MR. BENTHAM'S ANNIVERSARY ADDRESS TO THE LINNEAN SOCIETY

(*Continued from page* 94)

PRESERVED specimens have the great advantage over living ones, that they can be collected in infinitely greater numbers, maintained in juxtaposition, and compared, however distant the times and places at which they had been found. They are often the only materials from which we can obtain a knowledge of the races they represent; although still consisting of individuals only, they can, by their numbers, give better ideas of species and other abstract groups than the almost isolated living ones; and their careful preservation supplies the means of verifying or correcting descriptions or delineations which have excited suspicion. Their great drawback is their incompleteness, and the impossibility of deriving from them all the data required for the knowledge of a race or even of an individual. It is owing to the frequency with which characters supplied by preserved specimens, although of the most limited and unimportant a nature, have been treated as sufficient to establish affinities and other general conclusions which have proved fallacious, that the outcry I have alluded to has been raised against museums and herbaria by those very theorists whose speculations would fall to the ground if all the data supplied by preserved specimens were removed from their foundation.

In respect of these deficiencies, as well as in the means of supplying them, there is a great difference between zoological and botanical museums. Generally speaking, zoological specimens show external forms only; botanical specimens give the means of ascertaining internal structure; * and as a rule the characters most prominently or most frequently brought under the observer's notice acquire in his eyes an undue importance. Hence it is that external form was for so long almost exclusively relied upon for the classification of animals, whilst the minutiæ of internal structure were at a comparatively early period taken account of by botanists, while palæontologists are still led to give absolute weight to the most uncertain of all characters—outline and external markings of deciduous organs. External form is, however, really of far greater importance in animals than in plants; the number, form, size, and proportions of limbs, the shape and colour of excrescences, horns, beaks, feathers, hair, &c., in animals may be reckoned almost absolute in species when compared with the same characters in the roots, branches, and foliage, and, to a certain extent, even in the flowers of plants. In plants, local circumstances, food, meteorological conditions, act readily in modifying the individual, and producing more or less permanent races of the lowest degree (varieties); whilst animals in these respects are comparatively little affected, except through those slow or occult processes by which the higher races, species, or genera in all organisms are altered in successive ages or geological periods. Even relative position of external parts, so constant in animals, is less so in plants. Animals being thus definite in outline, and a very large proportion of them manageable as to size, their preserved specimens, carcases, or skins can be brought together under the observer's eye in considerable numbers, exhibiting at once characters sufficient for the fixation of species; whilst, with a few rare exceptions, a whole plant in its natural shape can never be preserved in a botanical museum. And, although good botanical specimens have a general facies, often sufficient to establish the species if the genus is known, yet the most experienced botanists have often erred in their determinations where they have been satisfied with external comparison without internal examination.

Identification of species is, however, but a small portion of the business of systematic biology, and for higher purposes the classification of species, and the study of their affinities, the pre-eminence of ordinary zoological over botanical specimens soon fails, those characters distinguished by Prof. Flower as adaptive are proportionately more prominent, and the essential ones derived from internal structure are absent; and not only do the former thus acquire undue importance in the student's eyes, but arguments in support of a favourite theory have not unfrequently been founded on distortions really the result of bad preparation, although supposed to be established on the authority of actual specimens, and therefore very difficult to refute. Mounted skins of vertebrata, showy insects in their perfect stage, shells of malacozoa, corals, and sponges, necessarily form the chief portion of a museum for public exhibition; but science and instruction require a great deal more; museum collections really useful to them should exhibit the animal as far as possible in all its parts and in all the phases of its life. This necessity has been felt in modern times, and has resulted in the establishment of Museums of Comparative Anatomy, amongst which that of our own College of Surgeons has certainly now taken the lead. But I have nowhere seen, except on a very small scale, the two museums satisfactorily combined. The idea, however, is not a new one; several zoologists have expressed their opinions on the desirableness of such an arrangement, which it is to be hoped will be duly considered in the formation of the new National Zoological Museums about to be erected at South Kensington, for the double purpose of exhibition and science. The requirements of the gazing public are sure to be well provided for, and there is every reason to believe that the exertions of scientific zoologists will not have proved useless, that we shall in the portion devoted to science and instruction see the skins of vertebrata preserved without the artist's distortions, accompanied, as far as practicable, by corresponding skeletons and anatomical preparations, as well as by the nests and eggs of the oviparous classes; insects with their eggs, larvæ, and pupæ; shells with the animals which produce them, &c., always with the addition, as far as possible, of the collector's memoranda as to station, habits, &c., in the same manner as herbarium specimens are now frequently most carefully completed by detached fruits, seeds, young plants in germination, gums, and other products.

Here, however, will arise another source of false data to be carefully guarded against—the mismatching of specimens, which in botany has probably produced more false genera and species than the misplacing of garden labels. The most careful collectors have in good faith transmitted flowers and fruits belonging to different plants as those of one species—the fruits perhaps picked up from under a tree from which they were believed to have fallen, or two trees in the same forest with similar leaves, the one in flower the other in fruit, supposed to be identical, but in fact not even congeners, and the mismatching at the various stages of drying, sorting, distributing, and finally laying in the specimens, have been lamentably frequent. Collectors' memoranda, if not immediately attached to the specimens or identified by attached numbers, have often led the naturalist astray, for collectors are but too apt, instead of noting down any particulars at the time of gathering, to trust to their memory when finally packing up their specimens. And so long as reasoning by analogy was never allowed to prevail over a hasty glance at a specimen and the memoranda attached to it, false genera and species arising from these errors were considered indisputable. *Magallana* of Cavanilles was, till recently, allowed materially to invalidate the character of Tropœoleæ, overlooking the strong internal evidence that it was founded upon the fruit of one natural order carefully attached to a poor flowering specimen of another.

Zoological museums and botanical herbaria differ very widely in the resources at their disposal for formation, maintenance, and extension of their collections. Zoological museums are by far the most expensive, but on the other hand as exhibitions they can draw largely on the general public, whilst herbaria must rely mainly upon science alone, which is always poor; both, however, may claim national assistance on the plea of instruction as well as of pure science, and for practical or economic purposes the herbarium is even more necessary than the museum. The planning the new museums so as best to answer these several purposes for which they are required, has, we understand, engaged the attention of the Royal Commission on Scientific Instruction and the Advancement of Science, and our most eminent zoologists have been consulted; any further observations on my part would therefore be superfluous. If our Government fail in their arangements for the promotion of science, it will not be for want of having its requirements laid before them.

I am unable to say what progress has been made of late years in zoological museums, my notes on Continental ones were chiefly taken between the years 1830 and 1847, and would therefore be now out of date. It would, however, be most useful if some competent authority would undertake a tour of inspection of the more important ones, as in the great variety of their internal arrangements many a useful practical hint might be obtained, and we much want a general sketch of the principal zoological and botanical collections accessible to science, showing in what branch each one is specially rich, and where the more important

* By *internal structure* is here meant the morphology of internal organs or parts, usually included in the comparative anatomy of animals, not the microscopical structure of tissues, which is more especially designated as vegetable anatomy.

typical series are now respectively deposited. In herbaria a few changes have recently taken place which it may be useful to record. Paris, I mean of course the brilliant Paris of a twelvemonth back, had lost considerably. Of the many important private herbaria I had been familiar with in earlier days, two only, those of Jussieu and of A. de St. Hilaire, had been secured for the national collection, Webb's had gone to Florence, J. Gay's, which would have been of special value at the Jardin, was allowed to be purchased by Hooker and presented by him to Kew. The celebrated herbarium of Delessert is removed to Geneva, whilst his botanical library, one of the richest in existence, is locked up within the walls of the Institut. These are but partially replaced by M. Cosson's herbarium, which has much increased of late years, and to which he added last spring the late Schultz Bipontinus's collection rich in Compositæ. The national herbarium of the Jardin des Plantes is still one of the richest, but no longer *the* richest of all. The limited funds at the disposal of the Administration have allowed of their making but few acquisitions; their staff is so small and so limited in the hours of attendance, that the increase of the last twenty years remains for the most part unarranged, and their library is most scanty. Science has been out of favour with their governments of display. It would be out of place for me here to dwell upon the painful feelings excited in my mind by the dreadful ordeal through which a country I have been so intimately associated with for more than half a century is now passing, feelings rendered so acute by the remembrance of the uniform kindness I have received from private friends as well as from men of science, from Antoine Laurent de Jussieu and his colleagues to the eminent professors of the Jardin, who have now passed through the siege; but I may be allowed to express an anxious hope that when the crisis is passed, and the elasticity of French resources will have restored the wonted prosperity, the new Government may at length perceive that, even politically speaking, the demands of science require as much attention as popular clamour.

The Delesserian herbarium has been well received at Geneva, where it has been adequately deposited in a building in the Botanic Garden, very near to the Natural History Museum now erecting. At Paris it had been for some time comparatively useless, owing to the attempt to class it according to Sprengel's Linnæus, but now an active amateur committee, Messrs. J. Mueller, Reuter, Rapin, and others, under the presidency of Dr. Fauconnet, have already made great progress in distributing the specimens under their natural orders; and Geneva, already containing the important typical collection of De Candolle, and Boissier's stores rich especially in Mediteranean and Oriental plants, has become one of the great centres where real botanical work can be satisfactorily carried on; and as she has had the good sense to level her fortifications, she may accumulate national treasures with more confidence in the future. Munich has lost much of the prospect she had; the Bavarian Government failed to come to terms with the family of the late von Martius, his botanical library has been dispersed, and his herbarium removed to Brussels, where it is to form the nucleus of a national Belgian collection. At Vienna the Imperial herbarium is now admirably housed in the Botanical Garden, and is in good order, with the advantage of a rich botanical library in the same rooms. At Berlin, where the Royal Herbarium, like the Zoological Museum, has always been kept in excellent order, want of space is greatly complained of since it has been transported to the buildings of the University. At Florence, as we learn from the *Giornale Botanico Italiano*, the difficulties with regard to the funds left by Mr. Webb for the maintenance of his herbarium have been overcome, and it is to be hoped that the liberal intentions of the testator who made this splendid bequest for the benefit of science will no longer remain so shamefully unfulfilled. To the above six may be added Leyden, Petersburgh, Stockholm, Upsala, and Copenhagen, as towns possessing national herbaria sufficiently important for the pursuit of systematic botany; but when I visited them, now many years since, they were all, more or less, in arrear in arrangement. I know not how far they may have since improved. In the United States of America, the herbarium of Asa Gray, recently secured to the Harvard University, now occupies a first rank. That of Melbourne in Australia, founded by Ferdinand Mueller, has, through his indefatigable exertions, attained very large proportions; and that of the Botanical Garden of Calcutta, under the successive administration of Dr. Thomson and the late Dr. T. Anderson, had recovered in a great measure its proper position, which, I trust, it will henceforth maintain. Our own great national herbarium and library at Kew is now far ahead of all others in extent, value, and practical utility; originally created, maintained, and extended by the two Hookers, father and son, their unremitting and disinterested exertions have succeeded in obtaining for it that Government support without which no such establishment can be really efficient, whilst their liberal and judicious management has secured for it the countenance and approbation of the numerous scientific foreigners who have visited or corresponded with it. Of the valuable botanical materials accumulated in the British Museum during the last century I say nothing now, for the Natural History portion of that establishment is in a state of transition, and my own views as regards Botany have been elsewhere expressed. I have only to add that we have also herbaria of considerable extent at the Universities of Oxford, Cambridge, and Edinburgh, and at Trinity College, Dublin, and to express a hope that the necessity of maintaining and extending them will be duly felt by these great educational bodies, if they desire to secure for their professorial chairs botanists of eminence.

3. Pictorial representations or drawings have the advantage over museum specimens, that they can be in many respects more complete, they can represent objects and portions of objects which it has been impossible to preserve, they can give colour and other characters lost in the course of desiccation, they preserve anatomical and microscopical details in a form in which the observer can have recourse to them again and again without repeating his dissections, and although, like a museum specimen, each drawing represents usually an individual, not a species, yet that individual can by exact copies be multiplied to any extent for the simultaneous use of any number of naturalists, whilst specimens of the same species in different museums are corresponding only, not identical, and imperfect comparison and determination of specimens supposed to be authentic (*i.e.*, exactly corresponding to the one originally described) have led into numerous errors. Drawings, moreover, of diagrams and other devices can represent more or less perfectly the abstract ideas of genera and species, they can exhibit the generic or specific character more or less divested of specific or individual peculiarities.

Drawings on the other hand are, much more than specimens, liable to imperfections and falsifications arising from defective observation of the model and want of skill in the artist, and errors thus once established are much more difficult of correction than even those conveyed by writing. A pictorial representation conveys an idea much more rapidly, and impresses it much more strongly on the mind, than any detailed accompanying description by which it may be modified or corrected, and is but too frequently the only evidence looked into by the more theoretical naturalist. This is especially the case with microscopical and anatomical details of the smaller animals and plants, the representations of which, if very elaborate and difficult to verify, usually inspire absolute confidence. Drawings are also costly, often beyond the means of unaided science, who here again, as in the case of gardens and museums, is obliged to have recourse to the paying public; the public in return require to have their tastes gratified, artistic effect is necessarily considered, thus increasing the cost and removing the pictures still further from the reach of the working biologist. It appears to me, however, that collections of drawings systematically arranged have not generally met with that attention which they require from directors of museums, and that their multiplication in an effective and cheap form ought to be a great object on the part of Governments, Scientific Associations, and others who contribute pecuniarily to the advancement of science.

To be effective, the first requisites in a zoological or botanical drawing are accuracy and completeness; it is a faithful representation not a picture that is wanted. Many a splendid portrait of an animal or plant, especially if grouped with others in one picture, has been rendered almost useless to science by a graceful attitude or an elegant curve which the artist has sought to give to a limb or to a branch, and those analytical details which are of paramount importance to the biologist are neglected, because they spoil the general effect. We next require from an illustration, as from a description, that it should be representative, or to a certain degree abstract, and this requires that the artist, if not himself the naturalist, should work under the naturalist's eye, so as to understand what he delineates. Great care should be taken, in the selection for the model of an individual in a normal state, as to health, size, &c, and in the selection and arrangement of the anatomical details, so as to represent the race rather than the individual, all of which requires a

thorough acquaintance with the questions to be attended to. It is true that the artist working independently and copying mechanically may serve as a check on the naturalist, who in minute microscopic examinations may be apt to see too much in conformity to preconceived theories; but that is not often the case, the most satisfactory analytical drawings I have always found to be those made by the naturalist's own hand, and I have long felt how much my own inability to draw has detracted from the value of botanical papers I have published. And thirdly, when we consider that the great advantage of an illustration over a description is, that the one gives us at a glance the information which we can only obtain from the other by study, we require that each drawing or plate should be as comprehensive as is consistent with clearness and precision. Outline drawings or portraits without structural details often omit the essential characters we are in search of; where details are unaccompanied by a general outline, we miss a great means of fixing their bearing on our minds. Structural details may also equally err in being too numerous or too few, or too large or on too small a scale. If the plate is crowded with details of little importance, or which may be readily taken from the general outline, they draw off the attention from those which it is essential should be at once fixed on the mind, and if enlarged beyond what is necessary for clearness, they require so much the more effort to comprehend them, unless indeed they be destined to be hung up on the walls of a lecture-room. I believe it to be the case with some drawings of the muscles of vertebrata, or of the internal structure of insects, as I know it to be with those of ovules and other minute parts of flowers of the late Dr. Griffith and others, that with their very high scientific value, their practical utility is much interfered with by the large scale on which they are drawn. A great deal depends also on the arrangement in the plate, always keeping in mind that the object is not to please the eye, but to convey at one view as much as possible of comparative information without producing confusion.

Biological illustrations in general have much improved in our time. It is true that some of the representations of animals and plants dating from the middle of last century will enter into competition with any modern ones as to the general outlines and facies, but analytical details were almost universally neglected, and colouring when attempted was gaudy and unfaithful. At present I believe we excel in this country in the general artistic effect, as unfortunately also for the naturalist in the costliness, of our best zoological and botanical plates; the French are remarkable for the selection, arrangement, and execution of the scientific details, and as a model I may refer to some of the publications of the Paris Museum, such as the Malpighiaceæ of Adrien de Jussieu, and also for the excellent woodcuts illustrating their general and popular works; the Germans and some Northern states for the admirable neatness of microscopic and other minutiæ executed at a comparatively small cost, owing partially at least to the use of engravings on lithographic stone.

4. Written Descriptions are what we must chiefly rely upon to convey to the general or to the practical naturalist the results of our studies of animals and plants; but descriptions are of two kinds—individual descriptions and descriptions of species, genera, or other races. The former are like preserved specimens or delineations, materials for study, like them they require in their preparation little more than artistical skill guided by a general knowledge of the subject; but abstract descriptions, whether specific or relating to races of a higher degree, require that study of the mutual relations of individuals and races and their consequent classification which constitute the science of systematic biology, and this distinction should be constantly kept in view for the just appreciation of all descriptive works. Any tyro can with care write a long description of a specimen unimpeachable as to accuracy, but it requires a thorough knowledge of the subject and a keen appreciation of the bearings of the points noticed to prepare a good description of a species. For the latter to be serviceable it must be accurate, it must be full without redundancy, it must be concise without sacrificing clearness, it must be abstractive not individual, and lastly, the most difficult qualification of all and that which constitutes the main point of the science, the abstraction must be judicious and true to Nature.

The paramount importance of accuracy is too evident to need dwelling upon. We are all liable to errors of observation. Imperfect vision or instruments, optical deceptions, accidentally abnormal conditions of the specimen examined, hasty appreciation of what we see from preconceived theories, are so many of the causes which have occasionally led into error the most eminent of naturalists, and require to be specially guarded against by repeated observation of different specimens and constant testing at every step by reasonings from analogy. Errors once established on apparently good authority are exceedingly difficult to correct, and have been the source of many a false theory. Where loose examination and hasty conclusion have been frequently detected, we can at once renounce all confidence in an author's descriptions—in his genera and species—unless confirmed from other sources, but an accidental oversight on the part of a naturalist of established reputation is the most difficult to remedy, notwithstanding the eagerness with which some beginners devote themselves to hunting them out. No botanist was, I believe, ever more careful in verifying his observations over and over again, and in submitting them to the tests supplied by the extraordinary methodising powers of his mind, than Robert Brown, no one has ever committed fewer of what we call blunders, or established his systematic theories on safer ground, yet even he has been detected in a few minor oversights, eagerly seized upon by a set of modern speculative botanists, lovers of paradoxes, as justifying them in devoting their time and energies to the disputal of several of his most important discoveries and conclusions.

The value of a description as to fulness and conciseness is practical only, but in that point of view important. A description, however accurate, is absolutely useless if the essential points are omitted, and very nearly so if those essential points are drowned in a sea of useless details; the difficulty is to ascertain what are the essential points; and hence one of the causes of the superiority of monographs and floras over isolated descriptions, such as those of Zoologies and Botanies of exploring expeditions, which I insisted on in my address of 1862; in the former the author must equally examine and classify all the allied races, and thus ascertain the essential points; in the latter case he is too easily led to trust to what he believes to be essential. My own long experience in the using, as well as in the making, of botanical descriptions, has proved to me how difficult it is to prepare a really good one, how impossible it is to do it satisfactorily from a first observation of a single specimen. However carefully you may have noted every point that occurs to you, you will find that, after having comparatively examined other specimens and allied forms, you will have many an error to correct, many a blank to fill up, and much to eliminate. I have more than once had to verify the same species in two authors, the one giving you a character in a few lines which satisfies you at once, the other obliging you to labour through two or three quarto pages of minute details, from which some of the essential points are omitted.

But the great problem to be solved at every stage in systematic or descriptive biology, and that which gives it so high a scientific importance, is the due detection and appreciation of affinities and mutual relations, and in this respect the science has made immense progress within my own recollection, and especially during the last few years the gradual supplanting of artificial by natural classifications has been too often commented upon to need repetition. It is now, I believe, universally admitted that a species consists of individuals connected together by certain resemblances or affinities the result of a common descent. It is also acknowledged that for scientific purposes these species should be arranged in groups according to resemblances or affinities more remote than in the case of species, although here commences the great difference of opinion as to the meaning of these remote affinities, whether they also are the result of a common descent, or of that supposed imitation of a type which I have above alluded to. For those, however, who have once connected affinity with consanguinity, it is difficult to recede from so ready an explanation of those mysterious resemblances and differences, the study of which must be the ruling principle to guide us in our classifications. All this has now been fully explained by more able pens than mine; my only object in repeating it is to point out clearly the need of treating all systematic groups from the order down to the genus, species, or variety, as races of a similar nature, collections of individuals more nearly related to each other than to the individuals comprising any other race of the same grade, and of abolishing the use of the expression *type* of a genus, or other group, in any other than a purely historical sense, as a question of nomenclature.* If a genus has to be

* For the purposes of instruction some one species is often named as *a* type of a genus, that is to say, as fairly representing the most prevalent

divided, our laws of nomenclature require the original name to be retained for that section which includes the species which the founder of the genus had more specially observed in framing his character, and therefore, and for that reason only, it becomes necessary to inquire which was or which were the so-called typical species—the biologist's or as it were the artist's, not Nature's type.

I need not repeat what I said in 1862 of the comparative value of monographs and faunas or floras over miscellaneous descriptions, observing only that the immense progress made in the accumulation of known species henceforth diminishes still more the relative importance to science of the addition of new forms when compared to the due collocation and correct appreciation of those already known. Much has been done of late years in the latter respect, but yet some branches of biology, and perhaps entomology more than any other, are very much in arrear as to supplying us with available data for investigating the history of species and their genealogy; their origin, progress, migration, mutual relations, their struggle, decay, and final extinction. It is to be feared that in insects as in plants, but too large a proportion of the innumerable genera and sub-genera have been founded rather on the sortings of a collector than on the investigation of affinities; and, indeed, that must in a great measure be the case so long as a large proportion are only known from their outward form at one period only of their varied phases of existence.

The days of a Systema Naturæ, or single work containing a synopsis of the genera and species of organised beings, are long since passed away. Even a Species Plantarum, now that their number at the lowest estimate exceeds 100,000, has become almost hopeless. The last attempt, De Candolle's Prodromus, has been nearly forty years in progress, the first portion has become quite out of date, and all we can hope for is that it may be shortly completed for one of the three great classes of plants. Animals might have been more manageable were it not for the insects. Mammalia estimated at between 2,000 and 3,000 living species, birds at about 10,000, reptiles and amphibia under 2,000, fishes at about 10,000, crustacea and arachnida rather above 10,000, malacozoa about 20,000, vermes, actinozoa, and amorphozoa under 6,000, would each by themselves not impose too heavy a tax on the naturalist experienced in that special branch who should undertake a scientific classification and diagnosis of all known species. In one important branch, indeed, the fishes, this work has been most satisfactorily carried out in Dr. Günther's admirable Genera and Species of all known fishes published under the misleading title of "Catalogue of the Fishes in the British Museum," and recently completed by the issue of the seventh volume. The sound philosophical views expressed in his preface to that volume (which, by some strange inversion, bears a signature not his own) can be appreciated by us all, and zoologists are all agreed as to the care with which they have been worked out in the text. Insects are, however, the great stumbling-block of zoologists. The number of described species is estimated by Gerstaecker at above 160,000, viz. : Coleoptera, 90,000; Hymenoptera, 25,000; Diptera, 24,000; Lepidoptera, 22,000 to 24,000. Mr. Bates thinks that, for the Coleoptera at least, this estimate is too high by one-third, but even with that deduction the number would exceed that of plants, and it is probable that the number of as yet undiscovered species in proportion to that of the described ones is far greater in the case of insects than of plants. We can therefore no longer hope for a Genera and Species of insects, the work of a single hand, or indeed guided by a single mind. The great division of labour, however, now prevalent among entomologists may procure it for us in detail, with one drawback only, that the smaller the portion of the great natural class of Arthropoda to which the entomologist confines his attention, the less he will be able to appreciate the significance of distinctive characters, and the more prone he will be to multiply small genera—that is to enhance beyond their due value the races of the lowest grades—to the great inconvenience of the general naturalist who has to make use of the results of his labour.

A Genera Plantarum is still within the capabilities of a single botanist, although he must, of course, trust much to the observations of others, and it therefore cannot be so satisfactory as if he had examined every species himself. The last complete one was Endlicher's, the result of several years' assiduous labour, but now thirty years old. Dr. Hooker and myself commenced a new one, of which the first part was published in 1862, and which might have been brought nearly to a close by this time had we not both of us had so many other works on hand to deter us, although the researches necessary for these other works have proved of great assistance to the Genera. As it is, the part now nearly ready for press carries the work down to the end of Compositæ, or about half through the Phænogamous plants. In regard to works of a still more general description, the exposition of the families or orders of plants, we have nothing of importance since Lindley's "Vegetable Kingdom," dated 1845, but republished with some additions and corrections in 1853, and Le Maout and Decaisne's "Traité Générale," mentioned in my address of 1868, and of which Mrs. Hooker is now preparing an English translation, under the supervision of Dr. Hooker. Dr. Baillon has also commenced a "Histoire des Plantes," containing a considerable number of useful original observations, and illustrated by excellent woodcuts, but as a general work, one portion is of too popular a character, and in some cases too diffuse to be of much use to science, and the generic character too technical for a popular work without any contrasted synopsis, and its great bulk in proportion to the information conveyed will always be a drawback. I cannot believe that the author can have been a party to the unblushing announcement of the French publisher, that it is to be completed in about eight volumes. If carried out on the plan of the first one, it must extend to four or five times that number. In Zoology, Bronn's most valuable "Klassen und Ordnungen der Thierreichs," continued after his death by Keferstein and others, which I mentioned in my address of 1866, has advanced but slowly. The Amorphozoa, Actinozoa, and Malacozoa, forming the first two volumes, were then completed, and Gerstaecker has since been proceeding with the Arthropoda, commencing with the Crustacea for the third volume, of which only the general matter and the Cirripedia and Copepoda are as yet published, and three or four parts of a sixth volume for birds have been issued by Selenka, treating the anatomical and other matters in great detail. Another general work of merit, although on a smaller scale, has been proceeding as slowly. Of Carus and Gerstaecker's "Handbuch der Zoologie," the second volume, containing the Arthropoda, Malacozoa, and lower animals, had been already published in 1861, and to this was added in 1868 the first half of the Vertebrata for the first volume, with a promise that the remainder should appear in the autumn, but which promise has not yet been fulfilled. Among the other recently published systematic zoological handbooks of which I have memoranda as published in various Continental states, the most important are said to be Harting's, published at Kiel, in the Netherlands, of which up to 1870 only three volumes had appeared, containing the Crustacea, Vermes, Malacozoa, and lower animals; A. E. Holmgren's "Swedish Handbook;" Zoology, of which Mammalia were published in 1865, and Birds in 1868 to 1871; and Claus's "Grundzüge," and Troschel's "Handbook" (7th edition) for University Teaching in Germany.

In a comparative sketch of the more partial monographs, faunas, and floras, I had wished to direct my attention more especially to the means afforded us of comparing the plants and animals of different countries; and with this view one of the questions I addressed to foreign zoologists was—"What works or papers are there in which the animals (of any of the principal classes) of your country are compared with those of other countries?" The answers to this query have not been generally satisfactory. Where the zoology has been well investigated, we have popular handbooks, elaborate memoirs, and works of high scientific value, or splendidly illustrated. But short synoptical faunas, so useful to the general naturalist and corresponding to the floras we now possess of so many different countries, are very few; the statement of the general geographical range of each species, so prominent a feature in many modern floras, is still less thought of, and indications of allied or representative races in distant countries are equally rare. We have indeed several excellent essays on the geographical distribution of animals; I had occasion to allude to several of them in my address of 1869, but they are in general chiefly devoted to discussion, with statements of such facts only as bear upon the author's conclusions, not records of facts which may be useful to the geographical or general biologist. These must be collected from a great variety of separate works and papers, of which I have received long lists from Denmark, Sweden, Germany, Switzerland, Italy, France, and the United

character; but to prevent any confusion with *the* imaginary type, it would surely be better to call it an "example," as, indeed, is often done. In geographical biology the word "type" is used again in another sense, which, however, does not lead to any misunderstanding.

States. As yet I only have had time to refer to a few which appeared to bear more immediately on the objects I had in view, but I hope on some future occasion to return to the subject. In the meantime I must content myself with glancing rapidly over the different countries, taking them in the order adopted in my former addreses, and endeavouring to show the progress making in supplying our deficiencies. Towards these deficiencies I would particularly call the attention of entomologists and terrestrial malacologists, for insects and land shells are of all others the animals whose life and local stations are the most closely dependent on vegetation. In the following notes I am further precluded from entering into details as to the zoological works or memoirs mentioned, by the consideration that they would be superseded by the analysis given in the annual reviews inserted in *Wiegmann's Archiv*, and more especially in our own admirably conducted *Zoological Record*, which so strongly claims the support of everyone interested in the promotion of Zoological Science.

(*To be continued.*)

ZOOLOGY

Note on Transversely Striated Muscular Fibre among the Gasteropoda.*

IN studying the radula of a species of *Acmæa* (probably *A. Borneensis* Rye), obtained by Prof. A. S. Bickmore at Amboyna, I noticed, on placing the structure under a power of 100 diameters, that certain of the muscular fibres which adhered to it, when torn from the buccal mass, had a different appearance from the others. On increasing the power to some 800 diameters, it was at once evident that the different aspect of these fasciculi was caused by fine, but clearly defined, transverse striation. Suspecting that it was an optical delusion, caused by a very regular arrangement of the nuclei of the fibres, I subjected the muscle to various tests and to still higher magnifying powers. I also introduced under the same glass some of the voluntary dorsal muscles of a small crustacean for comparison. The structure of the ultimate fibres in both appeared to be similar. These seemed to be composed of a homogeneous tube or cylindrical band of translucent matter, with nuclei interspersed at irregular intervals. In neither was there any appearance of separation into transverse discs, as is seen in the striated muscles of vertebrates. That the striated appearance was not due to contraction and folding of the muscle, was evident upon taking a side view of one of the fibres, when the striæ on each side, as well as the intervening elevations, were seen to correspond exactly to each other. The only perceptible differences between the muscles of the crustacean and the striated muscles of the mollusk, appeared to be that the latter were much more finely striate; the striæ being six to eight times as numerous as in the former in the same space. No difference between the striated and nonstriated muscles of the *Acmæa* could be observed, except in the fact of the striation. In both the nuclei were irregularly distributed. The appearance of the striated fibre reminded one of a string of rhombic beads, which bore no relation to the position of the true nuclei. The striated fibres appeared, after a careful dissection of the parts in a number of specimens, to be the retractors of the radula; they were longer and in narrower bands than the nonstriated fibres, and comparatively much fewer in number. The striation was most evident toward the middle of the fibres, and became evanescent toward their extremities.

Lebert and Robin (Müller's Arch. f. Anat. and Phys., 1846, p. 126) state that the primitive muscular fasciculi of invertebrates often have the nuclei and intervening clear spaces "arranged in such regular order that they might, at the first glance, be mistaken for transversely striated muscular fibres. The latter, however, are actually found in one acephalous mollusk, *Pecten* (and probably in *Lima* also), and some annelids," and are constantly present in the voluntary muscles of *Crustacea* and *Insecta*. In the further researches of M. Lebert (Annales Sci. Nat., t. xiii. 1850, p. 161), he observes that there is nothing extraordinary in the discovery of transversely striated muscular fibre in *Polyzoa* (*Eschara*) by Milne-Edwards, and in *Actinia* by Erdl, since "the further we have pursued the study of the comparative histology of muscular fibre, the more convinced we have become that transversely striated muscular fibre is to be found in a large number of animals of very inferior organisation, without regard to their more or less advanced position in the animal kingdom."

Striated muscular fibre has lately been shown to exist in the "tail" or appendix of *Appendicularia* by Moss (Trans. Lin. Soc., vol. xxvii. p. 300). It was already known to exist in *Salpa*, (Eschricht, ov. Salperne), in the articulated brachiopoda (Hancock, Tr. Roy. Soc., 1857, p. 805), and in *Pecten* (Lebert, Annales Sci. Nat. 1850, 3rd ser. t. xiii. p. 166; and Wagner, Lehrb. d. vergleich. Anat., t. ii. p. 470, 1847), as well as in *Eschara* (Milne-Edwards, Annales Sci. Nat., series ii. t. iv. p. 3). I believe, however, that this is the first instance in which it has been shown to exist in the class *Gasteropoda;* and this, as well as the rarity of such cases among the lower invertebrates, is a sufficient apology for bringing forward such an isolated fact. Other duties have not yet permitted me to determine whether this phenomenon is constant throughout the genus, or whether it does or does not occur among allied genera. W. H. DALL

* Communicated by the author, from the "American Journal of Science and Arts," vol. i., Feb. 1871.

SCIENTIFIC SERIALS

IN the first paper in the *American Naturalist* for May, Prof. C. F. Hartt opens out quite a new field for investigation in the rock-inscriptions of Brazil, and illustrates it with nine plates of very great interest. The inscriptions occur on the rocks in various districts, and are many of them very rude, representing human and other figures, the sun, moon, and stars, and others very difficult to decipher. Prof. Hartt mentions as a curious circumstance that the hands and feet are always represented by radiating lines, usually only three digits being drawn for each hand and foot; the number rarely reaches four, and never five. This, he thinks may be explained by the fact that many tribes of Brazil are unable to count beyond three or four. The antiquity of these rock paintings and sculptures is undoubted, being mentioned by many ancient writers, as well as by Humboldt and others in more recent times. There can be no doubt that they ante-date the civilisation of the Amazons, and there is a strong probability that some of them, at least, were drawn before the European discovery of America. A short paper, by Dr. F. R. Hoy, on Dr. Koch's *Missourium tetracaulodon*, made by Prof. Owen into a Mastodon, points out several particulars in which Dr. Koch's account of the discovery of the fossil is not to be relied on, especially the inference of the great antiquity of man deduced from it. Mr. J. H. Emerton gives an account of the so-called "Flying Spiders," which are merely blown about by the wind. Among the "Miscellany" is an interesting note by Mr. A. Garrett, on the Distribution of Animals in the South Seas, especially in the Viti Islands. The number is altogether one of unusual interest.

Archiv für Anthropologie, 1870, Heft 3. An essay on "Theories of Sexual Generation," by Prof. His, of Basel, is rather historical than speculative, tracing the two principal lines of opinion represented in early science by Hippocrates and Aristotle, as to the respective functions of the two parents, and the mode of transmission of their bodily characteristics to the offspring. Among modern writers Prof. His dwells especially on Harvey's views. A paper by Dr. Welcker, "On the compressed feet of Chinese ladies," contains careful drawings, showing the shoe, the foot, and the abnormal position of the bones. As complete an account is given as the subject needs from an anatomical point of view. Dr. Jensen, occupied in studying the proportions of the brain in the insane, arranges for this purpose, a "stereoscopic-geometrical drawing apparatus," by the aid of which to produce geometrical drawings on which measurements can be made. Dr. Schaaf hausen's dissertation on "Cannibalism and Human Sacrifice," is a valuable, though somewhat undigested contribution to the subject. Among the motives assigned for cannibalism, the principal are hunger, revenge, superstition, such as induces savages to devour a brave warrior to obtain his courage, and lastly, the gluttonous longing for a kind of flesh which is described as appetising. Human sacrifice may sometimes be a relic of early cannibalism, an offering to deities who devour human flesh, or it may be an act of propitiation. There is evidence of the ancient or modern existence of cannibalism in most countries of the world, Great Britain being distinctly included. Even in modern times it occasionally breaks out in the civilised world, but on the whole its frequency among savages, and its general disappearance under improved social conditions, enable the writer, who argues in favour of a steady progression in the civilisation, to put it fairly into his argument.