussed. The name was given by Williamson to some plant remains from the lower Coal Measures of Halifax, which he thought might be true ferns. From an examination of the anatomy of this fossil, which has a dichotomously branching stele, Mr. Hick concludes that *Rachiopteris* cannot possibly be a root, but is probably a stem or leaf-structure of a plant having more affinity with ferns than with lycopods.

At the same meeting Mr. J. H. Ashworth described the structure and contents of the tubers of an hepatic, *Anthoceros tuberosus*, from the banks of the Swan River, West Australia. These tubers, which are attached to the lower surface of the thallus by a stalk, are well protected by three or four layers of corky cells on the outside, while the interior is filled with closely packed cells containing granules and oil-drops. The granules give all the reactions for proteids, and seem to be aleurone grains comparable to those forming the proteid reserve material of seeds. Similar tubers were also found enclosed within the substance of the thallus. Such well-protected resting organs, or gemmæ, are eminently adapted to preserve the existence of a species in such a climate as that of West Australia, where periods of severe drought have to be provided against.

I.

The Determination of Fossils.

THE Note in our last number headed "Pavingstone Palæontology" has brought us, as we expected, communications from various people who felt that our remarks applied to them. In some cases they were not far out; but as to other cases we thought it clear that we were not criticising all published lists of fossils, and certainly not those that were compiled with the properly acknowledged aid of specialists. The difficulty of the geologists is well put by the letter from a "Stratigraphical Geologist" printed in the present number; it is the difficulty of finding specialists. Those who live in the great centres of intellectual activity are apt to make light of this difficulty, but it is one that we fully recognise. Specialists in palæontology are not numerous, their names and addresses and the subjects with which they are prepared to deal are not always so well known as are those of Cabinet Ministers, finally they are not always anxious to work over carpet-bags full of imperfectly preserved fossils, left with them by too enthusiastic friends. On the other hand, the real specialist on any subject is, or ought to be, glad to examine specimens belonging to the particular group that he studies, especially when these have been collected with due attention to horizon and locality. We have therefore thought that the publication of a list of those studying particular groups may be of value, first, as showing stratigraphical geologists where they can obtain assistance, secondly, as putting specialists in communication with those who can forward their own studies by material and by information, and lastly, as indicating what groups of fossils are still in need of students. The list that the kindness of the palæontologists mentioned in it enables us to publish may help in these directions; and with regard to the last point, we would urge each stratigraphical geologist, provided he has had sufficient zoological training, to make himself a specialist in some small branch that is not represented here; thus the list will gradually become more complete, and by the organisation of labour, workers will be able to render mutual aid, while British geology and palæontology will advance with firmer foot.

Concerning this list some remarks are necessary. No name in it is published without the express sanction of its owner. But this sanction has been given upon definite conditions to which we must direct the attention of those desiring a specialist's assistance. Every specimen sent to a specialist must be labelled with definite locality and horizon. The sender must give satisfactory assurance that he desires the information for purposes of publication, and not merely for the sake of having his collection named. Full acknowledgment of the assistance rendered by the specialist must be published. The specialist reserves the right of himself publishing, in any way that seems to him best, any new species or other points of biological interest afforded by the material submitted to him. It is also important to notice that many of these specialists are connected with public institutions or have their time otherwise largely occupied; in some cases they will justly demand to receive some further benefit, as by the presentation of selected specimens to their institution. In no case can NATURAL SCIENCE be responsible for the sending of collections, for the determination of specimens, or for the publication of results; but the sender and the specialist between them must make their own arrangements and their own bargain.

We may also point out that this list does not profess to be a complete list of British palæontologists. Some we may have overlooked and omitted to ask; some whom we have asked have not yet replied; others have refused their assistance; while others, though they profess a readiness to help all *bonâ fide* workers (which is more than we asked them to do), are not so ready to inform the workers of their good intentions. However, we hope at no distant date to publish a supplement to this list, and we hope also that our list will be copied, with or without additions, by any of our contemporaries that share our desire of helping scientific workers.

LIST OF SPECIALISTS.

VERTEBRATA—		
Mammals ..	.. From any horizon.. ..	.. R. Lydekker.
,, ..	.. British Pleistocene ..	.. E. T. Newton.
,, Rodentia	.. From any horizon ..	.. C. Forsyth Major.
Birds	.. ,, ,, ...	.. C. W. Andrews.
Reptiles ..	,, ,, ...	R. Lydekker.
Amphibia ..		A. Smith Woodward.
Fish	.. ,, ,, ...	.. ,, ,,
,, ...	.. Palæozoic	.. R. H. Traquair.
,, ...	.. Coal-Measure	.. H. Bolton.
ARTHROPODS—		
Arachnids ..	.. From any horizon.. ..	.. R. I. Pocock.
Myriopods ..	.. ,, ,, ...	.. ,, ,,
MOLLUSCS	British Non-Marine, Tertiary to Recent	B. B. Woodward.
Cephalopods		
,, Esp. Nautiloidea	From any horizon.. ..	.. A. H. Foord.
,, Ammonoidea[1] ..	From Lias and Lower Oolite	.. S. S. Buckman.
Gastropods ..	.. Jurassic	.. E. Wilson.
,, ..	Palæozoic *Murchisonia*, *Ælisina*, and allied forms.. ..	M. Jane Donald.
,, ..	.. British Eocene and Oligocene[2]	G. F. Harris.
Pelecypods ..	.. ,, ,,	G. F. Harris.
,, ..	.. Cretaceous	.. H. Woods.
,, ..	.. Coal-Measure	.. H. Bolton.
BRYOZOA	.. Jurassic	.. J. W. Gregory.
,, ..	.. Precarboniferous[3].. ..	.. ,,
BRACHIOPODS ..	.. Mesozoic	.. J. F. Walker.
ECHINODERMS—		
Echinoids ..	.. Palæozoic	.. J. W. Gregory.
Asteroids ..	From any horizon..	,,
Ophiuroids ..		
Crinoids ..	,, ,, ..	.. F. A. Bather.
Cystids.. ..		
Blastoids ..		
FORAMINIFERA	,, ,, ..	F. Chapman. C. D. Sherborn.
PLANTS	.. Mesozoic	.. A. C. Seward.
,, ...	.. Palæozoic	.. R. Kidston.
Monocotyledons (Palms, etc.)	From any horizon	.. A. B. Rendle.
Algæ	.. ,, ,, ...	.. G. Murray.

The addresses of the above are mostly to be found in the lists of Members of the Geological Society and Geologists' Association, as well as in other lists and address-books.

[1] Suture-line to be marked in Indian Ink.

[2] If allowed to retain duplicates.

[3] If allowed to select specimens for British Museum.

II.

Zoology since Darwin.[1]

Part III.

NOW that we have seen what new paths zoology has taken since the time of Darwin, let us consider how its old, once exclusive, tasks, the description of the present state of animal forms, and the observation of their vital activities, have grown into systematics and biology in the narrower sense.

The theory of natural selection gave a new and mighty impulse to biology after it had been for a long time neglected. It entered on a flourishing period, which can only be compared to the brilliant age of biological discoveries made by Réaumur, Roesel, De Geer, Bonnet, Schäffer, and others in the eighteenth century. After Darwin's time how important became the relations of animals among themselves and to the plants, the influence of climate and food, and of light and warmth in the struggle for existence, in the phenomena of natural selection! The whole world afforded material, and books appeared, like H. W. Bates' "The Naturalist on the Amazon River," and A. R. Wallace's "The Malay Archipelago," real models of biological study. To these were added a whole host of naturalists, chiefly English and German, who everywhere found in the biology of animals and plants fresh proofs to support the Darwinian theory, though, at the same time, they pointed out puzzling phenomena, the solution of which, even to-day, defies the intelligence of the naturalist. Yet in this, as in other subjects, we know very well that neither our knowledge, nor our efforts, nor our means of arriving at the truth are as yet complete.

Formerly, geographical distribution was always reckoned among biological facts. This was probably only due to the fact that at that time people usually sought to explain the problem of the cause of faunistic differences by a reference to life-conditions, and as this seldom was satisfactory, animal geography was in reality a collection

[1] Lecture delivered by Professor Ludwig von Graff on his installation as Rector Magnificus of the K. K. Karl Franzens University in Graz, November 4, 1895. The profits from the sale of the original go to the Freitisch-Stiftung of the University. (*Continued from p.* 315.)

of lists, the perusal of which gave the zoologist no more food for thought than did the sight of a menagerie.

In this respect the new teaching of the theory of descent made a revolution, by first rendering possible a scientific treatment of zoogeographical facts. The faunistic character of a region is decided by its geographical age, and also by the phylogenetic stage of evolution of the animal world at the time of its settlement, and by its changing geographical relations to other faunal districts, during the different phases of the earth's history. It follows therefrom that it is not so much phenomena due to adaptation, but rather crises in the history of the stock, which decide the typical character of a fauna. Thus, zoogeography becomes an important branch of phylogeny.[2] A. R. Wallace, in his celebrated work, "The Geographical Distribution of Animals," laid stress on this point, and thereby became the teacher of modern zoogeography. A necessary condition, however, to the further progress of this science is the utmost exactness in the wearisome details of systematic descriptions of species.

Descriptive systematics have benefited from the new method, indirectly much more than directly, because the new teaching awakened general interest in zoology and botany, and thus directed more working energy into those channels than there ever was before. Moreover, it is easy to prove that the colossal addition to our list of animal forms—about 50,000 in 1832, to-day about 150,000—is due no less to the increase of means of communication and to the evolution of geography. It was not till the latter, from being the handmaid of history, passed into an independent science, and oceanographic questions came to the fore, that those big expeditions were undertaken, which form another characteristic of this period of zoology. One is involuntarily reminded of the time of Piso, Marcgravius, and Bontius, who, at the beginning of the seventeenth century, showed to wondering mankind the pictures of the Dronte and the Homo silvestris, from "The Two Indies," when one realizes that the "Challenger" Expedition of 1873–76 (concerned chiefly only with marine forms), brought back neariy 8,000 new species of animals. The description of these resulted in hundreds of new genera, families, and orders, and occupied sixty zoologists of all civilized countries twenty years, appearing finally in thirty-two quarto volumes, with

[2] Genealogical relations are brought especially into prominence in geographical distribution in those cases where there exists a proportion between the geographical separation and the amount of morphological difference. This important law was first formulated by H. Spitzer in his excellent "Beiträgen zur Descendenz Theorie" (Leipzig, 1886), and proved by him (pp. 259 et seq.) for the orders of apes and ostrich-like birds. This proportion should also be demonstrable in many other groups of animals. It may here be pointed out that one of the most decided opponents of the Theory of Descent with Modification (A. Wigand), made his agreement with the latter dependent upon the possibility of such a relation between geographical separations and morphological differences being proved. (A. Wigand, "Der Darwinismus und die Naturforschung Newton's und Cuvier's," Braunschweig, 1874–77.)

2,629 plates.[3] In many groups the results of this one expedition have increased the number of known species four- or five-fold.

The first result of this increase in the number of described forms was to render urgent a broader basis for, as well as a more definite content of, species description, in opposition to the Linnæan methods of systematic description, hitherto adopted, whose only scope was the separation of a new species from those *already known*, by distinguishing characteristics. One still had to try and grasp the "Specific" of an organism by which it could be distinguished from forms *yet to be discovered*. This demand, formulated even before Darwin's time by conscientious systematists, is of course difficult, and only to be complied with by one possessing an artistic sense of form. Furthermore, the Darwinians themselves frequently delighted in a wilful neglect of systematics, which arose partly out of contempt for the "hair-and-brush systematics" practised in museums (which was chiefly antagonistic to the new teaching), partly from an exaggerated conception of the variability of species—conceptions that produced the most eccentric phenomena in systematic work.

Happily, this fermentation period is over; we are learning to value again exact systematic description, as it has remained chiefly in the too-long neglected science of entomology. We only need to enlarge the methods of the latter by a more extended regard for comparative anatomy and evolution, in order to express ever more and more systematically the natural relationships of organisms. For one thing is sure, that the minute description, customary in entomology, of diagnostically important outward characters has done much less harm than the neglect with which these external characters were treated by the "scientific" zoology of the last decades. To this kind of zoology are due the facts that in modern monographs the systematic parts are often so superficially treated that they are useless to a conscientious zoogeographer, and that German zoology has been not unjustly reproached for bringing forth excellent theorists, and splendid comparative anatomists and embryologists, but no zoologists. As though, forsooth, knowledge of forms were not the foundation of all zoology, and as though one could obtain a living representation of the phenomena of variation without having practised the eye by exact systematic study in at least one group! Darwin himself gave a pattern of exact systematic description in the monograph on the cirripedes[4] at a time when the selection theory was already perfectly formulated in his mind. What student of the

[3] "Report on the scientific results of the voyage of H.M.S. 'Challenger,' during the years 1872–76, under the command of Captain Sir George S. Nares and the late Captain Frank Tourle Thomson. Prepared under the superintendence of the late Sir C. Wyville Thomson, and now of John Murray." 50 Vols., in quarto. London, 1880–95. See also "Challenger" number of NATURAL SCIENCE, July, 1895.

[4] Charles Darwin, "A Monograph of the sub-class Cirripedia, with figures of all the species." 2 Vols., London, 1851–54.

animal system is ignorant of the deep correlation existing between seemingly immaterial outward characters and important points in internal organisation, so that artificial systems built on the former alone nevertheless result in a grouping quite corresponding to natural relationships ?

The necessity of a change in this direction was, of course, recognised. Soon after its foundation in 1890, the German Zoological Society resolved upon the compilation of a gigantic systematic work, comprising all hitherto known species of animals,[5] and caused a new edition to be printed of Linnæus' "Systema Naturæ."[6] These are eloquent signs of the general need of deeper systematic work.

Yet it must not be overlooked that even the best descriptions of species to-day are pure abstractions, which comprise in one united individually coloured picture the results of research on a more or less large number of individuals. Through such syntheses as these one arrives at ideal species to which no one individual ever quite corresponds, and which do indeed satisfy the first-felt requirement, viz., comprehensibility, but which can never supply the material that we need for the scientific extension of the theory of descent. For that one would really want exact descriptions (divested as much as possible of the subjective) of countless single objects. It would be necessary to portray exactly the united examples of many generations with all individual traits, especially in those species to which great variability is ascribed. If the crossing of individuals could be carried on under varying external conditions, it would be possible to distinguish between constantly-inherited and variable characters. In the domain of botany an attempt of this sort has been made, namely, in Nägeli's "Researches on Hieraciæ,"[7] in which this quick-witted thinker insists upon the importance of a sharp division between uniformity and constancy on the one hand, and between multiformity and variability on the other. In the animal world such experiments as these are very much more difficult, but certainly not impossible, and yet hardly any have been undertaken.[8] In this province there lies open to the systematists of the future a field of work as large as it is fertile.

Systematics, therefore, which, in the descriptive period before

[5] The publication of this is happily ensured already, and competent workers have been secured for most of the animal groups. It will appear under the title, "Das Tierreich: Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen," published by R. Friedländer und Sohn, Berlin. (See NATURAL SCIENCE, vol. viii., p. 305, May, 1896.)

[6] Caroli Linnaei, "Systema Naturæ, regnum animale.' Editio decima, 1758. Cura societatis zoologicæ germanicæ iterum edita. Berolini, 1894.

[7] C. v. Nägeli, "Mechanisch-physiologische Theorie der Abstammungslehre," pp, 239 et seq. Munich and Leipzig, 1894.

[8] Even for the most elementary of the problems here named, viz., the one concerning the degree of variability of animal species in nature, very little material has hitherto been collected. Cf. A. R. Wallace, "Darwinism."

Darwin, was merely an insufficient inventory of short differentiating characteristics arranged with a view to comprehensibility, after his time developed into a pedigree expressing true blood-relationship, and will, in the next period of our science, be unable to dispense entirely with experimental research.

Looking back, we see how in all the chief branches of zoological science the theory of descent newly formulated by Darwin has become the motive of a thoroughness in research, not found in any earlier period. It is characterised by the preponderance of the morphological interest, which has led to such a one-sided neglect of physiology, that to-day, when the development of morphology forces the formulation of questions whose answers experiment alone can supply, neither the methods of work nor the worker himself are at hand to solve them.

Morphology, seeking for explanations, threatened to become a victim of a new edition of the Schelling-Oken natural philosophy, had she not in healthy self-knowledge already mapped out the new path, which led the way out of danger. Still governed by the slowly dying exclusively morphological standpoint, zoology begins to recognise as her new aim, the "doctrine of the causes of organic formation," and Roux has even founded a journal devoted only to this subject.[9] But this title does not comprehend the whole domain now to be striven for, which can perhaps be better called, "Comparative Physiology," or "Biomechanics."[10] Darwinism has steeped the old descriptive zoology with the philosophical spirit and made out of it a historical doctrine—it remains for the coming generation to transform it into a *causal* science resting on a basis of Experiment.

Ludwig von Graff.

[9] "Archiv für Entwickelungsmechanik," edited by W. Roux, Leipzig, 1894, &c.

[10] Y. Delage, "Une Science Nouvelle: la Biomécanique" (*Revue générale des sciences pures et appliquées.* 6e. année, No. 10. Paris, 1895).

III.

A Plea for Details in Comparative Anatomy.

IT is only of late years that human anatomists have realised how difficult it is to describe definitely the arrangement of any single part of the body. In former times the text-books were compiled from the dissection of one or two bodies, and the statements made were accepted, without question, as the normal condition of affairs. If a too enquiring student complained that the body he was dissecting differed in many points from the text-book description, he was told that he was unfortunate in coming across so abnormal a subject; but it seems to have seldom entered his, or his teacher's, head that there was almost as much chance of the body being correct as of the text-book. The next phase in the attitude of anatomists, one that followed the greater opportunities for studying the human body, was careful collection of all the arrangements of parts that differed from the text-book descriptions, and the conscientious recording of them as abnormalities; but the proportion in which these occurred was seldom worked out, nor apparently was it doubted for a moment that they really were abnormalities. Recently this reliance on the standard text-books, as though they were inspired, has given way to a more healthy scepticism, and anatomists are now doing their best to find out how great the variation of different parts really is, and to fix the normal arrangement only when this has been discovered from observation of a large number of bodies. This is the work which is being done in England by the Anatomical Society, and in Germany by a great many independent workers, who realise the necessity of having a large number of absolute facts before attempting to generalise or make deductions, before even saying "this we must at present regard as the normal." The lesson taught us by recent work in human anatomy is, that it is wrong to make any dogmatic statements as to the arrangement of any part of man's body until a large number of specimens has been examined and recorded. Probably the same lesson holds good for the other animals; but at present we are unable to speak definitely, and it is with the object of asking for more facts that I am writing this little paper.

It has probably happened to many of the younger anatomists, as it has happened to me, to have gone carefully through the dissection of some animal, and then to have been told that the subject had been thoroughly worked out by someone else. The information is usually given in a tone that leaves the impression on the student's mind that the anatomy of the animal in question is the private property of the first describer, and that to publish the same thing again would be a sort of infringement on his rights. From our present point of view, however, the record of every dissection that has been made would be most valuable, and there can be little doubt that an immense amount of valuable time and work has been lost to us through the worker's mistaken impression that, because it had all been done before, he was not justified in burdening literature with a repetition. It may be contended that, if every worker recorded all his observations, the world itself would not contain the books which would be made, and that a huge mass of useless lumber would more than counterbalance the value of a few useful facts. This I do not think would be the case; there are a great number of scientific periodicals, journals, and proceedings which could easily afford to enlarge their space if more material were forthcoming. Moreover, it is so easy nowadays to hear of and refer to the work of others, that less and less space will in future be needed for statements of work done. For instance, suppose an anatomist wishes, for his own instruction, to work through the anatomy of the cat, he would be more than justified in sending, on the completion of his investigation, a note to any zoological publication saying what he had done, what he had looked for, and that in every particular, if it so happened, his own observations tallied with those of Mivart in his classical work on the cat. If this were done we should soon have a valuable set of statistics, and should begin to appreciate which parts of the cat's body were most stable and which most variable; and it would be possible to contrast these parts with those of man, and eventually of other mammals.

In referring to the descriptions of work done by many observers, one is often led to regret that they have evidently compressed it into the smallest limits, and have left out all mention of points which to them appeared trivial, forgetting that some of these apparently trivial points might turn out to be important characters of an order or family, and that, by neglecting to record them, they might possibly be leaving out the most important point in the whole observation. How often one finds, in referring to papers on myology, two or three important muscles left out, presumably because, as they were quite normal, the recorder did not think it needful to encumber his communication with facts which were the same as those mentioned by others before. These omissions are often very serious to the worker studying the myology of a group: he cannot take it for granted that because the muscles in question are not mentioned they are therefore the same as those recorded by others; he cannot even feel sure that they have been looked for. Thus good work is irretrievably lost. I feel convinced that the saying "if a thing is worth doing at all it is worth doing well" applies to the work of recounting scientific observations quite as much as to any other action of life. A good proof of the correctness of the views here pleaded for can be gained by contrasting the early and late papers of many of our well known writers; their earlier works often sum up the anatomy of an animal in a page or two, while later on they will frequently devote pages to the details of one small portion of a creature's body, and will not hesitate to add columns of figures and minute measurements that seem ludicrous to anyone glancing over the paper, but may be welcome enough to the worker who is trying to harmonise the account of one person with that of another.

It may be that this appeal of mine for more descriptions and details will be open to misconstruction, and that I may appear to reproach the Publication Committees of our various societies with suppressing, or at least discouraging, a mass of technical detail. Nothing is further from my intention, and a glance at the *Proceedings* and *Transactions* of these societies would make any such charge appear ridiculous. But I cannot help feeling convinced that a good deal of work is done yearly by the younger anatomists of which no record is kept, partly because of the impression that, since it has been done before, it will not be welcome, and partly because they do not consider themselves well enough up in the literature of the subject to make a complete paper. Neither of these objections should allow sound work to be lost to science; comparisons and generalisations can be worked up from time to time as material accumulates, while our excellent *Zoological Record* and various indices will prevent papers being lost sight of, no matter where they may have been published. I think that every anatomist who has worked at mammals of late years will agree with me that a description founded on one animal is of very little use, and that if we want to know how great or how small a part variation plays in different animals, it will be necessary for every observer to record all the results of his work.

St. Thomas's Hospital. F. G. Parsons.

IV.

An Introduction to the Study of Anthropoid Apes.—IV. The Gibbon.

THE greater part of the literature on the gibbon is devoted to a consideration of its specific and generic characters. Our knowledge of its anatomy is based upon a very small amount of material. Until five years ago, when Kohlbrügge published dissections of four specimens, our information was confined to incomplete descriptions of the anatomy of five animals. The paucity of research upon this animal, which, for many reasons, is the most interesting of the anthropoids, is not due to lack of material, for within a recent period there have been thirty-five specimens, belonging to various species, in the Zoological Gardens at London. After their arrival in Europe, they are soon at the disposal of the dissector, for unfortunately they do not live long in confinement, few of them more than a year. Of three gibbons that were in the Rotterdam gardens, two lived for about a month, the other died after a sojourn of eight days.

The Nervous System.—The brain of the gibbon is comparatively small and simple, resembling in its form and topography much more the brains of cynomorphous monkeys than those of the three great anthropoids. Recently it has received a great deal of attention. Kohlbrügge had at his disposal the brains of twelve specimens (eight of *Hylobates syndactylus*, two of *H. leuciscus*, one of *H. lar*, and one of *H. agilis*), but his observations refer mostly to weight and measurement, and only slightly to the convolutions and fissures. Waldeyer (326, 327) has given a very full account of the fissures and sulci of three brains (*H. syndactylus*, *H. leuciscus*, and *H. lar*), with accompanying figures. The figures which Bischoff (293) gives of the brain of *H. leuciscus* are extremely good. Deniker (17) has given a clear account, accompanied with figures, of the brain of a fœtus of about full time. Figures of the brain of *H. syndactylus* are given by Sandifort (271). Kükenthal and Ziehen describe the fissures of the brains of *H. hoolock*, *H. lar*, and *H. leucogenys*, Ziehen of *H. muelleri*, and other references to the surface anatomy of the brain will be found in papers by Broca (103), Hervé (48), and Eberstaller (298*a*). Flower (301) and Cunningham (118) have examined the relationship of the cerebrum to the cerebellum, and of these to the skull-wall. The brain-weight and ratio has been estimated by Keith (146). The nerves have received a considerable amount of attention, those of the limbs from Hepburn (45), Kohlbrügge (313), and Ruge (316), while the two anatomists named last, Jhering (143), and Utschneider (209) have described the arrangement of the trunk plexuses. From the above list it will be noticed that there is a complete absence of any inquiry into the more minute anatomy of the nervous system.

The Muscular System.—Kohlbrügge (313) and Deniker (17) have given very complete descriptions of the muscles—in fact, the most complete accounts we have of the muscular system of any of the anthropoids. Bischoff (293) also investigated this system in detail, while Hepburn's (45) account refers to the muscles of the limbs only. The muscles of the face and of the trunk have been very exactly described and figured by Ruge (70, 190, 316). Other facts may be gleaned from the dissections of Sandifort (271) and Vrolik (210). There are a number of special papers, mostly dealing with muscles of the toes or fingers, by Bischoff (100), St. John Brooks (106, 107), Schulze (318), Testut (321*a*), and Keith (148, 311*a*).

The Joints and Ligaments.—The ligamentous structures have been described, but not very fully, by Deniker (17), Kohlbrügge (313), and Keith (250).

The Skull.—Most of the literature on the skull of the gibbon is of a general and unsatisfactory nature. No attempt has been made, upon a sufficiency of material, to determine either the specific or generic cranial characters. It is true that Giebel (305) and Anderson (291) pointed out certain features of the skull which they thought characteristic of certain species, but they had too few skulls at hand to draw conclusions with any degree of security. In a collection of gibbon skulls, the only one which is distinguished from the rest with facility is that of the Siamang *(H. syndactylus)*; all the others, with perhaps the exception of that of *H. agilis*, being recognisable from each other only by their labels. It is possible that an examination of a much larger collection than thirty-five skulls, which is the number I had for study, might lead to more positive conclusions, but as yet there is not material enough collected for such an investigation. Descriptions of the cranial characters may be found in Duvernoy (22), Bischoff (293), Fry (302), Schlegel (193), Huxley (49*b*), and in most text-books or general works on mammalian osteology. There are some papers dealing with special features, such as those of Albrecht (290) and Morselli (169) with the vermian fossa; of Gegenbaur (303) with the lachrymal bone; of Hamy (35) with the anterior nasal spine; of Regnault (182) with the sutures surrounding that bone; of Seydel (278) with the nasal cavities; of Keith (311*a*) with the temporal ridges; and of Waldeyer (211) with the posterior palatal spine.

The Skeleton.—Descriptions of the skeletal characters are given by Blainville (223), Duvernoy (22), Bischoff (293), Meyer (58), Mivart (61, 61*a*), Fry (302), Schlegel (193), and Vrolik (210). For observations on the bones of the hand and foot, one may consult Lucae (54), Rosenberg (187*a*), Lazarus (153), Kohlbrügge (313), and Deniker (17); regarding the vertebral column, Cunningham (118) and Kohlbrügge (313); for the sacrum, Broca (104) and Paterson (179); as to the sternum and ribs, Ruge (316) and Keith (149).

The Teeth.—The general characters of the teeth have been described by Owen, Huxley, and Tomes, and more minutely by Topinard (82), Magitot (56, 57), and Giebel (240, 305); Kohlbrügge (313) and Duvernoy (22) have also made passing observations concerning them. Bateson (92) and Lessona (314) have dealt with the anomalies of the dental series. No one, with perhaps the exception of Giebel, has worked out in any detail the dental characters of the species; but, speaking from my own experience, only the teeth of *H. syndactylus* present features at all distinctive, but, as I had occasion to remark when dealing with the skull, the material to which I had access was too small to allow of a positive statement being made.

The Alimentary System.—The alimentary tract has been examined from end to end by Deniker (17) and Kohlbrügge (313). Smaller and more general communications have been made by Bennet (292), Bischoff (293), Flower (28), Hunter (310), Yarrel (329), and Keith (311*a*). All, with the exception of the two last-named, have given descriptions of the liver.

The Respiratory System.—Deniker (17) and Kohlbrügge (313) give full descriptions of this system. Only the Siamang possesses air-sacs prolonged from the ventricles of the larynx—*see* Sandifort (271), Bennet (292), and Kohlbrügge (313). The last-named and Eschricht (299) give full descriptions of the muscles of the larynx. Some details concerning this system may be obtained from the writings of Bischoff (293), Hunter (310), Sandifort (271), and Duvernoy (22). Ruge (189) has investigated the relationships of the pleural and pericardial cavities to the chest-wall.

The Circulatory System.—It is much to be regretted that only very incomplete descriptions of the arterial and venous systems have been published. Deniker's (17) is the best, but a good deal may be learned from the accounts of Bischoff (293), Kohlbrügge (313), and Hunter (310). Keith (147, 311) has pointed out the arrangement of the trunks of the aortic arch and abnormalities of the inferior vena cava. The dimensions of red blood-corpuscles are given by Gulliver (135), and the position of the heart by Ruge (189).

The Ductless Glands.—The thyroid, thymus, and spleen are described by Deniker (17), and Kohlbrügge (313). Keith (311*a*) observed that the spleen did not become enlarged even in gibbons inhabiting very malarious districts.

The Genito-Urinary System.—Harlan (307) described a specimen which, according to him, was one of those extreme mammalian rarities, a true hermaphrodite possessing both ovaries and testicles. No microscopic examination of these organs was made, the testicles having been taken away in the removal of the skin. The greater part of his description of the genital organs agrees with the parts of a normal female. Both the male and female organs of the gibbon are somewhat peculiar, and no good description has yet been given of them. Bischoff (6, 293) and Deniker (17) give descriptions of the female; and Hunter (310) and Kohlbrügge (313) of both male and female organs. Harlan (307) observed regular menstruation in the female, but I have never observed a uterine discharge in animals shot in the jungle. Deniker (17) and Kohlbrügge (313) are the only writers that describe the urinary apparatus.

Psychology.—The gibbon is extremely difficult to get under observation in the jungle, owing to its timidity and wildness. Jungle notes refer only to its curious vocalisation and agile method of locomotion—*see* Theobald (314*a*), Blanford (294), Anderson (291), Tickell (323), Müller (272), and Mohnike (260). Observations of its habits in captivity have been made by Darwin (120), Bennet (292), Hermes (139*a*), Klein (312), and Schmidt (317).

Organs of Sense.—The arrangement of the touch-papillæ on the hands and feet has been described by Kollmann (150), and the organs of smell by Zuckerkandl (216).

External Characters.—The young of a great number, if not all species of gibbon, are born with hair of a fulvous or greyish tint, as are also the young of *Semnopitheci*, monkeys with which gibbons have structurally much in common. Between their third and fifth years, however, the fulvous or grey hair of the young gibbon is replaced by hair of a lighter colour—a dun, light or dark brown, or even black, although many individuals retain the hair of youth throughout life; so that in nearly all species of gibbon, the hair varies in different specimens from a light fulvous colour to black. A curious feature is the tendency of white hair to appear in a ring round the face and on the backs of the hands and feet. In *H. lar*, *H. pileatus*, and *H. agilis*, the white circumfacial ring is complete; in *H. leuciscus* and *H. muelleri* approximately complete; in *H. hoolock* it is represented only by a supraorbital band; and in *H. leucogenys* by an inframental stripe; while in *H. syndactylus* and *H. hainanus* it is quite absent. Good figures, showing well the external characters of *H. lar*, *H. hoolock*, and *H. leucogenys*, are given in the *Proceedings* of the Zoological Society of London (319, 319*a*). Hermes (139*a*) also gives a very good drawing of *H. lar*, and Bischoff (293) a photogravure of a young specimen of *H. leuciscus*. Bennet (292) and Horsfield (309) give descriptions of *H. syndactylus*, and most of the authors mentioned in the section dealing with classification have entered into this subject. The lines on the hands and feet have been depicted by Hepburn (46) and Alix (89); the tufted arrangement of the hair by Meijere (163); the external ear by Keith (311*a*). Measurements are given by Duvernoy (22), Lucae (54), Meyer (58), Hermes (139*a*), Tickell (323), Schmidt (317), Deniker (17), Cunningham (118), and Bischoff (293).

Distribution.—The areas occupied by the several species of gibbons have not been defined with any degree of exactitude. The genus is restricted to Further India and the Malay Archipelago. The N.W. corner of this region, Assam and the region to the west of the Irawadi, reaching right up to the base of the Eastern Himalayas, is occupied by *H. hoolock*—Anderson (291), Blyth (295, 296), Blanford (294), and Theobald (314*a*). Next to it, occupying the greater part of Burmah and stretching southwards in the Malay Peninsula to an uncertain extent, is found *H. lar*—see the authorities quoted above, Tickell (323) and Cantor (297). It is the only species found in the Siamese province of Bangtaphan at the base of the Malay Peninsula, where the writer has shot and dissected six specimens. To the South of the Malay Peninsula, *H. agilis* is said to occur (Cantor). *H. leucogenys* occurs in Siam (Sclater, 319*a*) probably in the Menam valley; at any rate, the writer never saw it in either the provinces to the S.E. or to the S.W. of that country. In the S.W. provinces of Siam, and in Cambodia, occurs *H. pileatus*, Gray (306), but how far northwards it extends is not known; Swinhoe (320) reports the occurrence of a gibbon in China south of the Yangstze. *H. hainanus* (Thomas, 322) occurs in the island of Hainan. In Borneo two species occur, *H. muelleri* and *H. leuciscus*, Everett (300), Müller (272), Thomas (322*a*); in Java, *H. leuciscus*, and in Sumatra, *H. agilis* and *H. syndactylus*, which latter is also said to occur on the Malay Peninsula, but this is very doubtful. Besides the authorities quoted above, Geoffroy St. Hilaire (304), Rosenberg (267), Trouessart (324), Hartmann (43), and Mohnike (260) may be profitably consulted.

Classification.—There are three questions pertaining to the classification of gibbons that wait an answer. The first is: What is their position among the primates? The second: Should the Siamang (*H. syndactylus*) be separated from the genus *Hylobates*? And the third: How many species are there?

As to the position of the gibbons in the series of primates, there is a tendency at present, with which the writer is in sympathy, to remove the gibbons altogether from the company of the anthropoids and place them in a position intermediate between the great apes and the cynomorphous monkeys—Kohlbrügge (313), Ruge (316), and Vrolik (325). They are really cynomorphous monkeys adapted to locomotion in an upright posture. In the prevailing systems of classification, of which there are too many to make mention, the gibbon is arranged with the great anthropoids in a family commonly called Simiidæ or Anthropomorpha—Huxley (49*a*, 49*b*), Geoffroy St. Hilaire (304), Duvernoy (22), Flower and Lydekker (301*a*), and Broca (104*a*).

As to the position of the Siamang, Gray seems to me to have made a move in the right direction in placing it in a separate genus—*Siamanga*, including it with the common gibbon—*Hylobates*—in the tribe Hylobatina. Its skull, teeth, and laryngeal sacs are strongly marked characters. Its nerves, arteries, muscles, brain, and viscera have, when only one animal is examined, nothing very peculiar about them; but when a larger number is examined, the sum of the Siamang's variations will be found to be strikingly different from those of ordinary gibbons.

There is still much doubt as to the number of species of gibbon. An extraordinary number of species has been named, and the list of synonyms is appalling—*see* Gray (134), Anderson (291), Blyth (295), Cantor (297), and Blanford (294). Some writers have been inclined to regard many, if not all, of the named species, excepting the Siamang, as mere varieties of one species—Gray (134), Kohlbrügge (313), and Schlegel (193). But there can be no doubt that all the species named in the paragraph on distribution are quite as well marked anatomically as the received species of *Semnopithecus* or *Cercopithecus*. Dahlbom (298) was in error in ascribing to species distinctive marks on the clavicles. It is true, as I have observed for myself in the dissection of six specimens of *H. lar* and three of *H. pileatus*, that it is impossible to draw an anatomical distinction between these species, but the series dissected is too small to allow of a final conclusion being drawn. Whether the species maintain their individuality through geographical segregation, or whether, if they were to meet and mix, sexual and social instincts would still maintain the present arrangement of species, are matters upon which no information has as yet been given. But the fact that certain of these species (*H. lar*, *H. pileatus*, and *H. hoolock*), if not all, have voices which can be distinguished, tends to show there is a physiological differentiation, and the colour markings are very constant. Gray (134) and Schlegel (193) give the most useful information regarding the number of species and the specific characters, and to bring these lists up to date I need but mention the more recent contributions on *H. hainanus*, Thomas (322), *H. leucogenys*, Sclater (319*a*), *H. entelloides*, Wunderlich (328), *H. leuciscus* (probably *lar*), Schmidt (317), and *H. concolor*, Everett (300).

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V.

Cunning in Animals.

THE nature of this subject requires an introductory statement of the writer's interpretation of the terms "Instinctive Activities" and "Intelligent Activities." This is the more necessary in view of the wide difference which exists in the definitions of the many distingushed writers who have treated on the cause and effect of animal and human action.[1] I incline to interpret the term "Instinctive Activities," broadly, as those accomplished by congenital psychological impulse, without the aid of experience; and my definition of "Intelligent Activities" I take *in toto* from Lloyd Morgan's scheme of terminology, viz., "those due to individual control or guidance in the light of experience through association."

A full definition of "Instinctive Activities" should perhaps contain a reference to that possibility of variation or variableness which is necessary in view of evolution. My attempt to estimate the nature of cunning, however, has led me to catalogue it as inseparably connected with intelligence, and on this account the consideration of such activities as I term "instinctive" may be set aside. Dr. Reid, in his recently published work, "The Present Evolution of Man," forms an entirely different conception of instinct. He speaks of a "conscious adaptation," and of instinctive impulses as "ways of thinking and acting." Such attributes I would include in my understanding of the term "Intelligent Activities," and as directly connected with the particular subject of this paper.

Probably no more highly specialised example of cunning could be found among lower animals than in the resource of a hunted fox. In man we have a degree of cunning which, as exemplified in the wiles of a Red Indian or the ingenuity of the clever criminal, surpasses that of any lower animal. But the intelligence even of savage man, coupled with his reasoning intellect, gives him an advantage. Yet the marvellously keen sense action of the red man probably does not exceed the power of sense in the fox; certainly the sense of smell in the fox and in all allied animals completely transcends that in man. In all intelligent actions, therefore, which require the use of some special sense, these differences of primary capability must be kept in mind.

[1] "Some Definitions of Instinct," by Lloyd Morgan, NATURAL SCIENCE, vol. vi., p. 321, May, 1895.

Further, I venture to say that the custom of regarding the causes of animals' actions as simply elementary forms of human mental action has given rise to much confusion. It is much more difficult than at first sight may be supposed, to comprehend to even a limited extent such actions of lower animals as are controlled by senses the keenness of which we cannot know. When the fox, by the power of his senses, becomes aware of the presence of hounds, the immediate effort towards self-preservation is probably a compound of two pure instincts, viz., that of fear and that of self-defence. Thereafter his actions become voluntary, and are frequently guided by a high degree of intelligence and cunning. But the fox, when hard pressed, does not revert to native instinct in a desperate effort to combat his pursuers. His intelligence rather prompts him to more and more clever stratagems. Darwin ("Descent of Man," p. 80) refers to animals becoming more sagacious in localities where they are hunted, and considers that they do so largely through observing the experiences of other animals. Young animals can be trapped more readily than old ones, and they are less wary at the approach of man. "Even with respect to old animals," he says, "it is impossible to catch many in the same place and in the same kind of trap, or to destroy them with the same kind of poison; yet it is improbable that all should have partaken of the poison, and impossible that all should have been caught in a trap." Leroy, who was Ranger at Versailles, and has written largely on these matters, states that in districts where foxes are much hunted, the young cubs are much more wary than are even the old foxes in districts where no hunting is practised.[1] Rae also ("Animal Intelligence," p. 430)[2] has described how Arctic foxes become suspicious of gun traps, and how they manage to steal the baits by gnawing through the string attached to the trigger, or by tunnelling in the snow across the line of fire and drawing the bait downwards. Dr. Rae ascribes these clever devices to "abstract reasoning," but Lloyd Morgan points out, as Darwin might also have done, that they occur only after one or two foxes have been shot, and therefore a certain amount of experience gained through observation. Traps set at the mouths of fox 'earths' are also avoided by cunning. Leroy explains this in characteristic language. He says that the fox "smells the iron of the trap, and this sensation has become so terrible to him, that it prevails over every other." He then refers to the length of time a fox will remain in an earth, the entrance or entrances of which are guarded by traps, and how he will dig his way out in a new direction to avoid this terrifying smell of iron. Further, he states that if a rabbit runs from the earth in which the fox is concealed, and is caught by the trap, the fox "infers that the machine has done its duty, and walks boldly and securely over it." Romanes quotes

[1] "Lettres Phil. sur l'Intelligence des Animaux," 1802, p. 86.

[2] See also Lloyd Morgan, "Animal Life and Intelligence," p. 366.

largely from Leroy, and appears to consider his explanation of the above case quite satisfactory. We are, of course, unaware of how much odour an iron trap may afford to a fox, but we are also unaware, I think, that the animal is terrified by the odour, or that the terror should subside, or be suddenly overcome when the fox sees that the trap has caught an animal of some sort. A Lanarkshire gamekeeper, whom I have accompanied while trapping foxes, related the following case, which shows the superior cunning of old, as against young, foxes, and further does not involve the need to imagine that the trap has a terrifying odour. He set his traps at an earth with four entrances, a trap at each, being aware that the earth was inhabited by a vixen and her cubs. He succeeded in catching the cubs without difficulty, but the old fox seemed, by the appearance of tracks near the mouths of the earth, to be passing in and out unhurt, in spite of the traps. Day after day he found his traps empty. As the tracks became more numerous, however, he became convinced, by daily examination, that the vixen was simply jumping over the danger each night, returning to the earth by the same method. That she should have returned, with knowledge of an existing danger and after her cubs had been killed, does not argue for much terror on the part of the fox. The keeper caught her, however, by the expedient of setting his traps further away from each entrance, so that instead of jumping over she jumped on to one.

I do not, however, desire to belittle the importance of fear or terror in controlling the actions of animals. At the same time, it is not possible, in a short paper, to go into the results of fear, or even to discuss the "shamming dead" phenomenon, although it is often closely connected with cunning.

With reference, however, to that form of fear-instinct which is described as suspicion or wariness—an ever-present condition in the wild animal—I desire to quote from Romanes[1] an instance given by Leroy. With reference to the stag, he says, "Often (when not being hunted at all), instead of returning home in confidence and straightway lying down to rest, he will wander round the spot; he enters the wood, leaves it, goes and returns on his steps many times. Without having any immediate cause for his uneasiness, he employs the same artifices which he would have employed to throw out the dogs, if he were pursued by them." Romanes then says, "It is remarkable enough that an animal should seek to confuse its trail by such devices, even when it knows that the hounds are actually in pursuit; but it is still more so when the devices are resorted to in order to confuse *imaginary* hounds which may *possibly* be on the scent." From this he argues that there is a logic of recepts in animals, and probably also a logic of preconcepts. If we accept Leroy's account, it seems to me unnecessary to conclude, as Romanes evidently does, that the artifices of the stag are directed against the pursuit of hounds alone. To

[1] "Mental Evolution in Man," p. 54.

believe this, is to imply that the artifices are reasoned out independently to meet a special case, instead of being, as it seems to me they are, the outcome of an hereditary practice of caution or wariness. To argue further that the stag deliberately resorts to these devices, "to confuse *imaginary* hounds which may *possibly* be on the scent," is to interpret the actions from a purely human point of view, believing that because a man, under given circumstances, would imagine and do so and so, therefore an animal can arrive at a similar outward result by no other method. In the case of the stag, I see no reason to believe that any idea or 'construct' of hounds is formed. It is merely in interpreting the actions that this idea has been formed. Sir E. Tennent relates ("Natural History of Ceylon," p. 35) that the habit of the jackal, after having run down its prey, is to conceal it in the jungle and issue forth on a tour of observation lest any predatory enemy may be near, afterwards returning to the carcase. In cases where this has been observed, and the observer has been discovered by the jackal, it is further stated that the jackal may practise the ruse of seizing some object in its mouth and setting off with it, in the hope of misleading the observer. Both the stag and the jackal, it seems to me, are simply employing their intelligence or cunning in guarding against what we may justly describe as an ever-present dread of attack in certain experienced lines. They are not imagining special cases o attack, and having calculated the best means of circumventing them, carrying their studied plans into execution: such work is reserved for generals and field-marshals. When a herd of red deer lies down for the midday siesta the sentinel is always alert on some convenient eminence. When a weasel runs into a hole he invariably looks out almost immediately: it is an excellent time to shoot him. This is observation akin to the jackal's, but I need not attempt to imagine the weasel's reason.

The instance of the stag, however, leads us naturally to the most remarkable cases of cunning related of the fox. The device adopted by the stag though not pursued, would, if repeated during a hunt, produce one of the cunning stratagems fairly well known in hunting. A fox, having a good distance between it and the hounds, has been known after crossing a wall and running well into an open field beyond, to retrace its steps and strike off at right angles under cover of the wall. The hounds, clearing the wall, pick up the scent on the opposite side, run well out into the field and throw up their noses. This example is practically an accelerated version of the stag's case. Like every instance of a fox's cunning escape from hounds, it is a method which depends for success on the hounds being misled in the matter of scent. A foxhound is a marvellously stupid animal if it has no scent to guide it. A fox, if over-run by a pack of hounds, can double back and pass through the midst of the hounds, while they are intently searching the ground with their noses. A greyhound, on the other hand, is helpless unless it keeps the hare full in view. It seems probable that experience has taught the fox that the particular creatures which pursue it do so by following the scent of its trail. Leroy's stag had probably acquired the same knowledge or percept. Both animals, therefore, acquire the habit of protection against being followed by scent. The devices which the fox can employ habitually in this way are too well known to require much exemplification. I shall, however, while shunning the familiar examples, take a single instance related to me by the eye-witness, a relative of my own, and a member of the Linlithgow and Stirlingshire Hunt. The hounds were drawing a cover on the south side of the Union Canal near Ratho. A fox broke cover, made straight for the canal and swam across. The hounds were taken along the side of the canal a short distance in a westerly direction, to where a tunnel passed below it. Through this they were taken to the other side of the canal and run back to the point opposite that at which the fox had plunged in. Here they at once found, but carried the scent along the bank in an easterly direction only for a short distance, attempts to trace it further being quite unsuccessful. My informant, who had been on the east side of the cover when the hounds were led off to the tunnel, and who had remained there to see if the hounds would 'find' on the other side of the canal, noticed a wet fox coming from the direction of the canal and making off towards the fields at the back of the cover. The hounds were therefore brought back to his side of the canal. There they 'picked up the scent,' and the whole company was presently heading towards Juniper Green. It happens, however, that the trail of a wet fox is difficult to follow, and, after the hounds had run through several gardens on the outskirts of the village of Juniper Green, reynard was given up. There seems no reason to suppose that the wet fox was any other than that started from the cover, which, recognising that the pursuers had gained the far side of the canal, swam quickly back to the side from which he had started.

If we attempt to estimate what a ruse of this description involves, we must first note that while in the cover, the fox, by means of its sense of hearing, smell, or sight, became aware of the approach of danger. The instincts of fear and of self-preservation then caused action. The conditions of wariness under which it lives, and the acuteness of its senses, unimpaired by any artificial conditions of life, probably enabled it to apprehend danger before the hounds became aware of its presence. At the same time, its intelligence, benefiting by experiences of life in a fox-hunting district and by association of circumstances, would enable it to form a more or less definite construct or series of constructs. Such constructs would be in some degree analogous to our human constructs, 'hounds' and 'hunters'; they would conform in a measure to our conceptions of the interpretations of these terms. The same experience rendered it unnecessary for the fox to define its constructs by examination—a feature commonly to be observed in deer, and other animals possessed of marked curiosity. The baying of the hounds alone would probably be sufficient to enable the fox to form a fairly accurate definition. Seeking to escape from the cover without detection, but fully aware of the fact that its pursuers are able to follow its track, probably knowing that this following is by what we call scent, the fox runs with all speed to the canal. The reason for crossing the canal must necessarily be more or less matter of speculation, but in the case cited, no other direction of flight was unguarded or without danger, by reason of hounds or huntsmen and the 'field' generally. We might say, in a manner, that the fox was driven across the canal; and probably the first direction is not generally chosen by the fox so much as controlled by the limits put upon its escape. At the same time there seems a good deal of evidence to show that, when pursued, a fox readily seeks water which may be near. It is commonly believed that the fox knows that scent is lost in water, and further, that if its body is wet its scent even on the ground is much less. So Leroy would unhesitatingly say that the fox seeks to wet himself in order that his track may be more difficult to follow. It is safer to believe, however, that the fox seeks only to escape, and has experienced that, having swam or run along through water, temporary respite from pursuit is obtained. This in itself would be quite sufficient to account for a hunted fox taking readily to water. Delay in pursuit being associated with this passage through water, and the animal having in all probability, as we have already hinted, a knowledge that the track is followed by scent, it seems possible that by intelligence, but without the process of reasoning, devices may be adopted by which the difficulties of the pursuers will be still more increased, as when a fox, coming to a shallow stream, enters the water and runs for some distance in the track of the stream before quitting it. In the case in point, the fox was too closely followed to spend time in the water, but, having reached the other side, its acute senses no doubt made it aware that, by some means or other, hounds were coming towards it along the newly-gained canal bank. Confronted with this sudden development, it evidently did not put any confidence in its wet trail, but rapidly, having gone along the bank as far as it safely could, it repeated the device of crossing the water. This, be it noted, entirely defeated the hounds.

I am, therefore, inclined to think that no higher process of intelligence is required than that which may be described as the purely animal one, in order that manifestations of cunning may be explained; and further, that the desire to attribute rational and highly intellectual processes, springs from the easily acquired practice of explaining animal actions by purely human formulæ.

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SOME NEW BOOKS.

Coal-Measure Molluscs.

A Monograph on Carbonicola, Anthracomya, and Naiadites. Parts I., II., and III. By Wheelton Hind, M.D. Pp. 181, xxi. pls., circa 600 figg. Palæontographical Society, 1894–1895–1896.

The present Monograph deals with the genera, better known by the names of *Anthracosia*, *Anthracomya*, and *Anthracoptera*. While confined to a description of British species, its author has explored various continental museums, in order to determine the identity of species recorded by European writers, and a critical bibliography of twenty-four pages deals with the literature relating to the subject from the year 1720. This bibliography illustrates how often unnecessary labour has been undertaken by authors unacquainted with the literature of their subject. It is on the whole a valuable contribution, though some of the comments on previous authors will not meet with general acceptance.

The replacement of "*Anthracosia*" by "*Carbonicola*" is regrettable on account of the wide-spread use of the former. It is questionable, also, whether it can be supported on strict grounds of priority. King put forward the term "*Anthracosia*," in 1844, for "a group of Unionidæ characteristic of the Coal Measures," but neither described nor figured specimens. It was a "preliminary notice" of the worst sort, and was not recognised by McCoy when, in 1854, he proposed the name of "*Carbonicola*" for the same group. McCoy failed, however, to understand the genus he described, and his diagnosis could only have been drawn up from specimens of other genera from a younger formation. This was pointed out by King, who repudiated the genus as in any way relating to the Coal-Measure *Unios* known to him, which he then described in detail and correctly. Dr. Hind agrees in the main with Professor King upon the question of McCoy's faulty diagnosis. McCoy failed to publish figures of any species of his genus, and under the circumstances it would seem better to have taken King's later paper of 1856 as the starting point, and to have retained *Anthracosia*, the diagnosis of which was clear and good.

Before entering upon a description of the various species of *Carbonicola*, the author defines what he regards as a species. He has felt it necessary "to give specific rank to any forms which seemed to be typical of a bed; in other cases, when in the same beds a series of varieties occurred, to include them under one species." This seems a curiously retrograde step—specific character is made a resultant of stratigraphical position, just as in the old days of cataclysms and creations, and a check is thus placed on all endeavours to work out the development of a genus and the mutual relations of its forms. Moreover, this has not even the effect the author aims at, viz., "as an aid to determine the horizons," for that which is defined by a horizon cannot also define a horizon. The only excuse for this course would be some proof that all the "varieties" included in the same bed were derived from a common stock; but the author neither defines his conception of a "variety," nor attempts any such proof. The remarkable variation of form which obtains in this genus is more than once commented upon; but we think that its importance was not sufficiently recognised in dealing with species, nor does it seem to have been noted that a large series of specimens from any one of several horizons furnish the most gentle gradation between several so-called species. Several of the species described in the Monograph are clearly but varieties of others. A good example of this is given on plate ii., where fig. 3 does duty as a somewhat rotund example of *C. robusta*, and figs. 7 and 8 as examples of *C. rugosa*. The majority of palæontologists would unhesitatingly put *C. rugosa* as a variety of *C. robusta*, a view held by Salter. The author has failed to find more than two specimens of *C. rugosa*, and neither of them seems to be complete.

The same failure to distinguish what constitutes a species is seen in the case of the genus *Anthracomya*. Fig. 4, plate xiii., represents the type-specimen of *A. dolabrata*, and is therefore not open to question. Six other figures on the same plate are said to represent specimens of this species, but to us they agree much more closely with *A. adamsii*. The only other figure upon this plate which could belong to *A. dolabrata* is fig. 14, and is labelled *A. modiolaris*. A comparison of fig. 4, the type, with fig. 5, which should be the same species, will show that the ventral border of the type is almost parallel with the hinge-line, while in fig. 5 it rapidly falls away from it posteriorly. If the hinge-lines and ventral borders of the figures upon plate xiii. be projected forwards with pencil until they meet, the resultant angles of forms said to belong to the same species are very instructive.

The genus *Carbonicola*, as now constituted, includes eighteen species, of which five are new. Two species are founded upon only two specimens each, and a somewhat similar occurrence is noted under *Anthracomya*, where two species are founded upon one specimen each, in one case an internal cast. Remembering the great variation of form, it is difficult to understand what good purpose can be served by the creation of species such as these.

The value of the specific forms of *Carbonicola* is not clearly determinable in the Monograph. *C. acuta* runs off in one direction into *C. robusta*, in another it first merges into *C. subconstricta*, and then passes on into *C. aquilina*; in still another direction it becomes *C. ovalis*, which Dr. Hind acknowledges to be little better than a variety. *C. obtusa* seems identical with *C. ovalis*. If *C. polmontensis* be a good species, then figs. 11 and 15 of plate vii. ought to belong to this species, although regarded as *C. subconstricta*; but the value of the former is doubtful, and the latter are almost certainly internal casts of *C. robusta*. The specimens figured 6 and 7, plate ix., are taken as types of *C. aquilina*, but they might equally well serve as elongated forms of *C. acuta*, and it is comparatively easy to find a place for them in a series from a single horizon, which would lead up to *C. robusta*.

Taking *Carbonicola* as a whole, it would seem that the genus started with a form of which *C. antiqua* might well serve as type, and that variation took place along several lines, and we believe upon the same line more than once. It therefore happens that between most of the recognised species there are all sorts of intermediate forms. Not unfrequently in our experience a mass of 50 to 100 specimens collected from one small area of a "mussel band," has yielded at least four species and the necessary intermediate forms. A reference to the distribution tables at the end of Part II. shows how often half-a-dozen species occur at the same horizon. The author would have rendered good service had he dealt at some length with the varietal forms, and the connection between species which could be established by them.

The genus *Anthracomya* is regarded as closely related to *Carbonicola* on the one hand, and the *Mytilidæ* on the other, and if not byssiferous in the adult, at least with a byssiferous ancestor or byssiferous fry. Sixteen species and four varieties are recorded. We have already alluded to the unsatisfactory nature of four species, and may mention in passing that the author admits the single specimen upon which *A. obovata* is founded "may be a deformity or even a hybrid." A form previously described as *A. carinata* is now placed as a variety of *A. minima*, since a series of intermediate forms completely connects the two. The species of *Anthracomya* are well defined on the whole, and there is an absence of that provoking, because not fully understood, tendency of one species to slide off into another.

In discussing the relationships of *Naiadites* (*Anthracoptera*), on p. 127, the author omits to contrast or compare it with the genus *Anthracomya*, although previously (p. 123) he has admitted a very close resemblance in both crushed and perfect examples. The difference upon which he relies in distinguishing the two genera, *i.e.*, the position and shape of the umbones is one of degree rather than of structure. On the whole, there is a much closer approximation in *Naiadites* to the *Modiola* and *Mytilus* type, although in one or two species even the author has failed at first to distinguish the genus. Eight species of *Naiadites* are described, two of which are new.

It is possible that the author has allowed several species to stand against his better judgment, for fear he should be thought iconoclastic, since he is well aware, for example, of the close relationship between *N. carinata*, *N. modiolaris*, and *N. triangularis*, and considers it would be perfectly justifiable to make them all into one species, a sentiment with which we cordially agree. We would go one step further, and put *N. elongata* as a variety of *N. modiolaris*, from which it would seem to have been derived by way of *N. triangularis*.

A series of diagrammatic sections forms the closing part of the monograph, and serves to indicate the stratigraphical position of the various species.

Dr. Hind would add considerably to the value of a succeeding monograph if he described the shell with greater uniformity. For want of this it is often extremely difficult to compare a couple of descriptions, or determine their relative value. The figures are good, but, if anything, too numerous; thirty-six figures, for example, of *C. aquilina* occur upon one plate.

Notwithstanding the various objections here raised, and the signs of great haste shown by the Monograph, we welcome it as a needed contribution to the literature of the Coal-Measures, and as likely to incite further study of the Mollusca of the series. H. B.

The Record of Big Game.

"Records of Big Game: containing an Account of their Distribution, Descriptions of Species, Lengths and Weights of Horns, and Field Notes." Square 8vo., pp. xvi. and 325, Illustrated. London; Rowland Ward, 1896. Price 30/– Nett.

The present is a record-making age, and it is therefore no matter of surprise that Mr. Rowland Ward's "Horn Measurements" has reached a second edition within the comparatively short time of about four years. In its present extended form the book is a great improvement on its predecessor, and, indeed, can no longer be regarded as a mere list of horn measurements, but forms, to a great extent, a valuable guide to the distribution—and, in some instances, to the habits—of the animals coming under the designation of Big Game. Especially is this the case with the African antelopes, in regard to which a series of interesting notes are communicated by that well-known observer and sportsman, Mr. H. A. Bryden, and it seems almost a pity that other authorities were not engaged to perform the same office for the animals of other regions.

As so many additions have been made to the genera and species of African antelopes of late years—to say nothing of emendations of the generic and specific titles of the previously-known forms—the book will be found a valuable guide to this group of ungulates to those who are unable to obtain the expensive memoir of Messrs. Sclater and Thomas. Indeed, almost the only fault we have to find with this part of the work is that in quoting from the original descriptions of several species, such as *Madoqua phillipsi* and *M. swaynei* (pp. 104, 105), *Cobus penricei* (p. 121), and *Cervicapra chanleri* (p. 137), the author has retained the "n. sp." after each name. The spelling of some of the popular names, as Lechwe, for the simpler Lichi, is, moreover, not to our personal liking, although it must be confessed that such matters are largely dependent upon the individual taste of the writers. So far as we can see, the list of antelopes is wonderfully complete, and includes such recently-described forms as *Cobus penricei* and *C. thomasi* (1895). Curiously enough, *Dorcatragus megalotis*, described in 1894, appears, however, to be omitted—at least, this name does not occur in the index. But then, is the index so to be trusted? We have tested it only in one place, where we found the following:—

Oreas canna	212
Oreotragus derbianus	116
———— *saltator*	212

This should read:—

Oreas canna	212
—— *derbianus*	212
Oreatragus saltator	116

We are not going to make this slip a reproach to the author, as we know too well, by sad personal experience, how exceedingly difficult it is to attain accuracy in such matters; but we would suggest that in the next edition the book would be vastly improved by a systematic index at the beginning.

With respect to the special object of the book—the measurement of the horns, antlers, tusks, and skins of Big Game—the author has evidently spared no pains, and he has in many cases been enabled to increase the "records" of the previous edition. Every sportsman will in this portion of the work find a mine of interest, and the scientific naturalist will likewise not fail to discover matter worthy of his attention.

In the matter of illustrations, the present issue contrasts most favourably with its predecessor, the number of cuts of heads having been greatly increased. Nearly all of these are excellent portraits so far as the actual delineation is concerned. But, for our own taste, many of them are far too "chalky." This is especially noteworthy in the case of the eland head, figured on page 211, which in this respect forms a marked contrast with that of the serow on page 219. We should also like to ask why the figure of the eland's head is lettered :—

"Eland (*Oreas canna*)
Eland (*Oreas derbianus*)."

Surely it belongs to one or other of those two well-defined species, and is not a "composite portrait."

Such criticisms as we have made will be seen to refer to unimportant points of detail. And we have much pleasure in congratulating Mr. Rowland Ward on the production of a work which must be invaluable to every hunter of Big Game, and which is a monument of untiring and successful energy on the part of its author.

R. L.

Voles and Lemmings.

Genera and Sub-genera of Voles and Lemmings. By Gerrit S. Miller. No. 12 of the North American Fauna Series. 8vo. Pp. 1–76, with 3 plates and many text-figures. Published by the United States Department of Agriculture, Washington, 1896.

No want perhaps has been more felt of recent years by mammalogists and writers on geographical distribution, than a careful and critical comparison between the mammals of Boreal North America and those of our Palæarctic Region. And such a comparison has been nowhere more needed than with the members of the sub-family Microtinæ, the Voles and Lemmings, a group highly characteristic of—indeed almost confined to—these two parts of the world, and one in which, while the Old and New World species were each by themselves as much confused as they well could be, no serious comparison at all had ever been instituted between the corresponding forms of the two sides of the Atlantic.

Such a comparison combined with a revision of the whole group, Mr. Miller has now made, in the only way in which it was possible, namely, by crossing the Atlantic and working out the European forms in a European Museum, after having previously gained a thorough knowledge of the American ones. We are pleased to note that Mr. Miller says our National Museum offers exceptional facilities for such a study, and we hope that he, and others, will make again such an admirable use of these facilities as he has done in the paper before us.

The astonishing confusion that has hitherto existed in the nomenclature and arrangement of the group may be partly gauged by the fact that for the twenty genera and sub-genera he recognises, Mr. Miller has had to discuss the claims to adoption of more than fifty names, while half a dozen widely different systems of classification have had to be discussed and—dismissed.

The results as a whole seem to be excellent, and this could hardly fail to be the case from the happy combination of abundant material, common-sense, care, and exhaustiveness, with which we know the work to have been done, and we have therefore practically no criticisms to make. Moreover, owing to the fact that the author does not attempt to deal with species, we are not confronted with that crowd of new names which, whether sound or not, appal the old-fashioned naturalist in most modern American work.

As usual in the series, the illustrations are numerous, clear, and admirably adapted to their purpose, and will help students to realise the characters of many rare forms, of which specimens are not available on this side of the world. O. T.

The Sports of Animals.

Die Spiele der Thiere. Von Karl Groos, Professor der Philosophie in Giessen. Pp. xvi., 359. Jena: G. Fischer, 1896. Price 6 marks.

Professor Groos, in an interesting preface, discusses the relation of his subject to the psychology of man, holding that all sides of the life of the lower creatures may throw light upon man, since among them may be studied the incipient stages of what becomes more highly developed in the higher creature. To the well-known proposition so ably developed by Lewes and Spencer, and shown by Dr. Groos to be due to Schiller, that the frolics of young creatures are an expression of exuberant energy, an overflow of nerve force, he adds the other suggestion that they frequently are a preparation for the important duties of adult life. As a little girl trains herself for a future maternity by devotion to a doll, so the kitten or tiger-cub playing with a ball may be training itself for its future catching of living prey.

The first chapter discusses at length the theory of superfluous energy as the cause of play. Admitting to the fullest the physiological importance of the principle, the author shows that the root of the matter lies deeper. Animals and men tire themselves out at their games: a dog that has returned from a long walk and is slouching listlessly along with its tongue out of its mouth, if it meets another dog will begin to gambol with it. By instances from many authors he leads up to the conclusion that there is a close connection between instinct and play, and that a deep-seated biological cause must be found for this.

The second chapter developes this theory of the connection between instinct and play. In a long review of the interpretations placed upon instinct by earlier writers, Dr. Groos gradually makes plain that he adheres most closely to Weismann's conception of instinct as a congenital property built up chiefly by selection and owing little, if anything, to inheritance of acquired characters. In the case of higher animals instinct becomes more and more merged in intelligent action. He believes, not that these higher animals play because they have youth as a time of overflowing energy, but that they have youth in order that they may play. Their instincts operate before they are needed for the real business of life, and the continual exercise of them in play changes the cast-iron congenital instinct into a more flexible habit, readier of adaptation by the intelligence to the varying exigencies of real life.

In the third and longest chapter of the volume Professor Groos has brought together in a systematic fashion an enormous collection of the facts regarding the play of animals. He classifies plays as follows:—(1) Experimental, in which the very young of all the higher animals, as soon as they arrive at the independent use of their faculties, or limbs and jaws, restlessly examine and experiment with every object that comes within their reach. Among these experiments, for instance, he puts the case of Miss Romanes' young monkey which took the greatest pleasure in learning to unscrew and rescrew the handle of a brush. (2) Locomotion, in which young animals practise their future modes of movement. Such are seen in the racing and chasing of young dogs, in the vertical jumping of young mountain-dwellers like chamois and goats, or in the distance jumping of young buck. (3) In the hunting games of the young, the instincts tending towards future use, are more clearly in evidence. Young lions, tigers, and cats play with inanimate objects like balls or stones, pushing them about and catching them when in motion, or chase living objects like the tail of their mother. (4) Games of combat—the innumerable instances of these which are known seem to him to imply chiefly a preparation for future combats between males for the possession of females. He believes that the instinct to challenge and to murder among all kinds of creatures is almost entirely confined to males. And so in the further divisions of (5) games of love, including the quest of bright colours and the practice of songs and cries, of (6) architectural games, and (7, 8, and 9) games involving respectively duties, imitation, and curiosity, the Professor carries out his general thesis of the gradual replacement of instinct by experience.

The psychologist will find a great deal of Professor Groos' book worthy of study. Its theory of attention and the gradual evolution of attention from curiosity is novel and interesting. From the point of view of the biologist, the most interesting part is the attempt to place a new meaning upon the period of youth, and to bring the activities of youth under the influence of natural selection.

Geographical Distribution.

A Geographical History of Mammals. By R. Lydekker. (Cambridge Geographical Series.) Pp. xii. and 400. Cambridge: University Press, 1896 Price 10s. 6d.

That of all the great sub-divisions of the animal kingdom, the mammals supply the most important evidence in questions relating to the former distribution of land and water, was long ago recognised by Wallace. Their limited means of dispersal, the great abundance of their fossil remains, and the consequent relatively complete knowledge of their past history are the chief factors which give them this special importance. It is true that of Pretertiary Mammalia little is known, and therefore other groups must be employed in attempting to determine the distribution of land and water in the earlier geological periods; but in later times, from the Lowest Eocene upwards and in many quarters of the globe, numerous mammalian faunas have been discovered which supply the strongest available basis for such speculations. This being the case, a volume on the distribution of this group, written by one who is equally familiar with living and extinct forms, will be peculiarly welcome both to zoologists and geologists. Such a book had indeed become a necessity, so great have been the advances in our knowledge of the Mammalia, particularly of the extinct forms, during the last few years, whole faunas having been discovered and described, which throw floods of light on many disputed questions, and render necessary a revision of many previously accepted opinions. The present volume supplies just what was wanted, being thoroughly up-to-date, and clearly and impartially written.

The sub-divisions of the land areas of the globe adopted by the author are very similar to those suggested by Blanford in 1890. Three great "realms," the Notogeic, Neogeic, and Arctogeic, form the main divisions; of these, the first includes the Australian, Polynesian, Hawaiian, and Austro-Malayan "regions"; the second, the Neo-tropical region only; the third, the Malagasy, Ethiopian, Oriental, Holarctic, and Sonoran regions. The advantage of this scheme is that it throws into strong relief the extreme distinctness of the Australasian and South American faunas; on the other hand, the "regions" are of very unequal value. Perhaps the most interesting and important parts of the book are the chapters on the Notogeic and Neogeic realms. The origin of the Marsupials of Notogæa is discussed at considerable length, and Mr. Lydekker comes to the conclusion that the Didelphidæ and Dasyuridæ probably originated from a common stock in South-Eastern Asia about the end of the Cretaceous period. The members of the first-named family afterwards migrated into Europe and Asia, thus accounting for their sudden appearance in the Oligocene deposits of those areas, while the Dasyuridæ, on the other hand, passed into the Australian region, where, being isolated, they gave rise to the highly differentiated and specialised Marsupial fauna, including the Diprotodontia. The differentiation of the latter probably took place at a very early date, since among the Australian types of Marsupials lately discovered in the Miocene of Patagonia, certain forms already exhibit the diprotodont modifications in the lower jaw. It is, of course, possible, and perhaps even probable, that this modification may have arisen independently in the S. American forms, but in any case it is hardly likely to have occurred there sooner than in the main centre of the group, Australasia. The former existence of an Antarctic continent, the relations of the Ethiopian fauna to that of S. America and of Madagascar, and many other questions of like interest will here be found thoroughly threshed out, all available evidence being brought to bear upon them.

In short, it may be said that this work is a very valuable contribution to the study of distribution, and should be read by all who are in any way interested in such problems. At the same time, it is not without defects, the more to be regretted, because in most cases they could easily have been avoided. For instance, in Fig. 12, the fact that the feet there represented are certainly not those of the elephant and hyrax, as stated in the legend, will be at once obvious to everyone, particularly to the author. Again, the statements that "the Soricidæ or Shrews are represented in Ethiopia only by three species," and that the Potamogalidæ are represented in Madagascar by *Microgale* (p. 234), are incorrect. In the last case *Geogale* is clearly intended, and, indeed, on p. 219 it is described as being a Malagasy representative of *Potamogale*.

The printing and illustrations are, on the whole, good, but the mingling of wood-cuts and process-blocks has a somewhat unpleasing effect.

The Geography of Plants.

Manuel de Géographie Botanique, par Oscar Drude, traduit par Georges Poirault, et revu et augmenté par l'auteur. Livraisons 11–13, pp. 401–512. Paris: Klincksieck. Prix de chaque livraison, 1 fr. 25 ct.

We are glad to see that the French translation and edition of Oscar Drude's useful work on Plant Geography is so nearly finished, and shall hope soon to have the opportunity of reviewing the work as a whole. Meanwhile, we may mention that the present issue brings us nearly to the end of Part V. "The regions of vegetation of the earth arranged in geographical order." It contains the concluding pages of Chapter ii. on "Northern Floral Regions," the whole of Chapter iii. on "Tropical and Southern Floral Regions," while Chapter iv., on the "Oceanic Floral Region," begins on p. 511. The bibliography at the beginning of each section is a useful feature, and we would suggest that every effort be made to render it as complete as possible. A good deal of work has recently been done both in this country and in Germany on the flora of Tropical Africa; but while reference is made to that of Prof. Engler and his colleagues, work done at Kew and the British Museum during the last few years is almost ignored.

BOTANY FOR SCHOOL CHILDREN.

HOW TO STUDY WILD FLOWERS. By the Rev. George Henslow, M.A., F.L.S. 8vo. Pp. 224, with 57 illustrations. Religious Tract Society, 1896. Price 2s. 6d.

"THE object of this book is to enable students to rapidly acquire an *accurate* knowledge of typical British wild flowers." "If teachers would place this book in the hands of their pupils, make them dissect and examine the flowers with its aid, and above all things *insist upon accuracy*, the great use of botany in schools, viz., the *training the young minds in systematic observation and accurate habits*, will be secured." The sentences we quote occur in that portion of Mr. Henslow's preface which is addressed to the teacher. And under certain conditions his book fulfils all that he claims for it. The conditions are an elementary knowledge of the general structure of seed-plants, and a teacher who has learnt some of his botany out in the fields and woods. From p. 49 onward the book is really a small British flora. Descriptions are given of the more commonly occurring genera or species, and the illustrations, the majority of which are good, will be a valuable help to the student. The addition of remarks on points of biological interest, serves somewhat to remedy the dryness incident to a mere systematic account. The thirty-six pages of introduction comprise a brief review of floral morphology, but must not by any means be regarded as an efficient introduction to the study of flowers. It will help the student to unravel the intricacies of the artificial key to the orders and genera (pp. 42–48), but if he is wise he will let this alone and trust to a teacher or friend until he is able roughly to allocate to their orders the more commonly occurring plants. The book is of a handy size and nicely got up, and looks very attractive in its neat red binding.

NOMENCLATURE IN ENTOMOLOGY, AND IN ZOOLOGY.

RULES FOR REGULATING NOMENCLATURE, with a view to secure a strict application of the Law of Priority in Entomological work. Compiled by Lord Walsingham and John Hartley Durrant. 8vo 18 pp. London: Longmans, Green. November 2, 1896. Price 6d.

LORD WALSINGHAM and Mr. Durrant have compiled a list of the Rules which regulate work done in entomology at Merton Hall. They have called them the "Merton Code." No one can offer the least objection to these gentlemen conducting their researches in an extraordinary manner, but we do not suppose other entomologists will accept the result.

The note to Rule 12 encourages the priority-maniac to flood us with hektographic copies of his new names, provided he fulfils certain conditions as to sale by publisher.

Rule 20 provides that "a name homophonous (*i.e.* differently written, but indistinguishable in sound) with a valid name is invalid," etc., "*e.g.*: *Ucetia*, Wkr. would invalidate *Eusesia*," a proposition arguing a peculiar standard of pronunciation among entomologists, and apart from that scarcely short of the ridiculous.

But Rule 21 goes even beyond this, in stating that "a name so similar to a valid one as to be almost homophonous or almost homonymous is invalid," etc.

Rule 25 states that "a name which is offensive (whether politically, morally, or by its irreverence) is invalid, and should be expunged from zoological nomenclature." *Philosophia stemma non inspicit*, and *Meretrix*, *Priapus*, *Orchis* do not suggest indelicacy to everyone. We do not see the necessity of introducing a vigilance committee into zoological literature.

The use of undefined names may be considered justifiable by some, but others, who have an equal right to an opinion, refuse to recognise *nomina nuda*, even if accompanied by the specific form introduced into the new genus, such as occur in the works of Fitzinger, Locard, Kuntze, Pomel, Dejean, and others.

We may take this opportunity of referring any readers interested in nomenclature to the excellent address on the subject delivered by Professor T. Gill as Vice-President of Section F, Zoology, of the American Association, and published in *Science* of October 23 last.

The Prices of Books.

In consequence of complaints made that in the last number of Natural Science the prices of several of the books reviewed were not given, we must apologise to our readers. At the same time, we wish to state that we do our best to ascertain the prices of all books sent to us. It is not yet every publisher that sees the wisdom of enclosing with the books that he sends us a statement of their price, and the constant writing of letters which this entails adds considerably to an editor's duties. One of our correspondents particularly complains that the Geological Survey does not advertise its publications as it should do. The same is the case with other Government establishments, to some of which we have already made successful representations, and we trust that the Director of the Survey may feel inclined to follow their example. The prices of the books reviewed in our last number are :—

Semon's Travels, 15 marks
Gregory's Jurassic Bryozoa, 10s.
Tyndall's Glaciers, 6s. 6d.
North's Roman Fever, 25s.

Other Literature Received.

Report of the Horn Scientific Expedition, pts. iii. and iv.: Dulau. Problems of Biology, G. Sandeman: Sonnenschein. Round the Year, L. C. Miall: Macmillan. Versuch einer Philosophischen Selektionstheorie, J. Unbehaun: Fischer, Jena. Artistic and Scientific Taxidermy and Modelling, M. Browne: A. & C. Black. Royal Nat. Hist., pts. 35 and 36, R. Lydekker: Warne. History of Mankind, pts. 11, 12, and 13, F. Rätzel: Macmillan.

Submarine Leakage of Artesian Water, R. L. Jack: *Proc. R.S. Victoria.* La Réproduction et l'évolution des guèpes sociales. Observations sur les Polistes, P. Marchal: *Bull Soc. Zool. France.* New Zealand Diptera, P. Marshall: *Trans. N.Z. Inst.* Intestinal Tract of Birds; Anatomy of Hoatzin, P. C. Mitchell: *Proc. Zool. Soc.* Fatigue in Reading, H. Griffing and S. I. Franz: *Psych. Rev.* Description of two n. gg. and n. spp. of Australian Fishes; New Family of Australian Fishes, J. D. Ogilby: *Proc. Lin. Soc. N.S.W.* The Witwatersrand, G. F. Becker: *Nat. Geogr. Mag.* Schistosity and Cleavage, G. F. Becker: *Journ. Geol.*

Trans. Perthshire Soc. Nat Science, vol. ii. Fac. Agron. Vet. La Plata, Nos. xix., xx., xxi. Essex Naturalist, October, 1896. Veterinarian, November. Nature, October 22, 29, November 5, 12, 19. Literary Digest, October 17, 24, 31, November 7. Revue Scientifique, October 24, 31, November 7, 14. Irish Naturalist, November. Feuille des jeunes Naturalistes, November. Nature Notes, November. Amer. Journ. Sci., November. Naturæ Novitates, October 19. Amer. Naturalist, November. Science, October 16, 23, 30, November 6. Scott. Geogr. Mag., November. Science Gossip, November. The Naturalist, November. Westminster Review, November. Amer. Geologist. October, November. Botanical Gazette, October. Review of Reviews, November. Pop. Science News, October, November. Knowledge, November. Photogram, November. Psychological Review, November and Supplement iii. L'Anthropologie, September-October. Bull. Geol. Inst Upsala, vol. ii., part 2. Victorian Naturalist, September.

OBITUARY.

HENRY TRIMEN.

Born 1843. Died 1896.

HENRY TRIMEN, like so many of the naturalists of the generation which is rapidly passing away, was educated for the medical profession and took his M.B. degree, but never practised. In 1867 he became lecturer in botany at St. Mary's Hospital and in 1869 entered the department of botany of the British Museum, as assistant to Mr. Carruthers. He remained at the Museum till 1879, when he accepted the post of Director of the Botanical Gardens, Ceylon. Dr. Trimen (as he was generally known) was an enthusiastic botanist, and his work as a field-botanist at home, as a curator in the great national herbarium, and in the wider scope as director of botanical enterprise in Ceylon, was thorough. The "Medicinal Plants" (1880) in four quarto volumes, in which he had the assistance of Professor Bentley, is one of the most valuable works of its kind. "The Flora of Middlesex," which he published conjointly with Mr. Thistleton Dyer, is an example of what a county flora should be, and his "Flora of Ceylon," which unfortunately remains unfinished, will take a high place among those of our colonies. Nor must we omit to mention his services to science as editor of the *Journal of Botany* (from 1872 to 1879), in the next issue of which a portrait and memoir are promised.

HENRY NEWELL MARTIN.

Born 1849. Died October 30, 1896.

DR. MARTIN has not long survived his resignation of the Professorship of Biology in the Johns Hopkins University. He was a graduate of Cambridge, England, and a Fellow of Christ's College. His best known work was written in conjunction with Professor Huxley, and is "Practical Instruction in Elementary Biology"; his physiological text-books, written while in America, are still extensively used in the colleges and schools of the United States. Dr. Martin's "Human Body" has gone through seven editions; and a memorial volume of his papers was issued a few years ago. An appreciative notice by Professor Michael Foster appeared in *Nature* for November 19.

The death is announced of the eminent French botanist, Auguste Adolphe Lucien Trécul, at the age of seventy-eight. Mr. Trécul's work has extended over the last half century, and his communications to various French scientific journals number 154 in the Royal Society's catalogue. The greater number will be found in the *Annales des Sciences Naturelles* from 1843 onwards, and in the *Comptes Rendus* of the French Académie des Sciences. They are chiefly concerned with the anatomy and morphology of seed-plants. Among the many subjects at which Mr. Trécul worked we may mention the following—the origin of roots and buds, secondary growth in thickness in the stem of dicotyledons, laticiferous vessels and sacs, leaves, the nucleus, chromatoplasts, the origin and structure of starch grains, yeast and fermentation. He also published numerous valuable papers on the structure of different members of the *Nymphæaceæ*, and a useful monograph on the *Artocarpeæ*. *Treculia*, a genus of the latter order, was named in his honour by Decaisne. Mr. Trécul was a member of the Institute. He died on October 17 last.

Moritz Schiff, born at Frankfort-on-Maine in 1823, died at Geneva, where he was professor of physiology, on October 6th. After studying at Heidelberg, Berlin, Göttingen, and Paris, he was appointed director of the ornithological department in the zoological museum at Frankfort, but his revolutionary tendencies did not find favour at German universities, and in 1854 he was glad to accept the professorship in comparative anatomy at Berne. In 1863 he migrated to Florence as professor of physiology, but hurting the susceptibilities of the Italians by his experiments on living animals, was obliged to return to Switzerland, where he was received by the University of Geneva in 1876. His physiological researches, dealing chiefly with the nervous system, but also with other branches, have quite recently been republished in the form of a jubilee Festschrift by his admiring students.

An account of Josiah Dwight Whitney, whose death we chronicled in our October number, is given in the *American Journal of Science* for October. Born in 1820, he graduated at Yale College in 1839; in 1855 was appointed State Chemist of Iowa, then State Geologist of California, and in 1860 was made Professor of Geology at Harvard, a position which was guaranteed him for life in consideration of the gift of his geological library. He was all his life engaged in geological research; his field work included a survey of New Hampshire, a geological exploration of the Lake Superior region, and a survey of the mining regions of all the States east of the Mississippi. He published several Reports on his work, also a book on the metallic wealth of the United States, and in 1869 "The Yosemite Guide-Book." America has lost in him one of her ablest geologists.

In chronicling the death of LUIGI PALMIERI, the well-known vulcanologist, we had no space to give details. He was born at Faicchio; occupied the chair of mathematics at three Italian Universities, and then that of physics at Naples. In 1854 he was appointed Director of the Observatory at Vesuvius, a post which he occupied with the greatest distinction till his death. Regardless of personal danger, he studied all the eruptions of the volcano, and published a book on that of 1872. He was also the editor of the annual publication, *Annales de l'Observatoire du Vésuve*, and an inventor of several scientific instruments, notably a rain-gauge and a seismometer.

THREE eminent medical men have lately died. SIR JOHN ERIC ERICHSEN, Surgeon Extraordinary to the Queen, was born on July 19, 1818, and died at Folkestone on September 23 last. He filled successively the posts of Professor of Surgery at University College, Surgeon to the Hospital, Emeritus Professor of Surgery, and at the time of his death was the President of the College. He had also been President of the Royal College of Surgeons, and of the Royal Medical Society, and had occupied other honourable positions. His chief work was the well-known "Science and Art in Surgery." SIR GEORGE MURRAY HUMPHRY, who was born in 1820, died on September 24. He had lived more than 50 years at Cambridge, and was, to quote the *Times*, "one of the greatest benefactors to the University of modern times," in that he placed the teaching of natural science on a firm and permanent basis. He was appointed Professor of Anatomy in 1866, and in 1883 accepted the Chair of Surgery. His best known writings are "A Treatise on the Human Skeleton," 1858; "On Myology," 1872; "Old Age and Changes incidental to it," 1889. GEORGE HARLEY was born at Haddington in 1829. After graduating in medicine at Edinburgh, he studied in Paris and other Continental centres, and on his return to England held a Professorship at University College. In 1859 he became Physician to University College Hospital. Dr. Harley specialised on the liver and kidneys, and was an exponent of the A.C.E. mixture for anæsthetics. In 1877 he published a book on spelling reform.

OUR obituary list has been so heavy of late that we can do little more than mention the following:—F. C. S. ROPER, botanist, at Eastbourne; ALEXANDER S. SMITH, of Cumberland, who possessed a unique knowledge of bird life on the Solway marshes, and gave many valuable specimens to the Carlisle Museum; on September 10th Dr. R. ZANDER, botanical assistant in the Agricultural College at Berlin; on September 26th, at Berlin, the botanist, L. RUDOLPH, aged 83; the coleopterist, Dr. E. EPPELSHEIM, an authority on Staphylinidæ, in Bavaria; Dr. MAX MÜLLER, an eminent surgeon and scientific writer, at Cologne, on September 3rd; at Bonn, on August 13th, Professor J. L. Delbœuf, professor of psychology at Liège, aged 65; Professor Richard Avenarius, a psychologist of Zurich; Professor Schnetzler, formerly in the Chair of Science at Lausanne University, aged 72; in Alençon, on September 1st, C. G. Gillet, the well-known mycologist, aged 91; R. v. Dombrowski, author of many monographs on game animals, in Vienna, on September 3rd; in September, at Saint-Gilles, Belgium, F. Müller, Honorary President of the Brussels Linnæan Society, aged 77; T. Margó, Professor of Zoology and Anatomy in Budapest University, on September 6th, aged 80; on September 10th, H. v. Foullon, the geologist accompanying the Austrian "Albatros" scientific expedition, murdered in the Solomon Islands by the natives; Emile Renbaugh, a German naturalist, by an accidental fall on the Sierra Madra Mountains, Mexico; H. D. van Nostrand, a conchologist, who possessed a very valuable collection of shells, at New York, on October 9th; the American botanist, W. H. Gibson, in July; Dr. C. E. Brown-Sequard, a scientific worker, at Atlanta, Ga., aged 30; J. B. Lembert, entomologist, murdered at the Merced River, California; Dr. Callender, Professor of Neurology at the Vanderbilt University, Nashville, U.S.A.; on February 18, E. Giovanardi, Professor of Descriptive Anatomy at Modena University; on July 5, Maurice Chaper, a student of Mollusca, at Paris; on October 19, Dr. R. Kerry, director of the bacteriological laboratory at the Veterinary Institute of Vienna; on November 16, aged 76, Admiral Sir George H. Richards, F.R.S., who between 1864 and 1874 was Hydrographer to the Navy; J. E. Gray, Harkness Scholar of Cambridge University, who died at Naples on November 8, the day after his arrival to occupy the University's table at the Zoological Station.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced:—Dr. A. D. Waller, to be Fullerian Professor of Physiology for three years, and Dr. A. Scott, to be Superintendent of the Davy-Faraday Research Laboratory of the Royal Institution; Dr. A. Hill, to the Chair of Anatomy at Cambridge; F. T. Howard, to be one of H.M. Inspectors of Schools, his place as Lecturer in Geology at University College of S. Wales, Cardiff, being taken temporarily by A. B. Badger; Dr. G. Winkler, to be Director of the School of Mines at Freiburg i. S.; Dr. H. Stuhr, to be Assistant in the Anatomical Institute at Breslau; Professor Bubnof, of Dorpat, to the Chair of Hygiene in Moscow University; Dr. S. Bianchi to be full Professor of Anatomy at Vienna; Dr. B. Boccardi, to be Associate Professor of Microscopical Anatomy in the University of Naples; Dr. J. Pantocsek, of Tavarnok, to be Director of the Land-Hospital in Pressburg, Hungary; Dr. V. Goldschmidt, to be Professor of Mineralogy in Heidelberg University; Dr. N. Andrussow, of St. Petersburg, to the Chair of Geology in Dorpat (Jurjev) University; J. de Winter, of the Zoological Garden at Antwerp, to be Superintendent of the Garden at Gizeh, Cairo; Professor F. Berwerth, to be Director of the Mineralogical Department in the Natural History Museum, Vienna, in place of Dr. A. Brezina, retired; F. Nansen, to be Professor and Curator of the Biological Institute in Christiania; M. B. Waite, to be Professor of Botany in the Graduate School of Georgetown University; Dr. C. A. Scott, to the Chair of Experimental Psychology and Child Study at the Chicago Normal School; Dr. Guy Tawney, of Leipzig, to be Demonstrator of Experimental Psychology in Princeton University; O. F. Cook, to be Curator of the Cryptogomic Collections of the National Herbarium, U.S.; W. J. V. Osterhout, to be Lecturer in Botany in California University in place of Mr. A. Howe, resigned; A. W. Grabau, to be Assistant in Geology, S. C. Prescott and A. W. Weysse, to be Instructors in Biology, G. H. Barton, to be Professor of Geology in the Massachusetts Institute of Technology; Dr. R. M. Bolton, of Philadelphia, to be Instructor in Bacteriology at Missouri University; Dr. H. M. Knower, to be Instructor in Biology at Williams College, U.S.A.; H. C. Prinsen-Geerligs, to be Director of the Experiment Station in Java. We are pleased to note that Mr. R. J. Etheridge has been assisting his father in the arrangement of the geological collections of the Australian Museum.

ON the occasion of the opening of the new Gatty Marine Laboratory at St. Andrews on October 30, Sir William Flower, who attended as Director of the Natural History Museum, Canon H. B. Tristram, Professor G. Gilson, and Dr. Michael Foster, were made LL.DD. of that University.

PROFESSOR GUSTAF RETZIUS was made honorary M.D. of the University of Würzburg on the occasion of the opening of the new University buildings.

A MEMORIAL statue to Dr. H. Burmeister is being erected by subscription in Buenos Ayres to commemorate his long and important services to science, and especially to the National Museum. We understand that the Argentine Government has refused permission for it to be set up in a public place, on the ground that Dr. Burmeister was a foreigner; and it is thus destined to occupy an honoured position in the hall of the University.

A Nansen Fund for scientific research has been established, and nearly £17,000 has already been subscribed. It is said that Nansen himself may be appointed director of the fund, which will be under the care of the Christiania University, the Norwegian Society of Science, and the Bergen Museum. Contributions may be sent to the committee of the fund at Christiania University.

We are glad to see that the Austrian Government is taking measures to admit women next year to all faculties, except theological, of the universities, and also to grant those lady physicians who had obtained degrees at foreign universities the right of practising after having undergone examination in Austria.

Those in charge of the Essex Technical Laboratories are printing in their *Journal* papers on practical work in Animal Life on the Farm. These are simple demonstrations on the parts of Invertebrata, with notes on harmless or noxious characters of the animals noticed, and should be of much service to farmers and others.

A new Pathological Laboratory, adequately equipped at a cost of over £15,000, has been added to the Western Infirmary at Glasgow. Private working rooms for original researches, as well as a large museum, are provided.

The fund for establishing a Pasteur Institute in India, has, we learn from *Nature*, reached the sum of 70,000 rupees, besides an annual income of 4,373 rupees. With 50,000 rupees more, work might soon be started in a fully equipped building.

At Algiers, France, there has been established a bacteriological laboratory, with an appropriation of about £100 per annum.

We learn from *Science* that the building in connection with the Massachusetts General Hospital, Boston, will soon be ready; it includes laboratories for chemistry, bacteriology, and histology.

The Neild Collection of Coal-Measure fossils, collected mostly in the neighbourhood of Oldham, has been given to the Oldham Corporation, and is to be arranged in Oldham Museum, to illustrate the geology of that district, by Mr. H. Bolton, of Owen's College Museum. The mineral collection is also being put into order, and the whole plan allows of a typical geological collection being developed, somewhat on the lines of that at Perth.

The Manchester Museum has just acquired the collection of Lancashire Coal-Measure Fossils made by Mr. George Wild, one of the most thorough and painstaking geologists of the county. It is a large collection, contains several types, and almost every specimen is labelled with locality, horizon, date of collecting, etc. The data are very full. The collection includes about 300 sheets of Coal plants, many bearing the successive slice of coal-ball to some of those described by the late Professor Williamson, who was dependent in a large measure for his material on Messrs. Wild, Neild, and Butterworth.

We are glad to hear that the Corporation of Liverpool has just voted a sum of £72,000 for the extension of the Derby and Mayer Museums. Since the extension will be along the downward slope of the hill, it will permit the two lower floors to be used for technical schools, so that the whole sum mentioned is not entirely devoted to museum purposes. We have been waiting for some time to hear what was to be done about the proposed Zoological Gardens in Liverpool. It is now some months since, at a preliminary meeting held in Liverpool on June 11, Professor Herdman moved: "That in the opinion of this meeting it is desirable, in the interests of science and education in this city, to establish zoological gardens, containing a collection of living animals, and that those present form a committee, with power to add to their number, for the purpose of advancing this object." This was carried unanimously, and a sub-committee was appointed to make enquiries for a suitable site. The site that it is now desired to acquire is in Sefton Park, and for this purpose a sum of at least £20,000 is needed. Liverpool certainly seems an excellent place in which to start a zoological garden, since it is in such direct communication by means of its trade with all parts of the world. It appears, moreover, to be a healthy place for exotic animals, so far as one can judge from those which live well enough in Mr. Crosse's well-known collection. We hope, therefore, that the money will soon be subscribed.

THE report of the trustees of the Australian Museum, Sydney, is chiefly remarkable for the record of 2,231 Mollusca added to the collections in 1895. Among the donors, the chief is Mr. W. A. Horn. A large collection of fossil Bryozoa was presented by Mr. R. Etheridge, jun. The usual want of funds has prevented the trustees from acquiring many specimens of great value, and this same want has seriously stopped collecting work, from which alone one can acquire duplicates to exchange with other institutions. One of the most important acquisitions during the year was one of Captain Cook's original MS. journals, the Log of the "Endeavour," presented by Mr. F. H. Dangar. A curious and unfortunate event was the destruction of the entire roof over the central part of the main building by white ants. This had to be shored up immediately on discovery, and the erection of a new roof will at once be proceeded with. The literature received by the library is printed in full catalogue manner, and thus admits of the cutting up of two copies, so as to form a card catalogue. This is an excellent arrangement and worthy the attention of other museums. The printing of the author's name in full to each entry, instead of using the repeat dash, would facilitate the arrangements considerably, and in but a few instances would extend the entry over another line. We are glad to note that, despite reductions in other directions, an official photographer is still attached to the staff, and a proper printing press with all plant necessary for the printing of labels will be in full working order next year.

THE Institute of Jamaica, to judge from its Report for the year ending March, 1896, is in a flourishing condition. The museum has been removed from the lower floor of Date Tree Hall to adjoining new premises. These consist of two floors, the lower devoted to the collections of the Government Geological Survey, the Jamaica woods, and most of the natural history collections; the upper floor filled with the anthropological and the rock and mineral collections. By reason of these changes the library accommodation has been greatly increased, and the art department given room to develop. An attempt has been made to increase the public interest in the museum and natural history generally by the publication of museum notes in the Kingston newspapers. There has been an increase of 28 per cent. in the attendance of visitors to the museum.

A MUSEUM of Arts and Sciences is being built by the Brooklyn Institute.

A MUSEUM of natural history has recently been established at Providence, R.I. Mr. James M. Southwick has been appointed Curator, and his object is to obtain collections representative of the local fauna, after which he hopes to form small loan collections for educational purposes.

THE Geo. H. Cook Museum of Geology in Rutger's College Museum, New Jersey, U.S., is described by its assistant curator, W. S. Valiant, in *Science* for October 16th. Several collections, including over 12,000 specimens of minerals, occupy part of the museum, which also contains large collections of recent molluscs, botanical collections, fossil tree-trunks, and a case of Ellenville quartz crystals, which the curator describes as a "gem." In the museum, which is open free daily, a collector and student of forty years' experience is constantly in attendance to answer any questions pertaining to the collections.

THE Berlin Botanical Museum will be enlarged by leasing seven rooms in a neighbouring building; these are required for research work, and for the rapidly-increasing collections.

THE Royal Society has awarded its medals this year as follows:—The Copley Medal to Professor C. Gegenbaur, for his researches in comparative anatomy, especially on the history of the vertebrate skeleton; the Rumford Medal to Professors P. Lenard and W. C. Röntgen, for their investigation of the phenomena produced outside a highly exhausted vacuum tube through which electrical discharge is taking place; a Royal Medal to Sir A. Geikie, on account of his many original contributions to geology; a Royal Medal to Professor C. V. Boys, for his invention of quartz fibres and investigation of their properties, his improvement of the radio-micrometer and investigations with it, for developments in instantaneous photography, and for his determination of the value of the constant of attraction; the Davy Medal to Professor H. Moissan, for the isolation of fluorine and the use of the electric furnace in the preparation of refractory metals; the Darwin Medal to Professor G. Grassi, for his important discoveries, especially on matters related to Darwinism.

THE Geological Photographs Committee of the British Association calls attention to the fact that no less than 1,408 photographs were received up to August, 1896. These represent an extremely valuable series of records of sections, both temporary and permanent, of the rocks of this country, and can be referred to at the Museum of Practical Geology in Jermyn Street. Circular No. 7, issued by the committee gives further instructions and suggestions as to the kind of photographs desired, and we would urge upon all our geological and photographical readers the importance of preserving such valuable records of sections exposed from time to time in their own districts. Mr. W. W. Watts (28 Jermyn Street, S.W.) will furnish the circular to anyone interested.

AT the opening meeting of the session of the Geological Society of London, the President announced that Lady Prestwich, in fulfilment of the terms of a bequest of her late husband, had offered to the society 260 bound volumes of geological tracts from his library; also that £800 had been bequeathed to the society by Sir Joseph Prestwich, the interest to be applied to the triennial award of a medal and fund: this bequest to take effect subsequent to the decease of Lady Prestwich.

The electric light has been installed in the apartments of this society at Burlington House, and this was formally inaugurated on November 25, when the President and Council were at home to Fellows from 8.30 to 11.0 p.m. Many specimens of geological interest were exhibited, and smoking was permitted. *Lumina mutantur, et nos mutamur in illis.*

THE Soirée of the Geologists' Association, London, was held on Nov. 6. The chief objects of interest were a large series of flint implements shown by Messrs. E. T. Newton, Benjamin Harrison, Dr. Alex. Mitchell, Dr. F. Corner, and Robert Elliott. Considerable interest was aroused by specimens of *Uintacrinus*, newly discovered by Dr. Rowe and others in the English Chalk, and exhibited and explained by Mr. F. A. Bather.

THE meeting-room of the Zoological Society, on November 17, contained a large assemblage of live-stock. Mr. Chalmers Mitchell introduced a fox-terrier puppy as a probable case of telegony, the sire of a previous litter having been a dachshund; but Sir Everett Millais maintained that the puppy was merely a throw-back to the beagle ancestors of the fox-terrier stock. Both Sir Everett and Mr. Tegetmeier refused to admit telegony. Mr. Leonard Hill showed some of the guinea-pigs on which he had repeated some of the experiments of Brown-Séquard, previously repeated by Romanes (see NATURAL SCIENCE, vol. viii,, p. 286); he had failed to prove the inheritance of a character produced by mutilation, the droop in the left eyelid of guinea-pigs whose parents had had the left cervical sympathetic divided turning out to be due to ophthalmia, from which a guinea-pig may suffer as well as a man.

THE annual course of Christmas lectures, specially adapted for children, at the Royal Institution this year will be delivered by Professor Silvanus Thompson, F.R.S., on "Visible and Invisible Light."

THE presentation of the first Bolitho Medal to Mr. Robert Etheridge, sen., is a peculiarly graceful act. We believe it has been recorded that Mr. Etheridge literally sat down and wept over the geology of the Devon and Cornish area when first he attempted to solve its mysteries, but having dried his tears, finally produced the famous paper which unlocked many of its secrets. The medal is of gold and is awarded by the Royal Geological Society of Cornwall.

THE Hull Scientific and Field Naturalists' Club (Secretary, T. Sheppard, 78 Sherburn Street), has an attractive programme of lectures for the current session. Those that are something more than the usual type delivered to a local society appear to be "Recent Progress in Local Entomology," by J. W. Boult and J. Porter, and "The Development of an English Village" (with local examples), by J. R. Boyle.

THE activity of Norwich as a centre of scientific work is well known, and the pages of scientific literature have always provided a goodly string of Norfolk men, especially in geology. Mr. James Moltram, in the last part (vol. vii., pt. 2) of the *Trans. Norfolk and Norwich Naturalists' Soc.*, has now given us a history of the Norfolk and Norwich Microscopical Society. This body was founded by W. K. Bridgman, Rev. J. Crompton, Thos. Brightwell, Rev. J. Landy Brown, and Arthur Morgan in 1852 and lasted until 1884. The Society did not itself publish, but the papers of its members found a place in other journals. It will be sufficient to mention that among its members were Frederick Kitton, Donald Dalrymple, Elijah Bleakley, H. G. Grasspoole, Francis Sutton, and J. B. Bridgman.

IT is pleasing to learn that the Royal Photographic Society's Exhibition was exceedingly well attended this year. Numerous excellent skiagraphs were shown, one of the thorax, showing the outline of the heart distinctly; several photographs of plants and flowers; also microphotographs of scientific and technical interest.

THE Geological Society of Stockholm has completed twenty-five years of active life, and the fact is commemorated in a special number of its Förhandlingar (No. 173), to which contributions have been made by A. E. Nordenskiöld, A. E. Törnebohm, L. Holmström, F. Svenonius, Hj. Sjögren, M. Weibull, H. Bäckström, J. J. Sederholm, G. Holm, and A. G. Nathorst.

THE next International Congress of Criminal Anthropology will meet in 1901 at the Hague, by invitation of the Dutch Government.

As we have already stated, the International Conference, held under the auspices of the Royal Society to consider a catalogue of Scientific Papers, decided that the International Catalogue of Scientific Literature to be begun in 1900, should relate to pure science only. The Federated Institution of Mining Engineers of Newcastle, however, is anxious for a Conference to consider the possibilities of preparing a Catalogue of the technical literature of Applied Science, and desires those interested in the scheme to communicate with the Secretary, Mr. Walter Brown, Neville Hall, Newcastle. Other matters, such as the postage on serials, it is suggested, might be also discussed.

THE Welby Prize of £50 is offered for the best treatise of practical utility on the causes of the present obscurity and confusion in psychological and philosophical terminology, and the directions in which we may hope for an efficient practical remedy. Competition is open to those who, previously to October 1, 1896, have passed the examinations qualifying for a degree at some European or American university. The essays, in English, French, or German, must be type-written and at least 25,000 words in length; they should be headed by a motto, and accompanied by a sealed envelope containing the name of the writer. MSS., to arrive before October 1, 1897, may be sent to Professor James Sully, London; Mr. G. F. Stout, Aberdeen; Professor O. Külpe, Würzburg; or Professor E. B. Titchener, Cornell University, Ithaca, N.Y. A French member will shortly be added to the Committee.

AMONG the free lectures being delivered under the auspices of the Leigh Browne Trust and the Humanitarian League, at St. Martin's Town Hall, is one by J. Arthur Thomson on "The Humane Study of Natural History," on December 8, at 8 p.m. The series was begun by Mr. Edward Carpenter, whose remarks we would comment on, if we could understand them.

DR. T. N. TSCHERNYSCHEW, of the Russian Geological Survey, has completed his observations on Nova Zembla. This island bears traces, like those in North Russia, of a formidable glaciation, followed by subsidence, during which the whole territory was transformed into an archipelago. Terraces, containing the shells of arctic molluscs, extend along the shores to a height of 160 metres. The present glaciers are in a period of growth.

A PORTION of the bequest made to the Swedish Academy of Sciences by A. F. Regnell, whose fortune was made as a physician in Brazil, was set aside by the academy to promote the study of the Brazilian flora. Every six years it yields about £1,150, which is applied in sending two Swedish botanists to Brazil for two years. The first expedition was undertaken by Drs. C. A. M. Lindman and G. O. A. Malme, who in 1892–94 explored Rio Grande, Paraguay, and Matto Grosso.

A SPANISH explorer, P. Joaquin Juanola, has discovered a lake, occupying the crater of an extinct volcano, in the island of Fernando Po, 1,330 metres above sea level. Monkeys and ducks are abundant round its banks, and it is said that the other members of the party saw a hippopotamus. This is very important, says the *Revue Scientifique*, and should be verified, for it must have been easy for the animal to swim to Fernando Po from Africa, if it really swam from Africa to Madagascar, as Dr. Blanford maintains.

PROFESSOR F. REGEL, of Jena, went to Columbia last July on a voyage of exploration, to last some nine months.

M. MAINDRON, the entomologist, has been commissioned by the French Government to make a collecting expedition to the Persian Gulf and India.

MR. E. A. ANTHONY, who was sent to Lower California by the Smithsonian Institution, is returning with large collections of shells, marine and terrestrial fauna and flora, containing many new species.

Mr. C. H. Sternberg has made a fine collection of fossil plants in the Dakota Group at Kansas.

Professor D. G Elliott has made good faunal collections in Somaliland.

Large collections of plants and animals from the north-eastern shores of Lake Nyasa, have been made by Mr. A. White, who has just returned to British Central Africa from a successful expedition into the Nyika plateau.

A correspondent of the *Daily Chronicle* of November 10th points out that Nansen's deep layer of warmer and salter water below the surface of the Polar Sea, originating probably in the Gulf Stream, with a temperature of 1° above freezing-point, confirms the observations made by Leigh Smith in 1871, 1872, and 1873, that warm undercurrents from the Gulf Stream ran along the north-western coast of Franz Josef Land.

Dr. Nansen is having a new yacht built by Mr. Colin Archer, for the purpose of taking soundings around the coast-line of Norway and Spitzbergen.

A regulation that will help to preserve big game in German East Africa has been drawn up. This provides for shooting licences, prohibits the shooting of all young or female game, and levies a tax of 100 rupees on the first elephant shot, and 250 for each succeeding one. These restrictions do not apply to animals shot for food, or to apes, wild boars, reptiles, or beasts of prey. Special game-preserves in the interests of science will be established, and hippopotamus reserves are suggested.

Dr. Koch, the bacteriologist, has been ordered to the Cape by the German Government to examine into and report upon the rinderpest.

Mr. A. Alder, of George Street, Brisbane, Queensland, is prepared to send full-size colored plaster casts of *Ceratodus forsteri*, Krefft, packed and shipped, for £3 10s.

It was announced in Natural Science (vol. iv., p. 164, March, 1894) that the people of Shrewsbury intended to erect some memorial of the illustrious native of that town, Charles Darwin. The project, however, was delayed for want of funds, largely in consequence of the fall of St. Mary's spire (*tom. cit.*, p. 256). We now learn that the deficiency has been made good by the Shropshire Horticultural Society, and that a statue, to cost from £1,000 to £1,200, is to be erected in the town. Further, such money as may be subscribed by friends of science and well-wishers to the memorial will be applied to the foundation of a memorial scholarship.

CORRESPONDENCE.

The Determination of Fossils.

In your November number, and under the head of "Pavingstone Palæontology," you give your readers some excellent advice on the subject of the determination of fossils. You say that the description of new species should always be handed over to trained zoological specialists, and no doubt this is highly desirable and generally possible; but when you add, "even the mere determination of fossils has nowadays become, like the determination of recent animals and plants, a task for the specialist in taxonomy, and the lists that we constantly see issued in connection with stratigraphical papers can be proved (as Natural Science has before now proved some of them) to be lengthy aggregations of error," you make a very serious indictment without indicating a practical remedy.

I think I shall voice the feelings of most writers of such papers in saying that they would only be too delighted to follow your advice and to get all their fossils named for them by competent men. As you truly remark, "correct conclusions cannot follow from inaccurate premises," and it is most important that fossils should be accurately named; but those who write such papers know that it is very difficult to get this done: the author may obtain the friendly assistance of one or two specialists, but the greater number of his fossils he has to identify as best he can for himself.

Now, unfortunately, in your present issue, you confine yourself to saying that we are very worthy and energetic people, but that not being universal geniuses we ought not to attempt a task which is so much beyond our capacities. No doubt there is much truth in this, and we anxiously await your next issue, in which we hope that you will tell us where the specialists are to be found who are always ready to examine and name the fossils collected by anyone who is working at stratigraphical problems. The idea is magnificent, and an Editor is of course omniscient, so you are doubtless prepared to inform us how your advice can be carried out in practice: in so doing you will confer an immense obligation on more than one

Stratigraphical Geologist.

[We beg to refer the "more than one," who have written to similar effect, to our Article on page 361.—Ed. Nat. Sci.]

Indexes of Periodicals.

Surely some better method than the present one of indexing periodicals might be found. Take Natural Science, for example. It has only been in existence since March, 1892, and we already have eight volumes with eight separate indexes. To look up anything in these indexes is already troublesome, and in a few years will be a laborious business. Who can be expected to wade through the fifty-four indexes of your contemporary, *Nature?* If some means could be devised whereby each succeeding index could be incorporated with the pre-existing indexes, much trouble would be saved. This might, perhaps, to a certain extent, be accomplished if each index were printed on a series of cards of uniform size, each corresponding with a letter of the alphabet; then, when a new index appeared, all items beginning, say, with the letter G, could be arranged together, although not further classified. The index would then cease to be attached to each volume, and would become a key to the whole series of volumes. Of course, the number of volume would have to be printed on each card, and a uniform size of cards for all periodicals would be desirable.

Bernard Hobson.

Owens College, Manchester.

[Our correspondent's suggestion, though not precisely novel, is no doubt most valuable, but the publication of such an index is rather beyond the powers of such a journal as ours; for the present volume, for instance, no less than 1,000 slips have actually been made and kept for incorporation, but who is to pay for their publication and distribution? Will Mr. Hobson begin with a subscription of £5? No doubt the task would be easier for a serial that published nothing but articles, and that required at most 100 slips to each volume. While, therefore, we desire to help the modern indexing movement, we feel obliged to leave its actual carrying out to such an institution as the Concilium Bibliographicum at Zurich, or that International Central Bureau of still wider scope which everyone is hoping to see firmly established. But as for Mr. Hobson, we are quite ready to sell him *two* copies of the present number, so that he may cut up the index and paste it down for himself.—ED. NAT. SCI.]

MR. WALTER HOWCHIN writes to us from Adelaide that we have done him an injustice, on page 10 of our July number, in stating "We cannot accept the *Cornuspira* because of the chambering shown in the figure." In his description it is distinctly stated that the foraminifer is a "non-septate tube," and that the appearance of chambering is produced by the "irregular coiling of the earlier convolutions of the tube." We must apologise to Mr. Howchin for having overlooked this satisfactory explanation.

WE are unable to take notice of anonymous contributions, but if the gentleman who writes under the title of "A Constant Subscriber" will kindly give us his initials and address, we shall be glad to reply to him. Meanwhile, we may request him to compare the earlier and later numbers of NATURAL SCIENCE with more exactness, when he will find that several changes we have introduced have enabled us to give more matter than formerly in the corresponding space.

SPECIAL NOTICE.

REDUCTION OF ANNUAL SUBSCRIPTION:—*Owing to the lower rate of postage, we are now prepared to send each number direct to any address in the Postal Union, immediately on publication, for an annual subscription of* 13s. ($3 *in America*), *or the equivalent in foreign money. Subscriptions for* 1897 *are now payable.*

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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.*

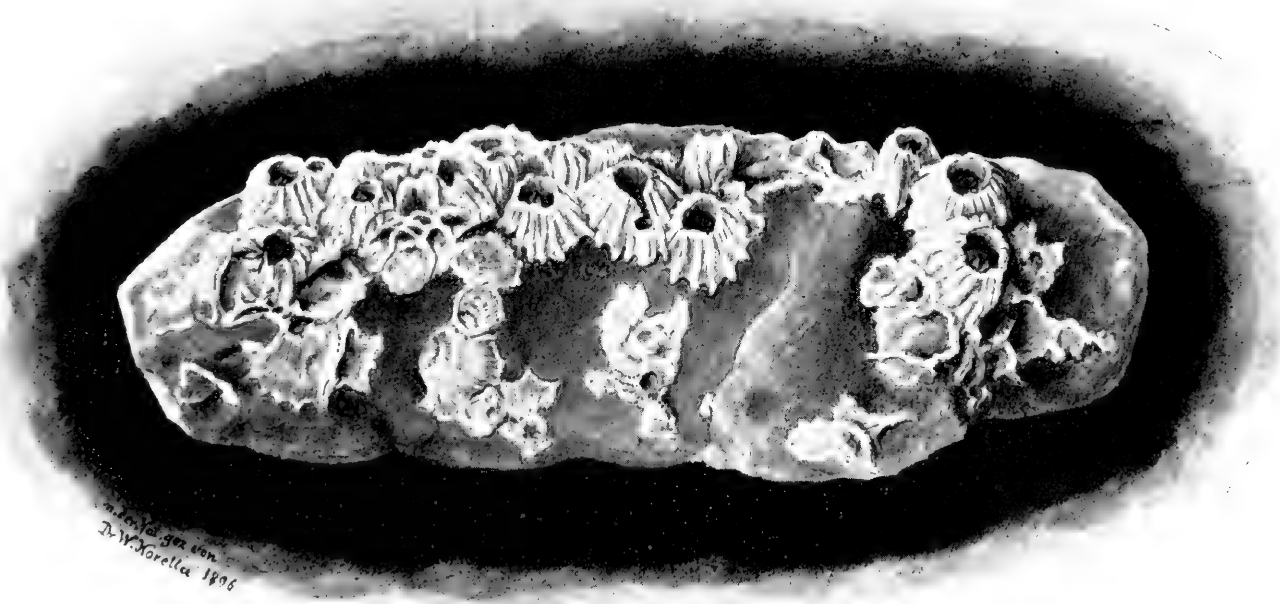
FIG. 1.

FIG. 2.

AMBER covered with (1) *Balanus porcatus*, da Costa, and (2) *Pomatoceros triqueter* (L.)

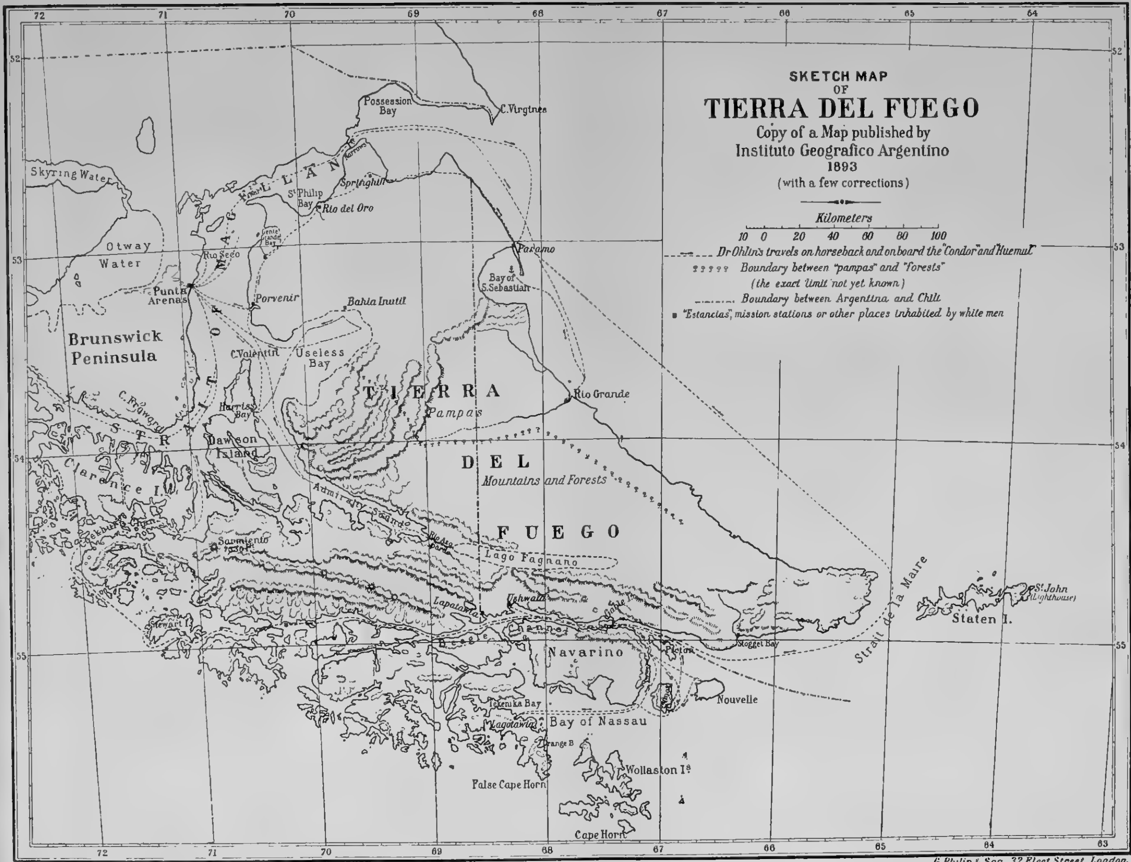
(*In the possession of Mrs. A. Fox, of Cromer.*)

[*See p.* 103.



AMBER covered with *Balanus porcatus*, da Costa.
(In the possession of Messrs. Stantien & Becker, of Königsberg.)

[*To face p.* 104.



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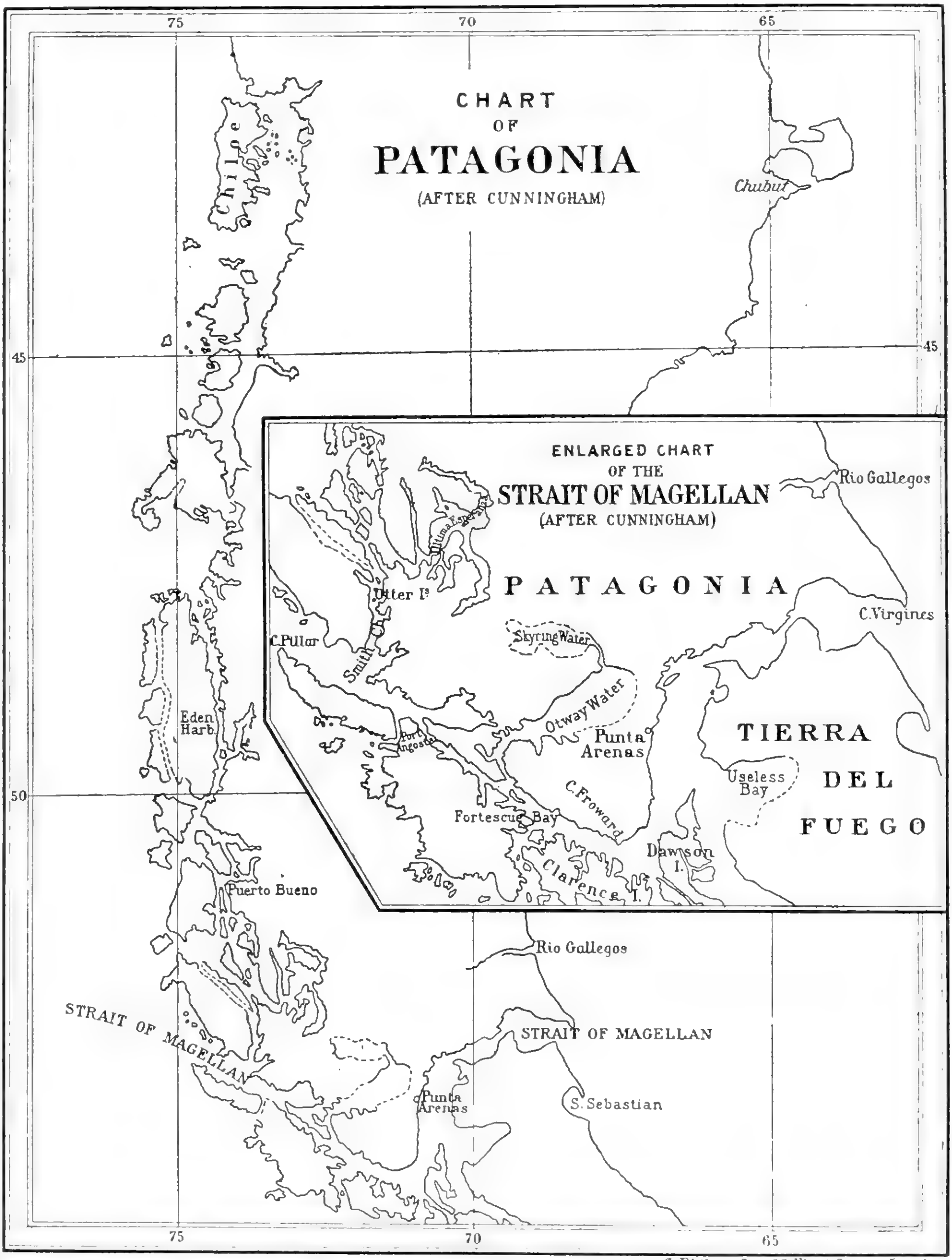

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