THE

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A

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Reviews.

I.—St. Hilaire on the Systematic Position of Man.

Histoire Naturelle Générale des Règnes Organiques, par M. Isidore Geoffroy St. Hilaire. Tome II. 1e partie. 1856.

The author of this elaborate work, whose comparatively early death has so recently been deplored by the scientific world, devotes a long and carefully written chapter to the consideration of the place and dignity of man in the universe—and more especially to the discussion of the proposition, that mankind should be regarded as a distinct kingdom of nature, the "Règne humain," equal in rank to the mineral, the vegetable, or the animal kingdom—a proposal which, singularly enough, appears to have originated with the great scoffer, Voltaire.

One might be disposed to distrust the sincerity of a vindication of the dignity of man from the author of "La Pucelle"—but no such suspicion can attach to the similar conclusion of a pains-taking zoologist, and as the chapter which M. St. Hilaire wrote upon this subject appeared in 1856—in the pre-Darwinian epoch in short—it may be instructive to consider both the data and the deductions of an author whose studies had been especially directed to the apes, and who published his conclusions before the din of recent battles arose. We therefore propose to give a brief summary of M. St. Hilaire's views, interpolating here and there, perhaps, a commentary of our own, but, for the most part, leaving the distinguished French Zoologist to speak for himself.

After enumerating the opinions of the various authors who up to 1855 had ventured to assign to man his place in the Systema Naturæ, M. St. Hilaire says:—

"We have seen successive naturalists regarding Man as one of the kingdoms of nature; as one of the principal divisions or sub-kingdoms (Embranchemens) of the animal kingdom; as one of its classes; as an order of the class Mammalia; as a sub-order; a family; a subfamily; a mere genus of Primates; nay, if we go back to Linnæus, as a species of a genus in which man does not stand alone! The same group therefore has received all imaginable positions in our system of classification—a world apart, according to some; a unit among the myriads of animals, according to others! The measure of human contradictions is full and no room is left for another."

Our author is here, however, more epigrammatic than accurate; for the "tableau des contradictions" was not really completed until an accomplished osteologist—proposing, in 1857, the system whose basis has been discussed and refuted in earlier numbers of this Review—seized upon the one vacant niche and proposed to make of "*Homo*" a sub-class.

But M. St. Hilaire's remarks upon the establishment of the order Bimana by Blumenbach, and its adoption by Cuvier, apply with redoubled force to this last of all possible innovations:—

"And how could this division stand, repudiated as it was by the anthropologists in the name of the moral and intellectual supremacy of man? and by the zoologists, on the ground of its incompatibility with natural affinities and with the true principles of classification? Separated as a group of ordinal value, placed at the same distance from the ape as the latter from the carnivore, man is at once too near and too distant from the higher mammalia—too near if we take into account those elevated faculties, which, raising man above all other organised beings, accord to him not only the first, but a separate, place, in the creation—too far, if we merely consider the organic affinities which unite him with the quadrumana; with the apes especially, which, in a purely physical point of view, approach man more nearly than they do the Lemurs, and *à fortiori* than they do the lowest Quadrumana.

"What then is this order of Bimana of Blumenbach and Cuvier? An impracticable compromise between two opposite and irreconcilable systems, between two orders of ideas which are clearly expressed in the language of Natural History by these two words: the human *kingdom* and the human *family*. It is one of those would-be *via media* propositions which, once seen through, satisfy no one, precisely because they are intended to please everybody; half truths, perhaps, but also half falsehoods; for what, in science, is a half truth but an error?

"Let us leave aside then, this order of Bimana—which in spite of the authority of two great masters—has in its turn become obsolete; so that, reposing on the ruins of all the rest there remain but two opposed conclusions, one purely zoological, the other anthropological and philosophical: the *human family*, that is to say man considered in respect of the facts of his organization and the phenomena of his life; the physical man, first term in the animal progression but almost in contact with the second: the *human kingdom*, that is to say, man considered in respect of his double nature; man as a whole, crown but not integral part of the animal world, above which he is elevated by his intelligence, as the latter is raised by its sensibility above the vegetable world."

Having thus clearly defined his position, M. St. Hilaire proceeds to support it, in the first place, by discussing the distinctive characters of "l'homme physique," and proving that they are such as to justify the separation of man as a distinct family only of the Primates; and, in the second place, by enumerating the characters of "l'homme tout entier," and endeavouring to deduce from them the necessity of the establishment of a "Regnum humanum."

The first argumentation occupies some sixty pages, and is so complete and satisfactory as to be worthy of detailed analysis.

Commencing with the well-known aphoristic summation of the characters of man—*situs erectus, manus duæ, pedes bini*, M. St. Hilaire proceeds to inquire whether these characters are truly distinctive of Man—being found in him only among animals.

With regard to the erect position, the reply is, that though some other animals, like the Penguins, have a true and habitual *situs erectus*, they differ widely in their organisation from man, while the creatures which approach him most nearly, never constantly and habitually maintain themselves in the erect posture: the natural attitude of the anthropoid ape being neither the vertical position of man, nor the horizontal posture of the lower quadrupeds, but an intermediate or oblique, attitude. The *situs erectus* then, and its correlative character, the natural 'heavenward,' or rather 'horizon-ward,' glance, stand good as distinctive peculiarities of man; the oblique pose of the anthropoid ape furnishing the half-way step from man to the quadruped.

The other two characters *manus duæ, pedes bini*, do not stand criticism so well. Before we can accept the diagnosis, that man has two hands and two feet, while apes have four hands, we must ask to have the difference between hands and feet clearly defined, and, as M. St. Hilaire remarks, this is by no means so easy a matter as it seems.

Cuvier defines the essence of a hand to be "la faculté d'opposer le pouce aux autres doigts pour saisir les plus petites choses;" but if we accept this definition, then, as M. St. Hilaire and Mr. Ogilby long ago showed, one-half of the so-called Quadrumana are Bimana—for none of the American apes have anterior members with opposable thumbs, and the Marmosets have the digit which represents the thumb in the fore limbs, as like the others, as it is in a cat; while *Galeopithecus* has no opposable digit either on the anterior, or on the posterior, limbs.

M. St. Hilaire perceiving the difficulty in the way of the Cuverian definition, and giving up the opposable thumb, proposes the following new one (p. 199), "La main est une extrémité pourvue de doigts allongés, profondément divisés, trés mobiles, trés flexibles, et par suite susceptibles de saisir, au moins par l'opposition des doigts à la paume," and premising this conception of a hand, maintains, that all the apes are quadrumanous. But it appears to us that this definition is as little capable of withstanding criticism as that which it is meant to supplant.

When uncramped by the use of shoes, the toes of a man's foot are separated from one another for a distance, equal to fully one-fifth of the total length of the foot, and they are, as M. St. Hilaire admits, and as everybody who has lived on board ship, or has seen savages, is aware, very moveable, very flexible, and capable of prehension by opposition, not only of the toes to the sole, but of the great toe to the second. In proof of the latter qualities of the human foot, our author cites the boatmen of Ka-ching in China; the weavers of Senegal; the Brazilian horsemen, who put their feet to the same uses as those for which we employ hands; the Carajas who contrive to steal and hide away even fish-hooks, with their feet, from their unsuspecting visitors; and he might have added, the treacherous Australian savages, who commonly pretend to approach unarmed, but all the while drag their spears through the grass with their toes.

Leaving aside the famous Miss Biffin, and the painter Ducornet, who may, or might, be seen in Paris, executing historical pictures on the great scale with his feet, there is ample evidence, that, of the elements of the definition of a hand given by M. St. Hilaire, only the elongation and deep division of the digits can be retained, even for Man. In Man in fact, while the longest interdigital cleft of the hand is rather less than half as long as the whole hand, the longest interdigital cleft of the foot is, as we have said, but little more than a fifth as long as the whole foot. Here, therefore, the distinction is clear. But in the Marmoset (*Hapale*) the longest interdigital cleft between the toes of the terminal division of the hind member is not more than 2-7ths as long as the whole division. So that if the whole length of the terminal division of a limb be taken as 35, the length of the longest interdigital space of the human hand may be taken as about 16, that of the human foot as about 7, and that of the hind limb of *Hapale* as 10. So that, judged even by this test, the latter is much more of a foot than a hand.

M. St. Hilaire's definition then seems as complete a failure as all the other attempts which have been made to justify the application of the title "four-handed" to the apes—a failure which becomes still more conspicuous, if, leaving the external features of the hand and foot, we turn to their anatomical structure; by which it may be readily demonstrated, that the arrangement of the bones and muscles of the terminal segment of the hind limb of every ape whatsoever is, in all essential respects, similar to that which obtains in the foot of man and other mammals, and is totally different from that found in the hand of man and in the terminal segment of the fore limb of other mammals.* In fact, there is no four-handed mammal in existence: no mammal, that is, the terminal segments of whose hind limbs are not far more like the foot of man than they are like his hand. The terminal segments of the fore and hind limbs of mammals have their several and distinct plans of construction, and in no case does a hind terminal segment take on the plan of a fore segment or the reverse. Either may become prehensile, but a prehensile foot, such as the apes and opossums possess, is a totally different thing from a hand.

* Professor Andreas Wagner, the highest living authority on the Mammalia, says, very judiciously, (Schrebers Säugethiere Suppt. Band, Erste Abtheilung, 1840, p. 13.) "Wenn Mann demnach der vordern Extremitat des Affen mit Recht eine Hand zuschreibt, zo kann man der hintern nur uneigentlich eine solche beilegen, da ihr wesentliche Stücke zur Berichtigung auf diesen Namen abgehen."

'*Manus duæ, pedes bini,*' therefore, is no distinctive character of man; but, nevertheless, we may quite agree with all but the two last paragraphs of the following statement by M. St. Hilaire, if for 'hands' we read "prehensile terminal limb segments":—

"Whence it follows that the existence of posterior 'hands,' when there is only one pair, or of more perfect 'hands' on the posterior limbs when there are two pair, is a character common to a great number of Mammals, of very different families. A single being presents us with the inverse arrangement; and the creature which is distinguished by forming so rare and remarkable an exception, the creature which in this respect stands alone, is Man.

"And by this circumstance the views of those authors who have attributed to the human group the value of a family, and not merely of a genus, are justified still more definitely than by the character derived from the vertical attitude. In almost every other respect, man is far nearer the apes than the apes are to the lemurs, and than these are to the lowest Quadrumana. We shall even see that, under many aspects, he becomes confounded, organically, with the first mentioned. By the very characteristic conformation of his extremities, he is, on the other hand, far more distant from the apes than the latter are, not only from the lemurs and lowest Primates, but even from a great number of Marsupials.

"So that here we find, on the one hand, man by himself—on the other, and separated from him by a vast interval, all the animals with hands."—(P. 208.)

In the last paragraphs here cited, M. St. Hilaire appears to us to have very greatly exaggerated the value of the deviation of the foot of man from that of the apes; for the differences between the foot of man and that of the chimpanzee, or that of the gorilla, are assuredly less than those between the foot of any Simian or Prosimian and that of *Galeopithecus;* and the term "vast interval" is hardly applicable to a separation which, as M. St. Hilaire expressly states, is only sufficient to justify the separation of Man as a distinct family.

M. St. Hilaire next considers the characters of the teeth of man, adverting to the well-known fact that the principal difference from the dentition of the apes lies in the shortness of the canines, and the consequent absence of that diastema, or interval between the incisors and canine in the upper jaw, and the premolars and canine in the lower jaw, which is present in the apes; and repeating the statement of Cuvier, that a similar equality and serial continuity of the teeth are only to be met with in the *Anoplotherium.* However, an approximation to these characters is found also in some of the Insectivora, animals far more closely allied to the Primates than is the fossil ungulate.

The singular peculiarities of the distribution of the hair on the human body—a distribution which is unique in the animal kingdom—are next discussed; and it is shown that, in this respect even, the higher apes are more similar to man than to the lower apes. The argument which follows (sect. xi. p. 218) bears so definitely upon a question which has been largely discussed in the pages of this Review, that we must give it in full:—

"The characters derived from the equality and the contiguity of the teeth and the partial nudity of the skin are far from being as important as those which preceded them, but they are very marked: they place man, in two additional respects, in very clear opposition with the animals whose organization most closely approaches his. For this reason they may very usefully be added to the definition of the *human family*.

"On the contrary, the other distinctive characters of man mentioned or indicated by authors are no longer distinctive and *absolute*, but are merely *relative*; are differences of *degree* and not of *kind*.

"It is no longer a question of anatomical or physical features, possessed by man and not by the apes, or by the apes and not by man, but of features common to man and to a part of, or even to all, apes; merely more or less marked in him than in them. So that these features would tend, if they existed alone, to make of Man, considered in a classificatory aspect, not a *family* apart from all animals, but the first *genus* of the family of apes. By the most of them he would be to the Chimpanzees and to the Orangs, what these are to the *Cercopitheci* and *Macaci*, and these to the lower apes; an additional term at the head of a common series.

"The facts of this second order, important as many of them may be in a physiological point of view, are far less so than the foregoing in their taxonomic aspect, and we may be permitted to pass more rapidly over them; indeed to restrict ourselves to the enumeration of those which authors have considered as particularly characteristic."

Those of our readers who have followed the controversy respecting the brain of Apes and Man, if that can be dignified by the name of controversy where all the facts are on one side and mere empty assertion on the other, will be amused on discovering the nature of the first of these "secondary facts" which M. St. Hilaire treats so cavalierly.

"The first, the most important of all, so important that one would be inclined, at first sight, to consider them as *the* characteristics *par excellence* of man, are those presented by the encephalon, particularly the cerebral hemispheres. If there is an abyss between the intelligence of man and that of the brute, ought not a large interval to exist between his cerebral characters and those of animals? Such a conclusion would certainly follow very logically from the doctrines held by many physiologists, regarding the functions of the brain, and particularly of the convolutions, but it is a conclusion, most distinctly refuted by the comparative examination of man and animals. Here, indeed, the facts of our cerebral structure exhibit, not a specially and exclusively human structure, but a higher degree of an organization which is found in the apes; merely relative, instead of absolute differences.

"The great development of the anterior cerebral lobes and of the corpus callosum, the multitude of the convolutions and sulci, the depth of the latter and consequently the considerable extent of the surface of the cerebrum, are, according to authors, the five principal characters by which the human brain is particularly distinguished. These are, in fact, so many indubitable marks of the superiority of man over animals; those species which, in the totality of their organization, resemble him most, are inferior to him in these respects. But are they *very* inferior? Assuredly I shall not go so far as to say, with Bory de St. Vincent, that between the brain of the Orang and that of Man there exist "no more essential differences than those which obtain between the same parts in different individuals of our own species;" a conclusion which this naturalist, too ready to interpret facts according to his own views, professes to draw from the beautiful researches of Tiedemann on the encephalon of the Orang, as compared with that of Man. But that which is certain, which results not merely from Tiedemann's observations, but from those of M. Serres and of all the masters of science; from all those also which have been made of late, and to which I have had the advantage of being able to add my own upon many points; is this proposition, which no one will confound with the assertion of Bory St. Vincent: by so much as, in the development of the anterior cerebral lobes, of the corpus callosum, of the convolutions and the extent of his cerebral surface, Man surpasses even the highest apes; by so much are these, and chiefly the Orang, superior in the same respects to the first apes of the second tribe (Cynopitheciens) which, in their turn, are similarly superior to the rest. There is an almost continuous series of modifications, of degradations, which are the more diverse, as they are far from always affecting to a similar degree the development of the anterior lobe, and that of the corpus callosum, or the condition of the convolutions. It may and does happen, that these remain very numerous in a cerebrum with its anterior lobes and corpus callosum more or less reduced; or, on the other hand, they may be more or less obsolete in a brain which is still remarkable for its general development, for the extent of its corpus callosum, and the volume of its anterior lobes. This last combination is that presented by many apes of the third tribe (Cebiens), especially, and more than by any other genus of the same group, by the Saimiris, which are so remarkable for the richness of their cerebral development. The same combination is found, but carried to a still greater excess, in all the apes of the fourth tribe (Hapaliens). In the Marmosets the brain is, at the same time, greatly developed as a whole (less however than in the Saimiris) and is devoid of convolutions; it is one of the richest brains in one direction, one of the poorest in the other.

"These facts have not yet been reduced to a law, either for the whole brain, or for the corpus callosum, or for the anterior lobes; but their connexion is easily apprehended, so far as the convolutions are concerned. If for the too complex comparison of generic differences, we substitute that of the general differences between one tribe and another, the following is the immediate result:—In Man, the convolutions are very numerous and are separated by deep sulci; in the first tribe (Simiens) they are less numerous than in Man, more numerous than in the second; in the second tribe (Cynopitheciens) they are more numerous than in the third (Cebiens); in which the cerebral gyri become more and more scanty, from the *Ateles* and the *Cebi* to the Saimiris and the Callitriches; exhibiting a gradual progress towards the fourth tribe (Hapaliens) which is distinctly characterized by the smoothness of the brain.

"There is, then, a decrease in the convolutions in a serial order, from Man to the first, second, third, and fourth tribes; which in this point of view constitute five terms of one and the same very regular series, from the maximum of the development of the convolutions observed in Man, to their complete disappearance in the Marmosets—and this series ends at the exact point, where the family of the Lemuridæ succeeds to that of the Apes; a distinct series in which we see (in a brain in other respects very differently constructed), the convolutions re-appear at the upper end of the scale, in the Indri and the Lemurs, to disappear anew, at the lower end, in *Microcebus*.

"Whence flows this consequence, that may and will be better defined, but will not be rendered more certain by future investigations: In any classification based on the constitution of the brain and particularly on the condition of the convolutions, two general divisions must be established among the Primates, one for man and all the apes, the other for the Lemuridæ; and in the former two sub-divisions: man and the apes with convolutions; then the apes with smooth brains.

"In other words, man is, in this respect, much nearer the higher Apes, than these are, not merely to the Lemurs, but even to the lower types of their own family."

After this clear and, upon the whole, just statement of the cerebral relations of man to the apes, M. St. Hilaire takes up the question of the facial angle. This angle, measured by the method of Geoffroy and Cuvier, he affirms to become as small as 64° in a South African people, the Makoias; which is 6° less than the limit ordinarily assigned to it in the human species. But in the adult Saimiri the facial angle measured in the same way amounts, he affirms, to 65°, and is but a few degrees less in the Gibbons and the *Semnopitheci*, among the old world apes; in *Cebus*, *Ateles*, *Eriodes*, *Lagothrix*, *Callithrix* and *Nyctipithecus* among the apes of the new world. After which, says M. St. Hilaire:—

"It descends to about 50° in the *Cercopitheci* (a few degrees more or less according to the species) to 40° in the Chimpanzee, to less than 40° in the Gorilla, to about 35° in the Orang. So that this last ape, this 'man of the woods,' whose pretended facial angle of 63° or 64° (which it really possesses when young) led to its being regarded as the highest of the apes, (such as it really is in virtue of its cerebral characters), here occupies one of the lowest places. It is almost on the same level as the *Theropitheeus*, and has below it only the *Cynopitheeus* and the *Cynocephalus*; those *dogheaded apes*, as the ancients called them; a name justified by their facial angle of 30°, that of a true Carnivore and almost that of a Rodent. Whence it follows that, in this respect, there is a passage, by almost insensible gradations, from the most civilized and orthognathous European, not only to the most prognathous negro, but to those very apes, which have the most prominent muzzles. A continuous series of variations, where one is astounded to see Man come in contact with the brute, considering how great is the distance from the highest apes to the lowest, and how great the interval between ourselves and the other races of mankind. From *Saimiri* to *Cynocephalus* there is 35° difference, from the European to the Makoia 16° to 18°, and almost 21° if we select one of those beautiful Caucasian skulls of 85° measured by Camper and by Cuvier."

In the same manner M. St. Hilaire shows that, in the development of the forehead and that of the chin, in the position of the occipital foramen, and in the obliteration of the intermaxillary suture, the skull of man is connected with that of the apes, which differ most widely from him, by intermediate gradations, while, on the other hand, he fully details the important characters in which Man and the higher apes agree. Our space, however, allows us to follow our author no further in this argument, especially as it still remains our duty to explain why, when he has taken these pains to demonstrate that Man, regarded structurally, forms only a family of the Primates, M. St. Hilaire nevertheless conceives himself bound to regard Man as a kingdom, equal in distinctness to Plantæ or Animalia. And here we confess ourselves somewhat at a loss; for while the reasonings we have detailed above are full (occupying as we have said sixty pages) clear in thought, and precise in expression, the argument leading to the latter conclusion is of the briefest, taking up not more than six pages of writing, whose style is as diffuse as its intellectual texture is loose.

Looked at structurally, M. St. Hilaire repeats, in this section, Man can constitute merely a family of the Primates, of that order of mammals in which the apes and lemurs form the other families. But then, he adds, the kingdoms of nature are distinguished from one one another by their faculties and not by their structure.

"It is by its peculiar faculties, which cease only when animality ends, and only by them, that the animal differs essentially from the plant and rises so high above it as to constitute a distinct kingdom: similarly it is by his faculties, so incomparably higher, by the addition of *intellectual* and *moral faculties* to the *faculty of sensation* and the *faculty of motion*, that Man in his turn separates himself from the animal kingdom and constitutes above it, the supreme division of nature, the Human Kingdom." p. 260.

It seems almost incredible that a man of science should base such a conclusion upon such an argument as this, which must obviously be at once invalidated by the admission, that animals possess even a trace of intellect, or a rudiment of moral faculty. But the comparison of a moderately intelligent and affectionate dog with a human infant before it has acquired speech, must abundantly convince any unprejudiced person, that the same moral and intellectual faculties are working in both; that in whatever sense the child can be said to possess reason, or to be capable of right and wrong, his four-footed playmate has a claim to a humbler share of the same distinctions. However, on this point, the words of a writer, with whom we have not always the good fortune to find ourselves in such entire agreement, so amply express our convictions, and, if true, are so entirely subversive of the proposition to establish a "Règne humain," that we may fitly conclude this article with them:—

> "Not being able to appreciate, or conceive of, the distinction between the psychical phenomena of a Chimpanzee and of a Boschisman, or of an Aztec, with arrested brain growth, as being of a nature so essential as to preclude a comparison between them, *or as being other than a difference of degree*. I cannot shut my eyes to the significance of that all-pervading similitude of structure—every tooth, every bone strictly homologous—which makes the determination of the difference between *Homo* and *Pithecus* the anatomist's difficulty." *

II.—The Collections of the Novara Expedition.

Die Ausbeute der Oesterreichischen Naturforscher an Säugethieren und Reptilien während der Weltumsegelung Sr Majestät Fregatte Novara. Von Dr. L. J. Fitzinger.

This paper, which has been recently read by Dr. Fitzinger, before the Academy of Sciences at Vienna, and is printed in their "Sitzungsberichte," (Vol. XLII.) gives a resumé of the collections made by the two Zoologists (Messrs. Zelebor and v. Frauenfield) attached to the Novara expedition, in the classes of Mammals and Reptiles. The determination of the species in these sections of the Vertebrates, has been assigned to Dr. Fitzinger and Herr Zelebor; the investigation of the Fishes is stated to have been entrusted to Professor Kner; and Herr von Pelzeln, we believe, has been for some time past engaged in working out the series of Birds.

Of Mammals 440 individual specimens were collected during the expedition, belonging to 176 different species, of which a list, containing the names without descriptions and localities, is appended. Among these are 11 considered to be hitherto undescribed, namely, seven Bats, three Rodents and one Armadillo, Of these 11 species, no less than six† are from the Nicobar Islands—one of the most novel and interesting localities visited by the expedition. Our previous

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* Professor Owen "On the Characters, &c. of the class Mammalia," Journal of the Proceedings of the Linnean Society, vol. ii. No. 5, 1857, p. 20, Note.

† *Pteropus nicobaricus; Pachysoma giganteum; Pachysoma scherzeri; Vesperugo nicobaricus; Mus novaræ; Mus palmarum.*

information upon the Fauna of the Nicobars, is derived mainly from Mr. Blyth's papers, in the Journal of the Asiatic Society of Bengal,* and we cannot but congratulate the Austrians on their good luck in having found so many species that had escaped the notice of so diligent a pioneer.

In the class of Reptiles 1420 individuals were obtained, referable to 290 species. Of them, 25, namely, seven Saurians, eight Snakes, and 10 Batrachians, are believed to be new to science. In this class the most interesting discovery is perhaps that of a Frog in New Zealand, as it has hitherto been a matter of doubt‡ whether there were Batrachians in those islands. For, although Polack has stated that, "Toads and Frogs are not uncommon, especially near the mountain districts," Dr. Dieffenbach, to whom we are indebted for the above quotation, cautiously adds, "they have never been seen by me."§ At any rate, whether "common" or not, Dr. Ferdinand Hochstetter—the worthy and well-known Geologist of the Novara Expedition—was the first person who captured and brought to Europe specimens of the Frog of New Zealand, having obtained them from the mountain-torrents of Cape Colville, near Auckland. The little animal has been accordingly most appropriately named after its discoverer, *Leiopelma Hochstetteri*.‖ It is also a remarkable fact, that the nearest known ally of this new genus and species of Frog is the *Telmatobius peruvianus*, of Western S. America. This is an additional proof, if more were wanted, of a remote relationship between the Faunas of the southern extremities of the New World and the Old, of which other instances are well known. As we have already mentioned is the case also with the Mammals, no descriptions are given of the new species of Reptiles, contained in the appended list. It is no doubt intended to reserve these for the general account of the Zoology of the Voyage, but at the same time, we cannot but think it a grievous mistake, to publish a quantity of new names of species without characters attached. The offence is certainly a common one, but not the less objectionable on that account. But it is to be hoped, that the great work, containing the results of the expedition in full, towards the expense of which, we believe, the Austrian Government has made a liberal grant, will soon appear, and render further complaints on this score unnecessary.

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* Vol. XV. p. 367, "Notes on the Fauna of the Nicobar Islands."

‡ See Darwin "On the origin of species," p. 424.

§ Dieffenbach's New Zealand, Vol. II. p. 206.

‖ See Verhand. d. K. K. Zool. Bot. Gesellschaft; Wien, 1861.

Original Articles.

III.—On the Cedars of Lebanon, Taurus, Algeria, and India. By J. D. Hooker, M.D., F.R.S. (With Plates I. II. and III.)

In the Autumn of 1860, Captain Washington, Hydrographer of the Navy, asked me to accompany him to Syria, where he proposed, amongst many other important scientific agenda, that we should examine the Cedar Grove on Lebanon, of whose history, position and age, nothing was accurately known. It had occurred to him, that although our visit must be far too brief to investigate any part thoroughly, or even to review all the points worth noting, yet that an examination of the trees on the spot might suggest to us the kinds of observations best worth making by future travellers, and would enable him to judge whether an accurate topographical plan of the valley in which the trees grow, were desirable. He further offered to have this executed, if necessary, by the officers of H. M. S. "Firefly," then surveying the Syrian coast, under the command of Captain Mansell, an officer who unites to the highest professional attainments, a thorough appreciation of the interests of science.

We arrived at Beyrout on the 25th September, and, thanks to Captain Mansell's arrangements, we were equipped and off on the following day, accompanied by himself, on a fortnight's journey, taking the Cedars in our way to the summit of Lebanon* (whose height had never been ascertained). On the 29th we reached the Kedisha valley, and camped in the evening at its head, under the Cedars, at an elevation of 6,172 feet.† We remained two nights there, and from it we twice ascended the Lebanon, which gave us excellent opportunities of studying the relative position of the grove to the surrounding country, from various heights and positions on the flanks of the enclosing valley. Furthermore, two of our party, the Rev. G. Washington and Mr. Hanbury, devoted a day to counting and measuring the trees, and to making a rough ground plan of their positions, which has proved of great use. Captain Mansell also procured a capital section of the lower limb of one of the oldest trees (which lay dead on the ground), and which is very

* By our observations, calculated from an assumed height of the barometer of 30 inches at the level of the sea, it is about 10,200 feet; according to those quoted by Van de Velde, it has been supposed to be as low as 9621, and as high as 10,051.

† By four sets of morning and evening observations, with four barometers, and two boiling-point thermometers. Assuming the height of the barometer at the level of the Mediterranean to have been 30 inches, the height of the chapel in the grove is, by Captain Washington's barometer, 6,210 feet; by my own, 6,165; by two siphons, 6,176; and by boiling-points, 6,138. According to Van de Velde, it is 6,315. The elevation of the summit and of the Cedars will be re-calculated when the necessary data for the lower level have been received.

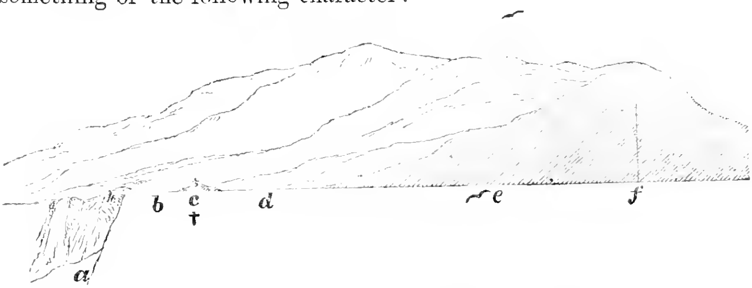
important, since it gives a totally different idea of the hardness of cedar-wood from what English-grown specimens do.

It is not my purpose to offer anything beyond an outline of the chief results we obtained; these will be given in detail elsewhere, when the materials necessary for substantiating them have arrived in England: they were certainly more novel and interesting than we had ventured to hope for, and determined Captain Washington to direct a detailed survey to be made of the whole head of the valley, or basin, in which the Cedars grow; this was executed by Captain Mansell last summer, and is now on its way to England, accompanied by sections of two of the youngest trees, which, as I shall have occasion hereafter to show, are much more interesting scientifically, than sections of the oldest would be. The history of the Cedars of Lebanon cannot, however, be isolated from that of their blood-relations, the Cedars of Taurus, Algeria and India, which I shall therefore also bring under notice in this sketch; regarding the Lebanon plant as the type of all, because it is in many respects intermediate botanically, as it is geographically, betweeen the others.

So far as is at present generally known, the Cedars are confined on Lebanon to one spot, at the head of the Kedisha valley; they have, however, been found by Ehrenberg* in valleys to the northward of this. The Kedisha valley, at 6000 feet elevation, terminates in broad, shallow, flat-floored basins, and is 2 to 3 miles across, and as much long; it is here in a straight line 15 miles from the sea, and about three or four from the summit of Lebanon, which is to the northward of it. These open basins have shelving sides, which rise 2 to 4000 feet above their bases; they exactly resemble what are called Corrys in many highland mountains; the floor of that in which the Cedars grow presents almost a dead level to the eye, crossed abruptly and transversely by a confused range of ancient moraines, which have been deposited by glaciers that, under very different conditions of climate, once filled the basin above them, and communicated with the perpetual snow with which the whole summit of Lebanon was, at that time, deeply covered. The moraines are perhaps 80 to 100 feet high; their boundaries are perfectly defined, and they divide the floor of the basin into an upper and lower flat area. The rills from the surrounding heights collect on the upper flat, and form one stream, which winds amongst the moraines on its way to the lower flat, whence it is precipitated into the gorge of the Kedisha. The Cedars grow on that portion of the moraine which immediately borders this stream, and nowhere else; they form one group, about 400 yards in diameter, with an out-

* When in Syria I was unable to obtain any information relative to the statement contained in Murray's Handbook of Syria (i. 585), that Cedars grew in other localities besides the Kedisha valley. Recently, however, I have inquired of my friend Professor Ehrenberg (the authority given for the statement), who informs me, in a letter full of interesting matter relating to the Cedars, that he found many trees in forests of Oak, &c., on the route from Bsherre to Bshinnate.

standing tree, or two, not far from the rest, and appear as a black speck in the great area of the corry and its moraines, which contain no other arboreous vegetation, nor any shrubs, but a few small berberry and rose bushes, that form no feature in the landscape. A section from east to west, along the axis of the basin, presents something of the following character:



a, Gorge of the Kedisha; *b*, lower flat; *c*, moraines with † cedars; *d*, upper flat; *f*, axis of the Lebanon, 3000 feet above the floor of the basin; *e*, summit of the Lebanon seen to the northward.

The number of trees is about 400, and they are disposed in nine groups, corresponding with as many hummocks of the range of moraines; they are of various sizes, from about 18 inches to upwards of 40 feet in girth; but the most remarkable and significant fact connected with their size, and consequently with the age of the grove, is that there is no tree of less than 18 inches girth, and that we found no young trees, bushes, nor even seedlings of a second year's growth. We had no means of estimating accurately the ages of the youngest or oldest tree; nor shall we have, till the specimens of the former arrive. It may be remarked, however, that the wood of the branch of the old tree, cut at the time, is eight inches in diameter (exclusive of bark), presents an extremely firm, compact, and close-grained texture, and has no less than 140 rings, which are so close in some parts that they cannot be counted without a lens. This specimen further, is both harder and browner than any English-grown Cedar or native Deodar, and is as odoriferous as the latter. These, however, are the characters of an old lower branch of a very old tree, and are no guide to the general character of the wood on the Lebanon, and still less to that of English-grown specimens, which are always very inferior in colour, odour, grain, and texture. Calculating only from the rings in this branch, the youngest trees in Lebanon would average 100 years old, the oldest 2500, both estimates no doubt widely far from the mark. Calculating from trunks of English rapidly-grown specimens, their ages might be calculated as low respectively as 5* and 200 years; while

* Three Cedar trees grown in Bedfordshire, at the age of 30 years attained the girths respectively of 6 feet; 6 feet 6 inches; and 5 feet 8 inches. Gard. Chron. 1853, p. 310.

from the rate of growth of the Chelsea Cedars, the youngest trees may be 22, and the oldest 6 to 800 years old.

The positions of the oldest trees (of the 400) afforded some interesting data, relative to the ages of the different parts of the grove, and the direction in which it had lately spread. There were only 15 trees above 15 feet in girth, and these all occurred in two of the nine clumps, which two contained 180 trees. Only two others exceeded 12 feet in girth, and these were found in immediately adjoining clumps, one on one side and one on the other of the above mentioned. There were five clumps containing 156 trees, none of which was above 12 feet in girth, and these were all to the westward, (or down-valley) side of the others. On this side, therefore, the latest addition to the grove has taken place.

Whether the grove has much diminished within the historic period, is a question which can only be decided by a careful collection and scrutiny of the records of old travellers. It would not surprise me, if proofs existed of its not having materially decreased since the days of Solomon; for it is very doubtful whether the wood was ever largely used in Jerusalem for building purposes. The word Cedar, as used in the Bible, applies to other trees, and only certainly to the *Cedrus Libani*, when coupled with some distinctive epithet. The foreign timber trade was, in Solomon's time, in the hands of the Phœnicians, and the quantity of first-rate oak and pine, on all the coast ranges from Carmel northwards, was so great, that it is improbable that the almost inaccessible valleys of the Lebanon should have been ransacked for a wood, that has no particular quality to recommend it for building purposes. The lower slopes of the Lebanon, also, bordering on the sea, were and are, covered with magnificent forests. So that there was little inducement to ascend 6000 feet, through 20 miles of a rocky mountain valley, to obtain a material, which could not be transported to the coast without the utmost difficulty and expense. It is further to be remarked, that it is difficult to reconcile the hypothesis of the former great extent of the Cedar forests, with the fact of almost the only existing habitat being the moraines of one of the most populous valleys on the mountain. Of mountain corrys, with the same elevation as that of the Cedars, there are hundreds on the Lebanon, some said to be almost inaccessible, and others quite uninhabited; had the Cedar ever formed continuous forests on the mountain, from which it had been removed by man, we should certainly expect to find extensive groves in such localities. I desire not to be misunderstood in this matter, for the question is of some scientific importance; I do not doubt that the *Cedrus Libani* is repeatedly alluded to in the Old Testament, by the Prophets especially, who aptly and unmistakeably designate that tree; but if, as I believe is allowed by the best Biblical critics and Hebraists, the word Cedar applies in Chronicles, &c., to more than one kind of tree, it is, in my opinion, an open question whether the *C. Libani* is one of those which supplied most of the timber employed in building Solomon's temple. The Cypress (also called Cedar by the ancients,) the *Pinus Halepensis*, and the tall fragrant *Juniperus* of the Lebanon, with its fine red heart-wood, would have been far more prized on every account.

On the other hand, that the grove has, within the historic period, increased and diminished in extent, owing to secular changes in the climate, cannot be doubted, when it is remembered, that no seedling has come to maturity (though thousands annually germinate), since the birth of trees the youngest of which is 18 inches in girth; and that the whole grove presents such a disparity in the ages of its trees, that only about 15 exceed as many feet in girth, and 385 fall below 12 feet girth. Upon this point I have collected some curious corroborative evidence, from the works of old travellers.

The nearest point to the Lebanon at which Cedars have been found, is the Bulgar-dagh chain of the Taurus in Asia Minor, and from that point forests extend eastward to Pisidia, in long. E. 32°, westward to long. E. 36°, and northward to the Anti-Taurus, in lat. 40° N.; growing at elevations of 4000 to 6400 feet above the sea. The Lebanon may be regarded as a branch of the Taurus, and is 250 miles distant from the Cedar forests upon that chain. Between individuals from the Lebanon, and the common Asia Minor form, there is said to be no appreciable difference, by those who have examined both: but there are two distinct forms or varieties in the latter country; one having shorter, more stiff and glaucous or silvery foliage than the other; this is the Silver-cedar, *C. argentea*, of our gardens. Northern Syria and Asia Minor form one botanical province; so that the Lebanon grove, though so widely disconnected from the Taurus forests, can be regarded in no other light than as an outlying member of the latter.

C. Atlantica. At a distance of 1400 miles from the Cedar forests of Asia Minor, and separated by the whole breadth of the Mediterranean sea, are those of Algeria. These form the prevalent arboreous vegetation throughout the eastern province of Constantine, which borders on Tunis, and they also abound on the eastern Atlas ranges; though whether they extend to the greater Atlas and into the kingdom of Morocco is not known. They characterize the upper mountain zone (5200—7200 feet), and approach within twenty miles of the sea. The African Cedar differs from that of Lebanon in having a perfectly erect, rigid leader, and straight stiff ends to the branches, all which, in the Lebanon plant, droop more or less. In the African, the cone is generally smaller, the leaves shorter and more glaucous, and the scales and seeds triangular in form (instead of quadrangular.) There are two forms of Cedar in Algeria, as in Taurus, and characterized by the same differences in each country, viz.: a greener longer-leaved, and a more silvery shorter-leaved variety. Nevertheless it is generally easy to distinguish the Atlas Cedar from the Lebanon one, and in beds of young plants the differences are very marked, though it is always possible to pick out deceptive specimens.

C. Deodara. Proceeding eastward from the Lebanon, we come, after another 1400 miles, to the Cedar forests of Affghanistan, which extend thence continuously eastward along the Himalaya, almost to the confines of Nepal. The *Cedrus Deodara* is in India exclusively a western tree; it begins where the influence of the monsoons is much diminished, that is, where the climate begins to approximate to that of the Levant. It inhabits various elevations between 4,000 and 12,000 feet, and in Affghanistan outnumbers all other Pines in abundance of individuals. The *C. Deodara* has a much more pendulous leader and ends to its branches, and longer leaves, of a more glaucous hue, than *C. Libani*, though not such silvery leaves as the *C. Atlantica*. The cones are as large as those of *C. Libani*, but the scales and seeds are of the same form as those of *C. Atlantica*, and hence markedly different from those of *C. Libani*.

From what has been said respecting each of these Cedars, it is evident, that the distinctions between them are so trifling, and so far within the proved limits of variation of Coniferous plants, that it may reasonably be assumed that all originally sprang from one. It should be added, that there are no other distinctions whatever between them—of bark, wood, leaves, male-cones, anthers, or the structure of these—nor in their mode of germination or duration, the girth they attain, or their hardiness.* Also, that all are very variable in habit; so much so, indeed, is this the case with the Deodar, which is the most distinct of all in habit, that though it was not introduced much more than thirty years ago, there are already five distinct varieties sold by nurserymen, some as stiff, others as dark-coloured, and others as short-leaved as the Lebanon Cedar. Also, that though the difference in the shape of the scales and seeds of *Deodara* and *Libani* are very marked, they vary much; many forms of each overlap; and further transitions between the most dissimilar, may be established by intercalation of seeds and scales from *C. Atlantica*.

To render these distinctions more clear, I have had drawings of the three Cedars made from native and cultivated specimens, selected by Professor Oliver and myself from the Herbarium and Museum at Kew, and which represent what we believe to be the most decided characters that they severally present; and that these are both faithful and characteristic portraits, Mr. Fitch's name is sufficient guarantee. They represent, in each case, the fully formed cone, and the same on the eve of bursting; the average and extreme forms of scales and seeds, the anthers, the foliage, and the extreme and mean lengths of the leaves.

Hitherto, *C. Atlantica* has been almost universally considered a

* The assumed distinctive characters between the Deodar and Lebanon Cedar that were founded on the form of the cones, the falling away of their scales, the shape of the leaf in section, the wood, its odour and durability, have all been satisfactorily disproved long ago.

variety of *Libani*, and *C. Deodara* a different species; habit having been relied upon exclusively, and botanical characters neglected; for a glance at the drawings shows that there is an obvious and marked difference, in the latter respect, between the common states of *Atlantica* and *Libani*, and none between *Atlantica* and *Deodara*. This is perplexing, for, as I have said above, *C. Libani* holds an intermediate position, both geographically and in characters of foliage, between the two that agree in the most important characters: and further, we can account, in a great measure, for the differences of habit, by the climate of the three localities; the most sparse, weeping, long-leaved Cedar is from the most humid region, the Himalaya; whilst the plant of most rigid and otherwise opposite habit, corresponds with the climate of the country under the influence of the great Sahara desert. No course remains, then, but to regard all as species, or all as varieties, or the *Deodara* and *Atlantica* as varieties of one species, and *Libani* as another. The hitherto adopted and only alternative, of regarding *Libani* and *Atlantica* as varieties, and *Deodara* as a species, must be given up.

I have dwelt thus at length upon the value of the characters separating the three Cedars, because the question, whether these are one species or three, stands at the threshold of all inquiry into the early history of the plant. My own impression is, that they should be regarded as three well-marked forms, which are usually very distinct, but which often graduate into one another, not as colours do by blending; but as members of a family do, by the presence in each of some characters common to most of the others, and which do not interfere with or obliterate all the individual features of their possessor. Moreover, I regard them as in so far permanently distinct plants, that though all sprang from one parent, none of them will ever assume all the characters either of that extinct parent or of the other two forms. There will, in short, be no absolute reversion amongst these. Each will yield varieties after its own kind, retaining some of the characters of their progenitors, and assuming others foreign to them all; and it will depend on their relative success in the struggle for life in a wild state, and upon the wants of man in a cultivated one, which of these shall be preserved, and for how long. Granting, then, that all are sprung from one, how does it happen that they are now so sundered geographically?

The discovery of the moraines of the Lebanon requires us to extend the influence of the glacial period into a lower western latitude than it has been heretofore proved to have reached. When perpetual snows covered the great axis of the Lebanon, and fed glaciers which rolled 4000 feet down its valleys, depositing the moraines to which the Cedars in the Kedisha valley are now confined, the climate of Syria must have been many degrees colder than now; the position of the Cedars fully 4000 feet lower, and the atmosphere greatly more humid. Arguing from analogy, it is reasonable to infer that, at such a time, the Cedars formed as broad a belt on the Lebanon, as they now do on the Himalaya and in Algeria, and were continuous with those of the Taurus; and that these also descended proportionally lower and spread much further to the eastward. Again, in the Sikkim and Nepal Himalaya, I have found abundant evidence of glaciers having descended to fully 4000 feet below their present level; and this has been corroborated by numerous observers in the western parts of the same range; so that there, too, the Cedar forests may be supposed to have once descended several thousand feet, and to have extended westwards along the Persian mountains, till they united with the Taurus forests.

It is more difficult at first sight to connect the Algerian with the Asiatic forests; but here the recent discoveries of extensive modern changes in the form and extent of the Mediterranean basin come in aid. It is not now doubted that the remains of the African *Hippopotamus* and *Rhinoceros* in Sicily prove a former continental extension from the Tunis coast to that island, and the soundings between Cape Bon and Sicily appear to corroborate this view. It would be folly to assume it as certain, that the extension of these most recent discoveries will clear up the early history of the diffusion of the Cedars; but it is conceivable; and if proved, it is reasonable to suppose that their subsequent segregation in the four areas they now inhabit, was effected by the warmth of the period which succeeded the glacial epoch. During such a warm period the vegetation of the low levels would be driven to seek colder localities, and to migrate both northward and up the mountains, where it has left traces in the grove on Lebanon, and in a few arctic plants which I obtained on the very isolated summit of that mountain. Lastly, it is an established fact, that all plants of wide diffusion vary much, and that the extreme forms occur towards the limits of the area they occupy; whence, in the case of the Cedars, what may once have been three prevalent varieties in different parts of a continuous forest, became, by isolation and extinction of intermediate forms in intermediate localities, three permanently distinct races or sub-species, which we now recognize as Lebanon, Algerian, and Deodar Cedars.

EXPLANATION OF THE PLATES.

PLATE 1.—Cones and leaves of *C. Libani*, from the Lebanon. Figs. 1–4, Scales of various forms from one cone, ripened at Kew; 5, Seeds from the same; 6—7, Anthers (magnified); 8, longest, shortest, and mean sizes of leaves, from native specimens.

PLATE 2.—Cones and leaves of *C. Atlantica*, from native specimens. Figs. 1—4, Scales; and 5, 5, Seeds from the same; 6, Anthers (magnified); 7, longest, shortest, and mean sizes of leaves, from native specimens; 8, Leaf, from young cultivated specimen at Kew.

PLATE 3.—Cones and leaves of *C. Deodara*, from native specimens. Figs. 1—3, Scales; 4—5, Seeds; 6, Anthers (magnified); 7, longest, shortest, and mean sizes of leaves.

IV.—On the Morphology of the Female Flower of the Abietineæ. (De Abietinearum Carr. floris feminei structura morphologica. 4to. pp. 12. Regiomonti Pr.) By Professor Robert Caspary.*

The structure of the female flower, or inflorescence, of Gymnosperms, has been the cause of more discussion than most questions of morphological botany. In earlier times, the views of botanists on this difficult subject were necessarily uncertain and arbitrary, because no accurate observations had then been made either of the perfect flower or of its evolution. As the study of morphology depends upon the correct knowledge of the *taxis* of the leaves and branches, the structure of the flowers of Gymnosperms could not possibly be understood at an earlier period. It is not my intention here to enter into details (which may be readily found elsewhere) regarding the various explanations which have been proposed; but I think it desirable to state the plain truth as respects the group of Abietineæ, so as to correct previous errors, and to obtain a basis of comparison to which the flowers of other Gymnosperms may be referred.

The true structure of the flowers of Abietineæ was described by A. Braun, as early as 1853, in the following terms, in a note of great importance, though short and modest,† which has been entirely neglected by subsequent writers. "The seed-bearing fruit-scales of the cones of Abietineæ, which lie in the axils of the bract-scales, have all the appearance of one-leaved shoots, but the progressive modifications of form exhibited by these scales in abnormally developed cones of *Pinus Larix*, prove that each scale consists of two leaves united together." In 1860‡ he expresses himself in a similar manner, only in more general terms, as to the structure of other Conifers and Cycads. The woody scales of the strobili of Abietineæ consist, according to A. Braun, of two carpels, which originate together, and are the first leaves of an undeveloped bud in the axil of the floral leaf.

Before these views of Braun were known to me I was led to the same conclusions, at Bonn, in the autumn of 1858, by the examination of larch cones, which had grown out into leafy branches in the axils of the scale. My observations on these were to the following effect:—

Along the axis of these cones or strobili are inserted linear, elongated bracts, with the woody scales in their axils. The axis does not end with the uppermost scales, but is abnormally prolonged for several inches beyond the apex of the cone. Such strobili have been figured by Richard.|| The slender prolongation of the axis differs in

* Communicated by Dr. T. Thomson, F.R.S. An abstract of Dr. Baillon's views, referred to in this paper, is given in the Nat. Hist. Review, Vol. I. Bibliography, p. 92.

† Individuum der Pflanze, p. 65.

‡ Ueber polyembryonie und Keimung von Cœlebogyne, p. 243.

|| Mémoires sur les Conifères et les Cycadées, 1826, t. 13, f. 9, fig. repetita in

no respect from a vigorous annual leaf-branch. It bears linear leaves, of the usual form, each of which has a leaf-bud in its axil. These leaf-buds are subglobose or ovate, and are covered by brown scales (nieder blätter). The two lowest of these scales, which are the most important as respects the true morphological structure of the cone-scale, stand right and left, as in most plants. These are the leaves commonly called the cotyledons of the branches. In these elongated cones there is generally no passage from the woody (seed-bearing) scales of the cone to the leaf-buds. Although I have examined more than 100 such scales, I have met with but few intermediate states explanatory of the true nature of the woody scales. In such intermediate states the cone is not, as usual, shortly ovate, but oblong, and attenuated at the tip, and the woody scales are a little emarginate at the apex. In the scales which appear to pass into the leaf-buds this emargination becomes by degrees more and more deep, till at last, near the summit of the cone, where they are more laxly imbricated, the woody scales are divided, almost to the base, into two obovate or ovate lobes, which are rounded at the apex, or a little mucronate, and are made inæquilateral, by an indentation on the outer side, below the apex. Each of these lobes bears on its inner and upper side, towards the lower margin, the ovate-globose rudiment of an abortive bud. Between the main axis and the bipartite scale I could see no bud. Further up on the axis the intermediate forms are further advanced. The scale is completely bipartite, and the segments are smaller, oblong, subtrapezoidal, obliquely truncate above, with rounded angles, and often wider upwards. As these scales present not even a trace of an ovule, they can no longer, with propriety, be called carpels; but it is most important to observe, that, between their segments and the axis, a leaf-bearing bud, covered with scale-like leaves, is developed. Still higher up on the axis the segments of the woody scale are smaller and more distant from one another, occupying, by degrees, a more and more lateral position with respect to the leafy bud developed between them and the axis, and approach gradually more and more in size, position, and shape to the two lateral scales of an ordinary leaf-bud, so as at last to pass completely into it.

It is thus clearly proved that the woody scale of the larch cone consists of the first two lateral scales (squamiform leaves) of an undeveloped leaf-bud placed in the axil of the bract which supports the woody scale, these two lateral scales springing in a united state from the outer side of the axis and ascending obliquely. This structure of the woody scale of the larch cone, and consequently of all Abietineæ, is so clearly and irrefutably shown by these monsters, that all other opinions on the morphology of the scales of Conifers are thereby demonstrated to be erroneous.

Seringe. Eléments de botanique, 1841, t. xiii. f. 12; et Decandolle, Organographie végétale, 1828, tab. 36, f. 3.

Among these errors may be mentioned the opinion of M. Baillon,* laid before the French Academy on the 9th July, 1860. Baillon, after examining the evolution of the flower of *Taxus baccata* L., *Phyllocladus rhomboidalis*, Rich., *Torreya nucifera*, Lieb., *Thuja*, *Pinus resinosa*, *Salisburia*, *Gingko*, Sm., and *Cupressus*, arrived at the opinion that the organs which R. Brown regarded as naked ovules are flowers reduced to a pistil, formed of two carpels, and enclosing one orthotropous ovule reduced to a nucleus; and that these very simple flowers are never inserted on a leaf or "bract" (or rather "carpel"), but always on the axis, on which they are sometimes terminal and sometimes lateral; and further, that the cupule or aril of Taxineæ is a dilatation of the axis, "commonly called a disk."

Now what are the reasons which lead M. Baillon to regard the naked ovule of Robert Brown, and almost all recent botanists, as two united carpels? He states that the first developed part of the flower (or what is usually called naked ovule) of all Conifers consists of two small tubercles, opposite to one another, and shaped like a horse-shoe, exactly resembling the carpels of Amarantaceæ, Chenopodiaceæ, &c., in the first stage of evolution. From this resemblance, he regards these tubercles not as the integuments of an ovule, but as carpels, and states that their apices afterwards form two equal or unequal styles. The nucleus of the ovule, according to him, appears after these carpels. This period of evolution is described in detail in *Pinus resinosa*, and illustrated by figures. As regards that part of M. Baillon's opinion which relates to the more tardy appearance of that which he calls the ovule, his figures do not show it to be the case; but, on the contrary, in *t.* 1, *f.* 10, in which the earliest rudiments of the "carpels" are shown, the ovule is also represented, so that M. Baillon's words† are contradicted by that figure. Baillon's statements regarding the evolution of the flower of Conifers are confirmed by M. Payer,‡ who seems to have examined *Pinus* and *Cupressus* chiefly. Payer, however, speaks in such a manner of the time of appearance of the "ovule" and "pistil" that it is doubtful which of the two he considers to appear first; but whatever his opinion may be, he, at all events, does not confirm M. Baillon, for he says "the flower appears in Cypresses and Pines as a little protuberance, on each side of which arises a little ridge resembling exactly . . . . . a very young leaf."

The priority of origin of the outer covering (carpels of Baillon), or the central body (ovule of Baillon), should by no means be neglected, as its determination may assist in fixing the nature of both. For if the central protuberance appear first and the external envelope later, the central protuberance is an ovule, because the nucleus appears before the integument; but, on the other hand, if

* Recueil d'observations botaniques, t. i. Paris, 1860.

† l. c. p. 7. "Ce qu'on voit apparaitre d'abord de la fleur femelle c'est une paire de petites feuilles carpellaires en forme de fer à cheval."

‡ In Baillon's paper, l. c. p. 17, et seq.

the exterior envelope appear first and the central swelling later, the body is a pistil, because the carpel always appears earlier than the ovule.

This mode of discovering the nature of the parts fails only in cases where a single ovule appears to be a direct continuation of the axis, as in *Rheum*, *Polygonum*, &c., because in these cases it is impossible to decide upon the instant of time at which the apex of the axis becomes changed into the nascent ovule or its nucleus. Baillon, indeed, mentions that the ovules of Conifers arise from the axis; but if the contrary view be established, the test of priority of origin may certainly be applied to the determination of the nature of the different parts of the organ under consideration.

Early in January, 1861, I examined, for the purpose of testing M. Baillon's statement, the female flowers of *Thuja orientalis* L., *Taxus baccata* L., *Cupressus sempervirens* L., *Callitris montana*, *Juniperus communis* L., *J. sphærica* Lindl., *J. Sabina* L., *J. virginiana* L., and *Pinus Larix* L. The climate of Regensburg not being hot enough to enable *Gingko biloba*, *Phyllocladus* or *Torreya* to flower, even in the greenhouse, I regret not to have had it in my power to examine more than a very few of the species on which M. Baillon's observations were made.

With the exception of the Larch, the flowers of all the plants which I examined were almost fully, or at least half, developed; but even in this state of advancement I was led to doubt the accuracy of M. Baillon's statement, that the outer covering (or integument of authors) consists of two carpels. For when two carpels are present, two separate apices (styles, Baillon calls them,) may be expected to be visible; and, in fact, all Baillon's figures of the adult organs in question show two lobes or apices, as in the figure of *Pinus resinosa*, *t.* i. *f.* 23, &c., *Thuja orientalis*, *t.* ii. *f.* 17, *Cupressus sempervirens*, *t.* ii. *f.* 20, 21, *Phylloeladus rhomboidalis*, *t.* ii. *f.* 24, *Taxus baccata*, *t.* ii. *f.* 14, 15. Except, however, in the Yew, in which I found the micropyle to present the appearance of an arched or more rarely straight fissure, the ends of which are opposite to the two highest leaf-scales (bracts), the margin of the organ in question (Baillon's pistillum) was not, in the plants I examined, by any means constantly two-lobed, and in the Junipers I never observed it to be so. The margin of the "pistillum" of *Juniperus sphærica*, which appeared fully developed, was invariably entire, and formed by a circle of ten or eleven cells. In the other species of Juniper it was generally obliquely truncate, and in the same species, nay even in the same specimen, it was at one time irregularly sinuate or repand or toothed, at another emarginate on one side or perfectly entire. In *Callitris montana* the orifice was very wide and surrounded by about twenty cells, and its margin was either irregular or repand, or 3-4-toothed, or quite entire. I never saw it two-lobed. In *Thuja orientalis* and *Cupressus sempervirens*, in which Baillon always figures it as two-lobed, I found it occasionally so, but more frequently the orifice was irregularly sinuate or lobed, irregularly crenate, or even quite entire. Richard, too, thus describes the organs of certain Conifers, *e. g. Pinus Cedrus*,* "margin unequally and irregularly cut into 2-5 segments, which are irregularly erose toothed or repand;" and *Pinus balsamea*,† "limb longer on one side and slightly divided at the margin into two or three somewhat unequal lobes." These descriptions and figures throw still more doubt on the existence of Baillon's "two carpels." It was, however, in *Pinus Larix*, in which I fully studied the evolution of the cone-scales, that I acquired a complete conviction of Baillon's error. In this plant, what Baillon calls the ovule, appears first in the form of a convex, almost hemisphærical boss, around which, some weeks later, the integument is produced, not under the form of two distinct horse-shoes, but of a complete ring, uniform in height all round. I tried in vain to find any indication of a double origin. It is impossible to consider the floral organ of *Pinus Larix* as anything else than a nucleus surrounded by an integument, that is, an ovule; and as it is incredible that the integument of *Pinus Larix* should, from the first, be a regular ring, while that of the other Conifers examined by M. Baillon presents, in its earliest condition, the appearance of two horse-shoes, the observations of MM. Baillon and Payer appear to me more than doubtful.

Were it however the case, that in some Conifers this integument originated as two distinct tubercles, it would by no means necessarily follow that these two tubercles indicate the presence of two organs of distinct origin, not referable to the integument of the gemmule. For:

1. Two-lipped integuments are occasionally met with, which no one regards as two distinct carpels. Thus in *Polygala comosa* the outer coat of the ovule is produced obliquely upwards and subcucullate, and is divided by a deep fissure into two lateral lobes. Payer makes no mention of these‡ in *Polygala speciosa*, though he figures§ the ovule-coat of *Tremandra verticillata* as two-lipped, which is only the case at a late stage of the development of the ovule. The period at which the lips appear seems, however, of little consequence.

2. Other organs certainly exist, which, though single and not composed of two united together, do yet, at their first appearance, show two distinct apices, as, for instance, the stipules of *Victoria regia* and *Euryale ferox*, whose evolution I have examined, and the upper palea of grasses which Payer himself describes and figures in *Briza media, Panicum aduncum, Triticum monococcum, Ehrharta panicea* and *Stipa juncea*.||

3. There are certain ovules whose coats sometimes originate equally all round, while at other times, in the same species and even in the same ovary, they are visible on one side earlier than on the

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* Richard Mém., p. 63, t. xvii. no. 1. f. D. † l. c. p. 76, t. xvi. f. L.
‡ Organogenie, t. xxxi. f. 39. § l. c. t. xxix. f. 31, 37.
|| Organogenie, p. 701, et seq.

other. This I have noticed in *Berteroa incana* and *Thlaspi arvensis*, in whose ovules the lower part of the cylindrical nucleus is thicker than the upper, and the two integuments arise seemingly both at once from the lower thickened part, at one time all round and at the same height, at another time unilaterally. As in these cases, true ovule-coats are developed on one side first, and not equally all round, it does not seem unfair to infer the possibility of their appearance in two distinct places or by two gibbi. The alternation of the two lips of the ovule-coat of Taxus, with the two uppermost bracts, may be understood to depend on the existence of more ample room for development on the two sides where there are no bracts, than on the other two, where the bracts come in contact with the ovule. It is well known, that organs increase most in size and vigour in those parts which are free and not interfered with by other organs, while they are weaker and smaller, where they are pressed on by neighbouring organs and deprived of nutriment. In the Abietineæ this may be the cause of the bilobation of the ovule-coat, as the two teeth in *Abies excelsa*, for instance, are on those sides of the ovule which are not pressed on either by the axis or the scale.

The second part of Baillon's proposition, regarding the flowers of Conifers, is that they always arise from the axis and never from a leaf or bract, or rather carpel. This is shown to be erroneous as to Abietineæ, at least by the monstrous larch described above. It is also excellently refuted by Baillon and Payer's own observations on *Pinus resinosa*. As described by Baillon, the scales of *Pinus resinosa* are developed in the following manner. The scale appears first as a small, dorsally compressed, broad boss in the axil of the bract. From the first boss spring three others, one central and two lateral. The lateral bosses become broader, assume the form of auricles, cohere externally, and, increasing mainly in width, are gradually converted into an obliquely ascending lamina, the scale itself, which bears a little above the middle in the median line, the subcentral boss, "the organic apex of the axis," which axis produces no more appendages, increases very little in size, and in the adult state, presents the form of a hook bent inwards and downwards. On the upper surface of the lateral wings, towards their lower margin, which is turned towards the primary axis, the ovules are, according to Baillon, produced at a later period.

From this description it is evident that three distinct organs, all differing in period of origin, can be distinguished, each of which is developed from that immediately preceding it.

1. The axis which originates in the axil of the bract.

2. The ear-shaped organs, which spring laterally from this axis, and are called by Baillon the two lateral lobes. These ascend obliquely and form the greater part of the scale, but are so situated with respect to the minute axis, as manifestly to exhibit the character of appendicular organs. They form two nearly right angles with the ascending axis, and spread out laterally and almost horizontally,

so that no one who has learned even the elements of morphological botany, can help recognising them as leaves, and as the primary and only leaves produced on the evanescent axis.

3. From the two lateral organs spring those third in order, namely, the ovules.

Now it is certainly wonderful, but it is not the less true, that Baillon and Payer, failing to distinguish the second organs (the lateral leaves) from the first, though Baillon's description is sufficiently accurate, have confounded both together, and considered them to be a single organ, called by Payer a flattened form of the peduncle; thus rashly following Schleiden, (who, more than twenty years before fell into the same mistake, of describing the axis and its primordial leaves as a simple axis), and Mirbel,* who 46 years before confounded these three very distinct kinds of organs under the common name of peduncle.

Payer further says,† that "this flattened form of peduncle does not surprise those who are aware of its existence in the branches of several plants, such as *Ruscus*, *Xylophylla*, *Phyllocladus*, &c." No one, however, but a tyro in morphology, would confound the scale of *Pinus resinosa*, on whose upper surface, almost in its middle, the growing point rises as the hooked apex of an evanescent axis, utterly distinct both in position and direction, from the morphological apex of the lamina of the proper scale, with the flattened branches of *Ruscus*, &c., whose withered growing point occupies the very apex of the lamina, and in which no trace of appendicular organs is found below the growing point.

Baillon, in a somewhat impressive manner observes, after stating some opinions of others on the structure of the flowers of Conifers, that "the new modes of observation afforded by the study of organogeny, may with propriety be applied to the verification of these opinions." M. Baillon may learn, from the mistakes into which he has been led by the employment of a method which he and Payer alone imagine to be new, that the different grades of evolution of an organ, cannot be understood without an accurate knowledge of the nature of the axis and its appendages, and of the relations which exist between them. M. Baillon, however, hardly knows the elements of morphology. How, for instance, does it happen, that, at the present day, he uses the term alternate,‡ which was thus applied a century ago, to describe the arrangement of the bracts of the female flowers of Conifers?

Dr. Lindley,§ who considers the scales of pine cones to be carpels, (that is, leaves), refers to a cone-like gall of *Pinus abies*, figured by Richard,‖ which he mistakes for a cone, and in which he regards the scales as being changed into the form of the acicular leaves of *Pinus abies*. Baillon has been led by Lindley into the same mistake, of regarding this gall as a cone, and only differs from Lindley, so far, that he thinks it is not the scales but the bracts which are changed

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* Elémens de physiol. végétale, 1815, i. p. 347. † In Baillon's paper, p. 20.
‡ l. c. p. 6. § Veg. Kingd. p. 227. ‖ Mém. t. xii.

into leaves.* Had Baillon read the passage in Richard, to which he refers, he would have seen that Richard correctly regarded the gall as a leafy branch, changed by the attacks of some insect into a false cone. Degeer† describes the insect by which these galls are made, (*Chermes abietis*, Linn.), and figures it and its gall.‡ He says, "those who have no accurate botanical knowledge, may readily mistake the galls for fir-cones and fruit." Kaltenbach§ says, in like manner, "that these galls closely resemble fir-cones, and may readily be confounded with them by ignorant people."||

From the observations given above, it is certain that the flowers of Abietineæ, consist of naked ovules rising from a carpel, and not of pistils springing from an axis. It has been almost universally acknowledged by authors, from the time of Richard down to that of Baillon,¶ that the flowers of Conifers and Cycads, are almost uniform in structure, following the same laws, with very trifling differences. It appears, therefore, probable that the ovules of all Conifers, *Taxus* included, are borne on carpels and not on the axis, though at first sight this appears incredible. I shall return to this subject elsewhere.

V.—On the Ancient Lake Habitations of Switzerland.
By John Lubbock, Esq., F.R.S.

Archæology forms the link between Geology and History—the past and the present. If in its more recent portions it is scarcely distinguishable from History, yet when we pass back to its commencement, we find ourselves to have imperceptibly glided into the domain of Geology, without noticing any boundary to separate the one from the other. The beginning of Archæology being, in fact, but the end of Geology, it is not surprising that they should, in the course of their development, have presented some remarkable analogies. M. Morlot has well pointed these out in his "Leçon d'ouverture d'un cours sur la haute antiquité, fait a l'Academie de Lausanne."

Even, indeed, as the remains of extinct animals were at first supposed to be few and far between, whereas, in fact, the surface of the earth is made up of the dust and skeletons of our predecessors, so the relics of man, long looked upon as rare and exceptional in their occurrence, are gradually presenting themselves in unexpected profusion. Loth, however, to distrust the existing chronology, our antiquaries long referred all the most beautiful and well-made weapons to the Romans, just as all fossils were attributed to the action of the Deluge. Passing on, then, with a graceful compliment to

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* l. c. p. 11. † Geschichte von Insekten, deutsch von Götze, iii. p. 66, et seq.
‡ T. viii. f. 1—29. § Monographie der Familie der Pflanzenläuse, p. 202.
|| I may further refer, for information about these galls and the insect which produces them, to Burmeister, Handbuch der Entomologie, ii. 1. abtheil, p. 90, and Koch, die Pflanzenläuse (aphider), p. 317, where the insect is well figured at f. 387 and 388. ¶ l. c. p. 11.

two of our most eminent contemporaries, M. Morlot points out that as Lyell, the reformer of Zoology, by studying the changes now taking place on the earth's surface, has explained the results which Geology brings before us, and thus arguing from the known to the unknown, has used the Present as a key to unlock the Past; so M. Thomsen, by collecting the implements and recording the habits of existing savages, has thrown much light upon the manners and customs of ancient times. Fully recognising the imperfection of the record in the one case as well as in the other, we must guard ourselves against any hasty conclusions and generalisations, but it seems now to be well established that a considerable elongation of the received chronology is required in Archæology as decidedly, though not of course to such an extent, as in Geology.

Perhaps, also, we may regard it as, to say the least, highly probable, that in Northern Europe there have been three great epochs in the history of man—primary, secondary, and tertiary—the first of Stone, the second of Bronze,* and the third of Iron. This conclusion, which we owe in the first instance to the Northern and especially to the Danish Archæologists, has been much strengthened by the recent researches in the lakes of Switzerland.

It is however probable, as was mentioned in our last number, that the Stone period will require much sub-division. In all classifications we are apt, at first, to take the apparent, for the real dimensions of the more distant portions, and it is only as we obtain a closer acquaintance with them, that we discover their real proportions. Thus, it would appear, that the Stone age must be divided into at least two periods; that of the drift on the one hand, and on the other hand, that to which the Danish Kjökkenmöddings and the Swiss Lake Habitations appear to belong.

These Lake-dwellings or "Pfahlbauten,"—a term whose nearest English equivalent is "Pile-works"—were made known to us in the following manner.

In consequence of the extraordinary dryness and coldness of the weather during the winter months of 1853 and 1854, the rivers of Switzerland did not receive their usual supplies, and the water in the lakes fell much below its ordinary level, so that in some places a broad strand was left uncovered along the margin, while in others shallow banks were converted into islands. The water level of this season was, indeed, the lowest upon record. The lowest level marked on the so-called stone of Stäfa was that of 1674, but in 1854 the water sank a foot lower. These unusual conditions, though very unfavourable to navigation, enabled the Swiss Archæologists to make the important discoveries which we are about to bring before our readers.

* In a grave at Mare Hill in Staffordshire, Mr. Carrington found "a piece of "lead, having the appearance of wire, which subsequent researches prove to have "been accidentally fused from metalliferous gravel present upon the spot." May not copper have been first obtained from some bright piece of ore, used as an ornament, and burnt with its wearer? The coincidence of a knowledge of metal with the practice of burning the dead is at least significant.

M. Aeppli of Meilen, on the Lake of Zurich, appears to have been the first to observe, in the bed of the lake, certain indications of human activity, which he justly supposed might throw some light on the history and condition of the earliest inhabitants of the Swiss valleys. In a small bay between Ober Meilen and Dollikon, the inhabitants took advantage of the lowness of the water to increase their gardens, by building a wall along the new water-line, and slightly raising the level of the piece thus reclaimed, by mud dredged from the lake. In the course of this dredging they found great numbers of piles, of deer-horns, and also some implements. The researches at this place conducted and described by Dr. F. Keller, have been followed by similar investigations in other lakes, and have proved that the early inhabitants of Switzerland constructed some, at least, of their dwellings above the surface of the water, as is done in the present day by savages in various countries, as for instance the Papous of New Guinea, whose huts, circular or square in form, are grouped on wooden platforms, elevated a few feet above the level of the water, supported by numerous piles driven into the mud, and connected with the land by a narrow bridge.

This method of construction, indications of which are found in various parts of Europe, was especially mentioned by Herodotus,* who describes the Pœonians of Lake Prasias, in Thrace, as living in cabins situated on a platform, supported above the water by great piles. Each cabin had a trap-door opening on to the lake, and the whole settlement communicated with the main land by a bridge.

The Swiss "*Pfahlbauten*," or lake habitations, have been described by M. Keller, in three memoirs presented to the Antiquarian Society of Zurich, in 1854, 1858, and 1860, and by M. Troyon, in a special work, "Sur les Habitation Lacustres," 1860, in which the author gives a general account of what has been done in Switzerland, and compares the results obtained in his native land, with the lake-dwellings of other countries and times. The discoveries in Lake Moosseedorf have been described in a special paper by MM. Jahn and Uhlmann (Die Pfahlbaualterthumer von Moosseedorf. Bern, 1857.); and we owe to M. Rütimeyer two works on the animal remains from the Pfahlbauten, the first "Untersuchung der Thierreste aus den Pfahlbauten der Schweiz," published by the Antiquarian Society of Zurich, in 1860; and still more recently a larger work—"Die Fauna der Pfahlbauten in der Schweiz." Collections of objects from these localities have also been made by many Swiss Archæologists.

The Flora has been studied by M. Heer, whose results are contained in the last memoir published by M. Keller. Nor must we omit to mention M. Morlot's short paper in the "Bulletin de la Societe Vaudoise," and his more recent "Leçon d'Ouverture d'un cours sur la haute Antiquité fait a l'Académie de Lausanne." From the conclusion of this lecture, indeed, I must express my dissent: not that I would

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* Her. Book V. ch. 16.

undervalue what M. Morlot calls the Practical Utility of Geology, nor that I am less sanguine as to the future advantages of Archæology. Science, however, is like virtue, its own reward, and the improvement of the mind must be regarded as the highest object of study. However this may be, M. Morlot is, to use his own metaphor, labouring earnestly in the vineyard, and is improving the soil, though, as in the old fable, it may be in the false hopes of finding a concealed treasure. The Swiss Archæologists have, indeed, made the most of a golden opportunity. Not only in Lake Zurich, but also in Lakes Constance, Geneva, Neufchatel, Bienne, Morat, Sempach, in fact in most of the large Swiss lakes, as well as in several of the smaller ones (Inkwyl, Pfaffikon, Moosseedorf, Luissel), similar lake-habitations have been discovered. In the larger lakes, indeed, not one, but many of these settlements existed: thus, M. Keller mentions, in Lake Bienne, eleven: in Lake Neufchatel, twenty-six; in the Lake of Geneva, twenty-four; in that of Constance, sixteen: and many more, doubtless, remain to be discovered.

The dwellings of the Gauls are described as having been circular huts, built of wood and lined with mud. The huts of the Pileworks were probably of a similar nature. This supposition is not a mere hypothesis, but is confirmed by the preservation of pieces of the clay used for the lining. Their preservation is evidently due to the building having been destroyed by fire, which has hardened the clay and enabled it to resist the dissolving action of the water. These fragments bear, on one side, the marks of interlaced branches, while on the other, which apparently formed the inner wall of the cabin, they are quite smooth. Some of those which have been found at Wangen are so large and so regular that the Swiss Archæologists feel justified in concluding that the cabins were circular, and from ten to fifteen feet in diameter. Though, therefore, the architecture of this period was very simple, still the weight to be sustained on the wooden platforms must have been considerable, and their construction, which must have required no small labour,* indicates a considerable population. It would, indeed, be most interesting if we could construct a retrospective census for these early periods, and M. Troyon has made an attempt to do so, though the results must, naturally, be somewhat vague. The settlement at Morges, which is one of the largest in the Lake of Geneva, is 1200 feet long and 150 broad, which would give a surface of 180,000 square feet. Taking the cabins as being 15 feet in diameter, and supposing that they occupied half the surface, leaving the rest for gangways, we may estimate the number of cabins at 311, and if we suppose that, on an average, each was inhabited by four persons, we shall have, for the whole, a population of 1244. Starting from the same data, we should obtain for the Lake of Neufchatel, a population of about 5000. Alto-

* "Increasing density of population is equivalent to increasing facility of production." Bastiat, Harmonies of Political Œconomy, p. 12.

gether, 68 villages, belonging to the Bronze Age, have been discovered in Western Switzerland, and by the same process of reasoning they may be supposed to have contained 42,500 persons; while for the preceding epoch, the population may, in the same manner, be estimated at 31,875.

For a moment it may surprise us that a people so uncivilised should have constructed their dwellings with immense labour on the water, when it would have been so much more easy to have built them on dry land. The first settlers in Switzerland, however, had to contend with the Boar, the Wolf, the Bear, and the Urus; and subsequently, when the population increased, and disputes arose, the lake habitations, no doubt, acted as a fortification, and protected man from man, as they had before preserved him from wild beasts.

Switzerland is not, by any means, the only country in which lake dwellings have been used as fortresses. In Ireland, a number of more or less artificial islands, called "Crannoges,"* are known historically, to have been used as strongholds by the petty chiefs. They are composed of earth and stones, strengthened by numerous piles, and have supplied the Irish Archæologists with numerous weapons and bones. From the Crannoge at Dunshauglin, indeed, more than 150 cart-loads of bones were obtained, and were used as manure! These lake dwellings of Ireland, however, come down to a much later period than those of Switzerland, and are frequently mentioned in early history. Thus, according to Shirley, "One Thomas Phelliplace, "in his answer to an inquiry from the Government, as to what castles "or forts O'Neil hath, and of what strength they be, states (May 18, "1567): 'For castles, I think it be not unknown unto your honors, "he trusteth no point thereunto for his safety, as appeareth by the "raising of the strongest castles of all his countreys, and that fortifi- "cation that he only dependeth upon is *in sartin ffreshwater loghes* "in his country, which from the sea there come neither ship nor "boat to approach them: it is thought that there in the said forti- "fied islands lyeth all his plate, which is much, and money, prisoners "and gages: which islands, hath in wars to fore been attempted, and "now of late again by the Lord Deputy there, Sir Harry Sydney, "which for want of means for safe conducts upon the water it hath "not prevailed.'"

Again, the map of the escheated territories, made for the Government, A.D. 1591, by Francis Jobson, or the "Platt of the County of Monaghan," preserved in the State Paper Office, contains rough sketches of the dwellings of the petty chiefs of Monaghan, which "are in all cases surrounded by water."† In the "Annals of the Four Masters," and other records of early Irish history, we meet with numerous instances in which the Crannoges are mentioned, and some in which their position has not preserved them from robbery and

* See Wilde's Catalogue, V. i. p. 220.
† Ibid. p. 231.

destruction; so that we need not be surprised to find that most of the Swiss Lake-habitations appear to have been destroyed by fire. Though, however, these latter resemble the Irish Crannoges in their position and use, they differ considerably from them in their construction. In one or two places, indeed, as for instance at the Steinberg, in the Lake of Bienne, it is possible that an island may have been formed, the bottom of the lake having been artificially raised. It is curious that a canoe laden with stones, was actually found near this spot, it having, apparently, sunk with its load, at the time when the Steinberg was in process of construction. After all, however, it seems probable that even in this case, the object was only to obtain a firmer foundation for the piles. At the present time the highest part is eight feet below the surface of the water, and nothing justifies us in looking back to any such alteration of level. Moreover, even now the piles project two or three feet above the surface, upon which, therefore, the cabins cannot have been intended to stand. A small island in Lake Inkwyl, however, reproduces almost exactly the Irish Crannoge.

After having chosen a favourable situation, the first step in the construction of the Lake-habitations was to obtain the necessary timber. To cut down a tree with a stone hatchet must have been no slight undertaking. It is, indeed, most probable that they made use of fire, in the same manner as is done by existing savages in felling trees and making canoes. Burning the wood and then scraping away the charred portion, renders, indeed, the task far more easy, and the men of the Stone period appear to have avoided the use of large trees, except in making their canoes. Their piles were imbedded in the mud for from one to five feet, and must also have projected from four to six feet above the water level, which cannot have been very different from at present. They must, therefore, have had a length of from 15 to 30 feet, and they were from 3 to 9 inches in diameter. The pointed extremity which entered into the mud still bears the marks of the fire, and the rude cuts made by the stone hatchets. The piles belonging to the Bronze period being prepared with metal axes, were much more regularly pointed, and the differences between the two have been ingeniously compared to those shown by lead pencils well and badly cut. Dragging the piles to the lake, and fixing them firmly, must have required much labour, especially when their number is considered. At Wangen alone M. Lohle has calculated that 40,000 piles have been used; but we must remember that these were probably not all planted at one time, nor by one generation. Wangen, indeed, was certainly not built in a day, but was, no doubt, gradually added to as the population increased. Herodotus informs us that the Pœonians made the first platform at the public expense, but that subsequently at every marriage (and polygamy was permitted), the bridegroom was expected to add a certain number of piles to the common support. In some localities, as at Robenhausen, on Lake Pfeffikon, the piles were strengthened by cross beams. The Pile-works of subsequent periods differ little from those of the Stone age, except, perhaps, that they are more solidly constructed. The piles, also, are less decayed, and project above the mud farther than those of the preceding epoch. M. Morlot considers that the horizontal platform rested upon the top of these piles, at such a height as to allow for all ordinary variations in the level of the water. M. Suter, however, supposes that in some cases, at least, the platform was not attached to the perpendicular piles, but rested upon the water, rising and sinking with it. The structure of the Pileworks at Wauwyl, in the Canton of Lucerne, certainly seems to favour this view. It was composed of four rectangular divisions, separated by narrow channels, over which, no doubt, bridges were thrown, and through which canoes might pass. The piles were less numerous than usual, and were grouped principally round the outer edge of the platforms. In this case they have been preserved by peat; they are from three to four and a half inches in diameter, all rounded, and not formed of split timber. In order to ascertain their length, M. Suter dug up two of them; the longest penetrated four feet through the peat, and ten feet six inches into the ancient bed of the lake; the other, also four feet through the peat, but only four feet six inches lower. M. Suter examined the piles carefully, but fruitlessly, to ascertain any manner in which the platform can have been attached to them.

The platform itself consisted of five layers of trees, curiously and carefully fastened together by clay and interlaced branches of trees, but like the perpendicular piles they were examined in vain for any traces of notches, mortises, holes, ligatures, bolts, or any other contrivance, by which the upright piles and the platforms could have been fastened together.

Not only were the debris of their repasts, and other rubbish thrown into the water, but more or less valuable weapons and instruments must have been sometimes lost in this manner, especially as children formed, of course, the usual proportion of the population. Many of the articles presently to be mentioned, were however, in all probability, engulphed at the destruction of the Pfahlbauten, some of which were perhaps burnt and rebuilt more than once.

The number of stone implements which have been already found is quite astonishing; at Wangen, in Lake Constance, many hundred weapons of various sorts have been discovered, and a great number also at Moosseedorf, Wauwyl and Robenhausen, in none of which places has a single piece of metal been as yet met with, a fact which, taken in connexion with the great number of bronze implements which have been collected from other Pileworks, clearly indicates that the settlements above mentioned, belonged to the age of Stone. Not only, however, is metal absent, and not only, as we have already seen, does the Fauna indicate a greater antiquity, but the stone weapons themselvess are less varied and less skillfully made. Most of them are made from rocks which occur in Switzerland, though it is probable that the flint was brought from France. The absence of any great blocks of this valuable material in Switzerland accounts for our not finding any of the large, flat axes which are so characteristic of northern Europe, and especially of Denmark. At Wangen, the stone implements resemble those of Moosseedorf, and are principally formed of indigenous rocks, which to judge from the fragments scattered about, were evidently worked up at these two places. One or two bits, however, consisted of Oriental Nephrite, which is green, transparent, and of remarkable hardness, and if these really belonged to the Stone age, the fact is very remarkable, as this substance, according to Swiss mineralogists, does not naturally occur in Switzerland, and must have been brought from Egypt or Asia. On this point, however, it would be desirable to have more information; since, if we are to suppose that any such extended commerce existed, it is difficult to understand why bronze and iron were not also introduced. Weapons of Nephrite have also been found at one or two other places, belonging to the Bronze age, and where therefore its presence is less inexplicable. The stone implements found in the settlements belonging to this earliest period consist of hammers, axes, knives, saws, lance-heads, arrow-heads, corn-crushers, and polishing blocks. Some of the hammers were made of serpentine with a hole pierced through one end, and are, like all pierced stones, of very great rarity, belonging perhaps only to the end of the Stone period. Some of them are cylindrical, others more cubical in shape.

The axe was preeminently *the* implement of antiquity. It was used in war and in the chase, as well as for domestic purposes, and great numbers have been found, especially at Wangen, (Lake of Constance) and Concise (Lake of Neufchatel). With a few exceptions they were surprisingly small, especially when compared with the magnificent specimens from Denmark; in length they varied from six inches down even as low as one, while the cutting edge had generally a width of from 15 to 20 lines. Flint was sometimes used, and nephrite, or jade, in a few cases, but serpentine was the principal material. Most of the larger settlements were evidently manufacturing places, and many spoilt pieces and half finished specimens have been found. The process of manufacture is thus described by M. Troyon. After having chosen a stone, the first step was to reduce it by blows with a hammer to a suitable size. Then grooves were made artificially, which must have been a very tedious and difficult operation, when flint knives, sand, a little water, and an unlimited amount of patience, were the only available instruments. Having carried the grooves to the required depths, the projecting portions were removed by a skilful blow with a hammer, and the implement was then sharpened and polished on blocks of sandstone.

Sometimes the hatchet thus obtained was simply fixed in a handle of horn or wood. Generally, however, the whole instrument consisted of three parts. A piece of horn, two or three inches in length, received the stone at one end and was squared at the other, so as to fit into a longer handle either of wood or horn. These intermediate pieces present several variations, some are simply squared, others have a projecting wing which rested against the handle, some few are forked as if to receive a wedge, and one had a small transverse hole apparently for the insertion of a peg.

The knives may be considered as of two sorts. Some differ from the axes, principally in having their width greater than their length. In other cases they were made of flint flakes. In this manner also were obtained the saws, which in addition had their edges somewhat rudely dentated; they were fixed into handles of wood by some sort of cement; but we do not find in Switzerland any of the semilunar saws, which are frequent in Denmark.

The arrow-heads were made of flint, or in some cases of rock crystal, and were, as in Ireland, of three principal sorts, between which however, there were a great many varieties. The first sort had a diamond shape, the posterior half of which was, in some specimens, shorter and rounded off. The second sort had the posterior margin more or less excavated, so that the angles being produced, as it were, into wings, clasped the shaft and enabled the arrow-head to be more firmly fixed. In the third sort, the middle part of the posterior side had a projection which sunk into the shaft. There are also found rounded stones, pierced with one, or sometimes with two holes. The use of these is uncertain, but they may perhaps have been used to sink fishing lines.

"Waste not, want not," is a proverb which the Lake-dwellers thoroughly appreciated. Having caught any wild animal, except the hare, they ate the flesh, used the skin for clothing, picked every fragment of marrow out of the bones, and then in many cases, fashioned the bones themselves into weapons. The larger and more compact ones served as hammers, and, as well as horns of the deer, were used for the handles of hatchets. In some cases pieces of bone were worked to a sharp edge, but they can only have been used to cut soft substances.* Bone harpoons, poignards, arrow-heads, and javelin heads also occur, and pins and needles of this material are very common. Teeth also, and particularly those of the wild boar, were used for cutting, and were also, in some cases, worn as ornaments or armlets. There can be little doubt that wood was also extensively used for different purposes, but unfortunately most of the implements of this material have perished. A wooden mallet, however, was found at Concise.

For our knowledge of the animal remains from the Pileworks we are almost entirely indebted to Prof. Rütimeyer, who has published two memoirs on the subject. (Mittheilungen des Antiq. Gesellschaft in Zurich, Bd. xiii. Abth. 2, 1860; and, more recently, a separate work, Die Fauna des Pfahlbauten in der Schweiz, 1861.) The bones are in the same fragmentary condition as those from the Kjökkenmöddings, and have been opened in the same manner for the sake of the marrow. There is also the same absence of certain bones and parts of bones, so that it is impossible to reconstruct a perfect skeleton even of the commonest animals.

The total number of species amounts to about 66, of which 10 are

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* According to Sir E. Belcher, however, sharpened pieces of horn are used by the Esquimaux in the preparation of flint weapons.

fishes, 3 reptiles, 17 birds, and the remainder quadrupeds. Of the latter, eight species may be considered as having been domesticated, namely, the Dog, Pig, Horse, Ass, Goat, Sheep, and at least two species of Oxen. The bones very seldom occur in a natural condition, but those of domestic and wild animals are mixed together, and the state in which they are found, the marks of knives upon them, and their having been almost always broken open for the sake of the marrow, are all evidences of human interference.

Two species, the one wild, the other domestic, are especially numerous,—the Stag and the Ox. The remains of these two indeed equal those of all the others together. It is, however, interesting, that in the older settlements, as Moosseedorf, Wauwyl, and Robenhausen, (Lake Pfeffikon,) the Stag exceeds the Ox in the number of specimens indicated, while the reverse is the case in the more modern settlements of the western lakes, as, for instance, those at Wangen and Meilen.

Next to these in order of abundance is the Hog. More sparing again, and generally represented by single specimens where the preceding occur by dozens, are the Roe, the Goat, and the Sheep, which is most numerous in the latter settlements. With these rank the Fox and the Martens. The Fox indeed, appears, whether from choice or necessity, to have been eaten during the Stone period. This conclusion is derived from the fact that the bones often present the marks of knives, and have been opened for the sake of the marrow. While, however, it is very frequent in the Pileworks of the Stone epoch, it has not yet been found in any settlement belonging to the Bronze period. Oddly enough, the Dog is, at least in the lake dwellings of the Stone period, rarer than the Fox, though more common than the Horse or the Ass; and of other species but few specimens have been met with, though, in some localities, the Beaver, the Badger, and the Hedgehog appear in some numbers.

The Bear and Wolf, as well as the Urus, the Bison, and the Elk seem only to have occasionally been captured; it is probable that the latter species were taken in concealed pits.

From the small lake at Moosseedorf, M. Rütimeyer has identified the following list:—Of the Dog, 3 specimens; Fox, 4 specimens; Beaver, 5 specimens; Roe, 6 specimens: Goat and Sheep, 10 specimens; Cow, 16 specimens; Hog, 20 specimens; Stag, 20 specimens.

It is certainly very striking to find two wild species represented by the greatest number of specimens, and particularly so, since this is no exceptional case; but the whole sum of the wild, exceeds that of the domesticated individuals, a result moreover which is confirmed by the other settlements of this epoch. Not only does this indicate a great antiquity, but it also proves that the population must have been sometimes subjected to great privations, not only from the necessary uncertainty of supplies so obtained, but also because we cannot suppose that foxes would have been eaten except under the pressure of hunger.

In his first memoir, Prof. Rütimeyer gives an interesting table, which I here subjoin, premising that 1 denotes a single individual; 2, several individuals; 3, the species which are common; 4, those which are very common; and 5, those which are present in great numbers. An x indicates a trace, and I have inserted a + in those cases in which the species have occurred since the table was constructed. I may also repeat that Moosseedorf, Wauwyl, Robenhausen, and Wangen belong to the Stone period, while Meilen and Concise were also inhabited during that of Bronze, and Auvernier and Steinberg have even produced a few weapons of iron.

			STONE.				BRONZE.			IRON.
			Moosseedorf.	Wauwyl.	Robenhausen.	Wangen.	Meilen.	Bienne.	Concise.	Auvernier.
1	The Brown Bear	Ursus Arctos	2	....	....	2	+	....	(x)	
2	The Badger	Meles vulgaris	2	2	1	....	x	....	+	
3	The Martin	Mustela Foina	2	3	....	....	....	....	(x)	
4	The Pine Martin	„ Martes	2	3	....	....	1	....	(x)	
5	The Polecat	„ Putorius	2	2	+					
6	The Ermine	„ Erminea	....	2						
7	The Otter	Lutra vulgaris	1	....	+					
8	The Wolf	Canis Lupus	....	1	+	(x)	x	....	+	
9	The Fox	„ Vulpes	3	3	1	1	(x)			
10	The Dog	„ familiaris	2	2	2	2	3	3	(2)	x
11	The Wild Cat	Felis Catus	2	2	+					
12	The Hedgehog	Erinaceus europæus	1	+	+					
13	The Beaver	Castor fiber	3	2	....	....	....	....	(x)	
14	The Squirrel	Sciurus europæus	2	2	....	1				
15	The Marsh Boar	Sus Scrofa palustris	5	5	5	5	5	2	(x)	
16	The Wild Boar	„ „ ferus	2	2	2					
17	The Domestic Hog	„ „ domesticus	....	? 1	....	....	....	3	+	x
18	The Horse	Equus Caballus	? 1	2	....	1	2	3		
19	The Elk	Cervus Alces	1	1	2	....	2	1	(x)	
20	The Stag	„ Elaphus	5	5	5	5	5	5	(x)	x
21	The Roe	„ Capreolus	4	2	2	2	2	....	(x)	
22	The Fallow Deer	„ Dama	....	....	....	....	x ?	x		
23	The Ibex	Capra Ibex	....	....	....	....	1			
24	The Goat	„ Hircus	2	2	2	....	....	3-4	(x)	x
25	The Sheep	Ovis Aries	2	1	2	....	(x)	3-4	(x)	x
26	The Urus	Bos primigenius	1	+	2	....	....	....	+	
27	The European Bison	„ Bison	....	1						
28	The Ox	„ Taurus domesticus	5	5	5	5	5	5	(x)	x
29	The Kite	Falco Milvus	....	....	1					
30	The Goshawk	„ palumbarius	2	1						
31		„ Nisus	2							
32	The Ringdove	Columba Palumbus	1							
33	The Wild Duck	Anas Boschas	3	1						
34	The Garganey	„ querquedula ?	2							
35	The Heron	Ardea cinerea	2	....	1					
36	The freshwater Tortoise	Cistudo europæa	1							
37	The edible Frog	Rana esculenta	3	2	+					
38	The Salmon	Salmo Salar	1							
39	The Pike	Esox Lucius	3	2	....	....	....			
40	The Carp	Cyprinus Carpio	2	....	+					
41	The Bleak	„ leuciscus	1							

The additional species added since this table was published are:—

42. The Mouse, M. sylvaticus. A single specimen, from Robenhausen. Our common house-mice and rats seem to have been unknown, and even this species is at present represented by but a single specimen.

43. The Hare, Lepus timidus. Of this species only a single bone has yet occurred. It was found at Moosseedorf. It is very remarkable that any nation should have eaten the Fox and spared the Hare, and nothing but a feeling of superstition can account for such an anomaly, which, however, accords well with the entire absence of the Hare from the Kjökkenmöddings of Denmark.

44. The Chamois, Antilope rupicapra. This species is represented by a piece of skull from Robenhausen.

45. A second race of domestic Oxen.

46. The Ass.

The additional birds which have been discovered are:—

Aquila fulva, Meyer. The Golden Eagle. At Robenhausen.
Aquila haliætus. A single bone found at Moosseedorf is rather doubtfully referred to this species by M. Rutimeyer.
Strix alves. From Concise.
Sturnus vulgaris. „ Robenhausen.
Cinclus aquatinus „
Tetrao bonasia „
Ciconia alba. Not unfrequent at Moosseedorf and Robenhausen.
Fulica atra. Robenhausen.
Larus. Sp. in „
Cygnus musicus. „
Anser segetum. „

The additional species of fish are:—

Perca fluviatilis. Robenhausen.
Scardinius erythropthalmus. „
Chondrostoma nasus. „
Lota vulgaris. „

And one or two species belonging to the genus Squalius.

The common Mouse and our two House-rats, as well as the domestic Cat and the Barndoor-fowl are absent from the Lake-habitations of Switzerland as from the Kjökkenmöddings of Denmark; at least Prof. Rütimeyer attributes to a later period a single bone of the latter which was found at Morges, a settlement belonging to the Bronze period.

The bones of the Stag and the Wild Boar often indicate animals of an unusual magnitude, while on the other hand the Fox appears to have been somewhat smaller than at present.

The Dogs varied less than at present, in fact they all belong to one variety, which was of middle size, and appears to have resembled our present Beagles. (M. Rütimeyer describes it as "resembling the Jagdhund" and the "Wachtelhund.")

The Sheep of the Stone period differed from the ordinary form, in its small size, fine legs, and short, goat-like horns: particulars, in which it is nearly resembled by some northern, and mountain varieties at the present day, as for instance by the small sheep of the Shetlands, Orkneys, Welsh hills, and parts of the Alps. At Wauwyl, however, M. Rütimeyer found traces of an individual with large horns.

The number of wild species of Sheep is so great, and our knowledge of them is so deficient, that M. Rütimeyer does not venture to express any opinion concerning the origin of our domestic varieties, except that he is inclined to trace them up to several wild races.

It is singular, that though remains of the Horse have yet been found in all the Pileworks, they are so rare that their presence may almost be considered accidental: thus Wangen has only produced a single tooth, Moosseedorf, a metatarsal bone, which has been polished on one side, Robenhausen, a single Os naviculare tarsi, and Wauwyl, only a few bones, which may all have belonged to a single specimen. On the other hand, when we come to the Bronze period, we find at Steinberg, numerous remains of this species, so that, as far as these slight indications go, the Horse, though undoubtedly present in the Stone age, seems to have been rarer than it became at subsequent periods. All the remains of the Horse belonged undoubtedly to the domestic species.

Though he refers some bones to the Wild Boar, and others to the Domestic Hog, yet he considers that the greatest number of the remains of this genus belong to a different race, which he calls Sus scrofa palustris. This variety was, in his opinion, less powerful and dangerous than the Wild Boar, the tusks being much smaller in proportion; in fact he describes it as having with the molar teeth of an ordinary full grown Wild Boar, the premolars, canines, and incisives of a young Domestic Hog. He considers that all the bones of this variety from Moosseedorf belonged to wild individuals, while of those from Nidau-Steinberg, Robenhausen, Wauwyl, and Concise, some bore in his opinion evidences of domestication. It has been supposed by some naturalists that this variety was founded only on female specimens, but in his last work, M. Rütimeyer combats this opinion at some length, and gives copious descriptions and measurements of the different parts. He also points out numerous sexual differences in the S. palustris, of the same nature, but not so well marked, as those of the Wild Boar. Relying also on its well defined geographical and historical range, he denies that it can be considerd as a cross between the Wild Boar and Domestic Hog, or that the differences which separate it from the former, can be looked upon as mere individual peculiarities. He considers, indeed, that as a wild animal it became extinct at a very early period, though the tame Swine of India which agree closely with this race may perhaps have been descended from it.

Our Domestic Hog first makes its appearance in the later Pileworks, as for instance at Concise. M. Rütimeyer does not, however, consider that it can have been derived from the Wild Boar (Sus scrofa), nor does he think that it was tamed by the inhabitants of Switzerland, but is rather disposed to look upon it as having been introduced, and the more so, as he finds at Concise traces of an Ox (*B. trochoceros*) which does not occur in the earlier Pileworks. In considering whether a given animal was wild or domesticated, we must be guided by the following considerations: the number of individuals represented; the relative proportions of young and old; the absence or presence of very old individuals, at least of species that served for food; the traces of long, though indirect, selection, in diminishing the size of any natural weapons which might be injurious to man; the direct action of man during the life of the animal; and finally the texture and condition of the bones.

Applying these considerations to the Sus palustris from Moosseedorf, it is evident, firstly, that the argument derivable from the number of young specimens loses much of its force on account of the great fertility of the Sow, and the ease with which the young can be found and destroyed; secondly, in the number of individuals represented, it is equalled by the Stag, which certainly was never domesticated; thirdly, some bones of very old individuals have been found and some of very young, even of unborn pigs; the smallness of the tusks is, according to M. Rütimeyer, a characteristic of the race and not an evidence of domestication; the bones are of a firm and close texture, and the only cases of decay have arisen from an extreme degradation of the teeth, which would certainly be unlikely to occur in a domestic animal. Finally, none of the teeth show traces of any filing or other preparation, except such as may have taken place after the death of the animal, from all of which reasons M. Rütimeyer infers that the inhabitants of Moosseedorf had not yet succeeded in taming either the Sus scrofa palustris or the Sus scrofa ferus.

M. Rütimeyer has paid great attention to the texture and condition of the bones themselves, and in many cases can from these alone distinguish the species, and even determine whether the bone belonged to a wild or a domesticated animal.

In wild animals the bones are of a firmer and closer texture, there is an indescribable, but to the accustomed eye very characteristic, sculpturing of the external surface, produced by the sharper and more numerous impressions of vessels, and the greater roughness of the surfaces for the attachment of muscles. There is also an exaggeration of all projections and ridges, and a diminution of all indifferent surfaces. In the consideration of the remains of Oxen, these distinctions have proved of the greatest importance. By their assistance, and this is in some respects the most interesting part of the work, M. Rütimeyer has convinced himself that besides the two wild species of Bos, namely the Urus (*B. primigenius*) and the Aurochs (*B. bison* or *Bison Europeus*), three domestic races of Oxen occur in Pileworks.

The first of these is allied to, and in his opinion descended from, the Urus, and he therefore calls it the Primigenius race. This variety occurs in all the Pileworks of the Stone period. The second or Trochoceros race, he correlates with a fossil species described under this name by F. von Meyer, from the Diluvium of Arezzo and Siena. This variety has hitherto only been found at Concise.

The third, or Longifrons race, is by far the most common of the three. It occurs in all the Pileworks, and at Moosseedorf and Wangen—that is to say, in the settlements which are supposed to be the oldest, almost to the exclusion of the Primigenius race. M. Rütimeyer considers that it is the domesticated form of *B. longifrons* of Owen, but as the word "longifrons" seems to him to be inappropriate and incorrect, he uses the name "brachyceros," which was originally proposed in manuscript by Owen for this species, but which has also been used by Gray for an African species, and ought not therefore to be adopted.

A subsequent portion of the work is devoted to the examination of the existing races of European Oxen. The old Trochoceros race he considers to be extinct, but he sees in the great Oxen of Friesland, Jutland, and Holstein, the descendants of the Bos primigenius. This race does not now occur in Switzerland, but he considers that there are at present in that country two distinct varieties of Domestic Oxen. The one of various shades between light grey and dark brown, but without spots, and prevailing in Schwyz, Uri, Wallis, &c., in fact, in the whole country south of a line drawn from the Lake of Constance to Wallis, agrees in its general osteological characters with the Bos longifrons of Owen. The other or spotted variety, which is generally of smaller size, and prevails in Northern Switzerland, is considered by M. Rütimeyer to be descended from the B. frontosus, a species found fossil in Sweden and described by Nillson.

I will not express any opinion of my own as to these conclusions. The subject is one no less difficult than important, and our space does not permit us to lay before our readers the details given by M. Rütimeyer, to whose work therefore we must refer all those who wish for more information on the subject. All naturalists must feel much indebted to M. Rütimeyer for the labour he has spent, and the light he has thrown upon the subject, whether we eventually adopt his conclusions or not. In six woodcuts at the termination of this memoir, I give representations of the skulls of these three races, and those of the corresponding fossil species.

Human bones occur in the Pileworks but very seldom, and may no doubt be referred to accidents, especially as we find that those of children are most numerous. One mature skull was, however, discovered at Meilen, and has been described by Professor His, who considers that it does not differ much from the ordinary Swiss type. And while his work was in the press, M. Rütimeyer received from M. Schwab four more skulls, two of which were obtained at Nidan-Steinberg, one at Sutz, and one from Biel.

M. Troyon has a very interesting chapter on the different modes of burial; he points out that the disposition of the corpse after death, had a deep meaning and is perhaps of greater importance than the nature of the tomb, which must in many cases have depended upon that of the materials which came to hand. The Greeks generally burnt their dead; considering fire as the means of purification, while the Persians, shrank from such an act, regarding fire, according to Herodotus, as a deity. Other nations, looking upon the earth as the universal mother, returned into her bosom the remains of their dead, fortunately ignorant of the deduction that as we brought nothing into the world so we can take nothing out of it, and regarding it therefore as a sacred duty to bury with the departed his most useful weapons and most beautiful ornaments. This belief seems to have been almost as general as the hope of a resurrection, and even among the Jews we find a trace of it in the words of Ezekiel (ch. xxxii. p. 27). "And they shall not lie with the mighty " that are fallen of the uncircumcised, which are gone down to hell " with their weapons of war."

In tombs of the Stone age the corpse appears to have been almost always, if not always, buried in a sitting position, with the knees brought up under the chin, and the hands crossed over the breast.* This attitude occurs also in many Asiatic, African, and American tombs. M. Troyon, quotes the following passage from a work published by André Thévet, in 1575; "Quand donc (speaking of the Brazilian aborigines), leurs parents sont morts, ils les courbent dans un bloc et monceau dans la lict où ils sont décédés, tout ainsi que les enfants sont au ventre de la mère, puis ainsi enveloppés, liés et garrottés de cordes, ils les mettent dans une grande vase de terre." M. Troyon adds, "Chez certains Indiens, les mères, après avoir donnè à l'homme, avant de l'inhumer, l'attitude qu'il avait dans le sein maternel, epanchent leur lait sur la tombe. Cet usage des mères, qui assimile l'homme après sa mort au petit enfant qu'elles nourrissent de leur lait, s'est conservé, sauf l'attitude, il est vrai, jusqu'au commencement de ce siècle, dans le centre de l'Europe, dans la vallée alpestre des Ormonts;" making this last statement on the authority of M. Terrise, who was himself an eye-witness of this extraordinary custom.

Making allowance for the marine animals, such as the seals and oysters, the cockles, whelks, &c., the fauna thus indicated by the remains found in the Swiss lakes, agrees remarkably with that which characterises the Danish Kjökkenmöddings, and belongs evidently to a far later age than that of the celebrated stone hatchets, which were first made known to us by the genius and perseverance of M. Boucher de Perthes.†

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* See for Denmark, Worsaae's Antiquities, Eng. Edit. p. 89. To judge from Mr. Bateman's excellent volume just published, "Ten years diggings in Celtic and Saxon Gravehills," the same position was, to say the least of it, very common in early British Tombs, in which also the corpse was generally deposited on its left side. It would be very interesting if some Archæologist would tabulate all the accounts of ancient graves, showing the ornaments and weapons which have been found with different methods of interment.

† Whether the Drift race of men were really the aboriginal inhabitants of Europe, still remains to be ascertained. M. Rütimeyer hints, that our geographical distribution indicates a still greater antiquity for the human race.

Instead of the Elephant and Rhinoceros we find in the later or second stone period, in that namely of the Kjökkenmödding and "Pfahlbauten," the Urus and Bison, the Elk and the Red deer already installed as monarchs of the forests. The latter indeed, with the Boar, appears to have been very frequent, and to have formed a most important article of food to the Lake-dwellers. The Urus, or great fossil Ox is now altogether extinct. It was mentioned by Cæsar, who describes it as being little smaller than an elephant. (Hi sunt magnitudine paulo infra elephantos, specie et colore et figura tauri.) According to Herberstein, it still existed in Switzerland during the sixteenth century, soon after which, however, it must have become extinct.

The Aurochs, or European Bison seems to have disappeared from Western Europe even earlier than the Urus. There is no historical record of its existence in England or Scandinavia. In Switzerland we cannot trace it later than the tenth century, but it is mentioned in the "Niebelungen Lied," of the twelfth century, as occurring in the Forest of Worms, and in Prussia the last was killed in the year 1775. At one period indeed, it appears to have inhabited almost the whole of Europe, much of Asia, and part even of America, but at present it is confined in Europe, to the imperial forests in Lithuania, where it is preserved by the Emperor of Russia, while, according to Nordmann and Von Baer, it still exists in some parts of Western Asia.

We have no notice of the existence of the Elk in Switzerland during the historical period, but it is mentioned by Cæsar as existing in the great Hercynian forest; and even in the twelfth century it was to be met with in Sclavonia and Hungary, according to Albertus Magnus and Gesner. In Saxony, the death of the last is recorded as having occurred in 1746. At present it inhabits Prussia and Lithuania, Finland and Russia, Scandinavia and Siberia, to the shores of the Amoor.

The Ibex disappeared from most of the Swiss Alps, perhaps not much later than the Elk. It lingered longest in the West. In Glarus the last one perished in 1550, though near Chiavenna it existed until the commencement of the 17th century, and in the Tyrol until the second half of the 18th, while it still maintains itself in the mountains surrounding Mont Iséran.

The extermination of the Bear, like that of the Ibex, seems to have begun in the East, and not yet to be complete, since this animal still occurs in the Jura, in Wallis, and in the South-Eastern parts of Switzerland.

The Fox, the Otter, and the different species of Weasels, are still the common carnivora of Switzerland, and the Wild Cat, the Badger, and the Wolf still occur in the Jura and the Alps, the latter in cold winters venturing even into the plains.

The Beaver on the contrary has at last disappeared. It has long been very rare in Switzerland, but a few survived until the beginning of the present century, in Lucerne and Wallis. Red deer were abundant in the Jura and Black Forest in the twelfth and thirteenth centuries, though they do not appear to have been so large as those which lived in earlier times. The last was shot in Basle, at the close of the eighteenth century, while in Western Switzerland and Wallis they lingered somewhat longer. The Roedeer still occurs in some places.

The Fauna thus indicated is certainly very much what might have been expected. We find most of the species which characterise the post-tertiary epoch in Europe. Some of the larger ones have since fallen away in the struggle for existence, and others are becoming rarer and rarer every year, while some maintain themselves even now, thanks only to the inclemency and inaccessibility of the mountainous regions which they inhabit. The gradual process of extermination, which has continued ever since, had however even then begun.

Taken as a whole, therefore, the animals of the Swiss Pileworks belong evidently to the Fauna, which commenced in post-tertiary times with the Mammoth, the Rhinoceros tichorhinus, the Cave Bear, and the Fossil Hyæna. These extinct species appear to have co-existed in Europe with all of its present indigenous inhabitants; it was, indeed, long supposed that man belonged to a subsequent period, but recent investigations have shown, that he is no exception to the rule.

While, however, we must regard the Fauna of the Stone age as belonging to the same Zoological epoch with that of the later drifts on the one hand, and the present time on the other; we cannot forget that the immense time which has elapsed since the end of the Tertiary period, has produced great changes in the Fauna of Europe. In this Post-tertiary era the Pileworks occupy, so to say, a middle position. Distinguished from the present Fauna of Switzerland in the possession of the Urus, the Bison, the Elk, the Stag, and the Wild Boar, as well as by the more general distribution of the Beaver, the Bear, the Wolf, the Ibex, the Roe, &c., they differ equally from the drift gravels in the absence of the Mammoth, the Rhinoceros, the Cave Bear, and the Cave Hyæna.

M. Rütimeyer, however, thinks that we may carry this division farther, and he considers that some of the Pileworks presenting a more archaic character than others, they may be arranged as follows:—

1stly, Moosseedorf.

2ndly, As being somewhat more recent, Wauwyl, Robenhausen, Wangen, and Meilen.

3rdly, The Lake-habitations of Western Switzerland.

It is of course unnecessary to point out the interest and importance of such a distinction, which accords so well with that indicated by the study of the weapons and the state of preservation of the piles. Thus, the Urus has only occurred at Moosseedorf and Robenhausen; the Aurochs only at Wauwyl; the Bear only at Moosseedorf and Meilen. A glance at the table given at page 250, will show that several other species have as yet only occurred at Moosseedorf and Robenhausen, a fact however which indicates rather the richness than the antiquity of these localities. Possibly indeed we may consider the presence of these larger species as an indication of their greater abundance in the oldest period; but we must not forget that not only the Bear and the Elk, but also the Aurochs and Urus come down to a much later period. On the other hand, the abundance of wild animals, and the fact that at Moosseedorf and Wauwyl the Fox was more abundant than the Dog, while elsewhere the reverse is the case, certainly speaks in favour of the greater antiquity of these two settlements.

The evidence derived from the distribution of the domestic animals is perhaps more satisfactory. The Sheep is present even at Moosseedorf, though not so numerous as at the Steinberg. On the other hand, the Horse is frequent at the Steinberg, while at Moosseedorf only a single tooth was discovered, and even this had been worn as an amulet or an ornament, and may have been brought from a distance. Finally, the domestic Hog of the present race is absent from all the Pileworks of the Stone period, excepting perhaps the one at Wauwyl, and becomes frequent only at the Steinberg.

If succeeding investigations confirm the conclusions thus indicated, we may perhaps conclude that the domestic animals, which were comparatively rare in the Stone period, became more frequent after the introduction of bronze, a change indicating and perhaps producing an alteration of habits on the part of the inhabitants.

Rare, indeed, as they may have been, Oxen, Horses, Sheep, and Goats could not be successfully kept through the winter in the climate of Switzerland, without stores of provisions and some sort of shelter. A pastoral people, therefore, must have reached a higher grade than a mere nation of hunters. We know, moreover, in another manner, that at this period agriculture was not entirely unknown. This is proved in the most unexpected manner, by the discovery of carbonised Cereals at various points. Wheat is most common, having been found at Meilen, Moosseedorf, and Wangen. At the latter place, indeed, many bushels were found, the grains being united in large thick lumps. At other times the grains are free, and without chaff, resembling our present wheat in size and form, while more rarely they are still in the ear. Ears of the Hordeum hexastichon L. (the six rowed Barley) are somewhat numerous. This species differs from the H. vulgare L. in the number of rows and in the smaller size of the grains. According to De Candolle, it was the species generally cultivated by the ancient Romans, Greeks, and Egyptians. In the ears from Wangen, each row has generally ten or eleven grains, which however are smaller and shorter than those now grown.

Still more unexpected was the discovery of bread, or rather cakes, for leaven does not appear to have been used. They were flat and round, from an inch to 15 lines in thickness, and, to judge from one specimen, had a diameter of four or five inches. In other cases the grains seem to have been roasted, coarsely ground between stones, and then either stored up in large earthenware pots, or eaten after being slightly moistened. A similar mode of preparing grain was used in the Canary Islands at the time they were conquered by Spain, and even now constitutes the principal food of the poorer classes. In what manner the ground was prepared for the cultivation of corn we know not, as no agricultural implements have as yet been found except sickles: it is probable however that bent stakes supplied the place of the plough.

Carbonised Apples and Pears have also been found at Wangen, sometimes whole, sometimes cut into two, or more rarely into four pieces, which had evidently been dried and put aside for winter use. The apples are more frequent than the pears, and have been found not only at Wangen, but also at Robenhausen in Lake Pfeffikon, and at Concise in Lake Neufchatel. Both apples and pears are small and resemble those which still grow wild in the Swiss forests. No traces of the Vine, the Cherry, or the Damson have yet been met with, but stones of the Wild Plum and the Prunus padus have been found. Seeds of the Raspberry and Blackberry and shells of the Hazel nuts and beechnuts occur plentifully in the mud.

From all this, therefore, it is evident that the nourishment of the dwellers in the Pileworks consisted of corn and wild fruits, of fish, and the flesh of wild and domestic animals. Doubtless also milk was an important article of their diet.

The list of plants found in the Pileworks stands as follows:—

Pinus abies.
„ picea.
„ sylvestris.
Quercus Robur.
Fagus sylvaticus.
Populus tremula.
Betula alba.
Alnus glutinosa.
Corylus avellana.
Prunus spinosa.
„ padus.
Rubus idæus.
„ fruticosus.
Wheat.
Hordeum distichum.
„ hexastichon.
Trapa natans.—This species was supposed to be extinct in Switzerland; but, as M. Troyon informs me by letter, it has recently been discovered in a living condition. It has, however, become very rare.
Flax.
Hemp.
Juncus.
Arundo.

Neither Oats nor Rye have yet been found. Small pieces of twine and bits of matting made of hemp and flax may have been parts of some article of clothing. For the latter purpose also there can be little doubt that the skins of animals were used, and some of the stone implements seem well adapted to assist in their preparation, while the bone pins, and the needles made from the teeth of boars, may have served to fasten them together.

The Pottery of the Stone age presents nearly the same characters in all the settlements. Very rude and coarse, it is generally found in broken pieces, and few entire vessels have been obtained. The potter's wheel seems to have been unknown, and the baking was very imperfect. The form was frequently cylindrical, but several of the jars were rounded at the base, and without feet. The rings of pottery, which at a later epoch were used as stands for these earthen *tumblers*, are not found in the Lake habitations of the Stone period, but some of the vessels had small projections which were pierced in such a manner that strings might be passed through them, and the vessels might in this manner be suspended. Some of them were also pierced by small holes at different levels. Professor Heer suggests that these may have been used in the preparation of curds, the small holes being intended to permit the escape of the milk.

Several of the vessels are ornamented with simple markings, generally mere impressions of the finger or of the nail. Neither in the Stone, nor in the Bronze period, do we ever find either in the pottery, or on the bronze weapons, any representation, however rude, of an animal; the ornamentation being generally confined to straight or curved lines, forming in many cases a very elegant ornament. One vase, however, which was found at Wangen, is distinguished by more elaborate ornaments, the lines being evidently intended to represent leaves.

The lakes on which Pileworks of the Stone era have as yet been found, are Constance, Zurich, Bienne, Neufchatel, Geneva, Inkwyl, Nussbaumen, Pfeffikon, Moosseedorf, and Wauwyl. Settlements of the Bronze period existed on the Lakes of Geneva, Luissel, Neufchatel, Morat, Bienne, and Sempach, but none have as yet been found on Lake Constance. It has been supposed from this that the age of Stone lasted longer in Eastern than in Western Switzerland, and that flint and serpentine were in use on Lake Constance long after Bronze had replaced them on the Western Lakes. We can hardly suppose that the inhabitants of Inkwyl and Moosseedorf in Berne, who imported flint from France, can have been ignorant of the neighbouring civilization on the Lake of Bienne. Perhaps, however, settlements of the Bronze age may yet be found on the Lake of Constance; but as the question now stands, Pileworks of the Metallic period are peculiar to Western and Central Switzerland. The constructions of the latter period are more solidly built, but do not otherwise appear to have differed materially from those of the Stone age. They are often, however, situated farther from the land and in deeper water, partly no doubt on account of the greater facility of working timber, but partly also, perhaps, because more protection was needed as the means of attack were improved. The principal implements of Bronze are, swords, daggers, axes, spear heads, knives, arrow heads, pins, and ornaments. The number of these weapons which have been discovered is already very great.

From the settlement at Estavayer, in Lake Neufchatel, the following collection of bronze implements has been obtained :—

Pins with large spherical and ornamented heads	36
,, ordinary heads	92
Knives	26
Bracelets	15
Sickles	5
Axe	1
Hook	1
Chisel	1
Small rings	27
Buttons	2
Dagger blade	1
Arrow head	1
Pieces of spiral wire	6
Making altogether	214 objects of bronze.

Again at Morges (Lake of Geneva) forty-two bronze hatchets and thirteen pins have been found. From the Steinberg M. Schwab has obtained five hundred bronze hair-pins, besides other instruments of the same metal. These are of the same type as those found in other parts of Europe, and the swords are characterised, as usual, by the small space allowed for the hand. They were, however, made in Switzerland, as is shown by the discovery at Morges of a mould for celts, and at Estavayer of a bar of tin.

The pottery of this period was more varied and more skilfully made than that of the Stone age, and the potter's wheel was already in use. Rings of earthenware are common, and appear to have been used as supports for the round bottomed vases. As neither copper nor tin occur in Switzerland, the possession of bronze implies the existence of commerce. It is difficult to say from whence the copper was obtained, but Saxony and Cornwall are the only parts of Europe which produce tin. It is, however, possible that Asia may have supplied both the one and the other. The presence of amber shows that there must have been a certain amount of communication with Northern Europe.

The Pileworks of Switzerland appear to have become gradually less numerous. During the Stone age they were spread over the whole country. Confined during the Bronze era to the Lakes of Western Switzerland, during that of Iron, we find them only on the Lakes of Bienne and Neufchatel. In these settlements not only has a new substance made its appearance, but the forms of the implements are different. We have indeed copies of the bronze axes made in iron, just as we found before that the early bronze celts were copies of the still earlier stone axe, but these are exceptional cases.

The swords have larger handles and are more richly ornamented; the knives have straight edges; the sickles are larger; the pottery is more skilfully made and is ornamented with various colours; the personal ornaments are also more varied, and glass for the first time makes its appearance.

Col. Schwab has found at the Steinberg more than twenty crescents, made of earthenware, and with the convex side flattened, to serve as a foot. They are compressed at the sides, sometimes plain, sometimes ornamented. from eight to twelve inches from one horn to the other, and from six to eight inches in height. They are considered by Dr. Keller to be religious emblems, and are taken as evidence of moon-worship. He refers to Pliny, xvi. 95; "Est autem id "(viscum) rarum admodum inventu et repertum magna religione peti-"tur et ante omnia sexta luna, quæ principia mensum annorumque his "facit, et sæculi post tricesimum annum, quia jam virium abunde "habeat nec sit sui dimidia; *omnia sanantem appelantes suo vocabulo.*" This passage he translates as follows: "The misletoe is however very rare, but when it is found it is gathered with great religious ceremony, especially on the sixth day of the moon, at which epoch begin their months, years, and divisions of thirty years, because it has then sufficient force, and yet is not in the middle of its course; calling it Heal-all in their language." This name has generally been referred to the misletoe. (See The Celt, Roman and Saxon, p.48.) But the Swiss archæologists consider that this is a mistake, and that it properly refers to the moon.

A field of battle at Tiefenau, near Berne, is remarkable for the great number of iron weapons and implements which have been found on it. Pieces of chariots, about a hundred swords, pieces of coat of mail, lance heads, rings, fibulæ, ornaments, utensils, pieces of pottery and of glass, accompanied by more than thirty pieces of Gaulish and Massaliote money anterior to our era, enable us to refer this battle-field to the Roman era.

After this period we find no more evidences of Lake habitations on a large scale. Here and there indeed a few fishermen may have lingered on the half-destroyed platforms, but the wants and habits of the people had changed, and the age of Pileworks was at an end.

We have, however, traced them through the Stone and Bronze down to the beginning of the Iron period. We have seen evidences of a gradual progress in civilization, and improvement in the arts, an increase in the domestic animals, and proofs at last of the existence of an extended commerce. We found the country inhabited only by rude savages and we leave it the seat of a powerful nation. Changes so important as these are not effected in a day; the progress of the human mind is but slow; and the gradual additions to human knowledge and power, like the rings in trees, enable us to form some idea how distant must be the date of their commencement. So varied however are the conditions of the human mind, so much are all nations affected by the influence of others, that when we attempt to express our impressions, so to say, in terms of years, we are baffled by the complexity of the problem, and can but confess our ignorance. Occasionally indeed we obtain a faint glimmer of light, but the result is only to show us obscurely a long vista, without enabling us to define any well-marked points of time. Thus in Denmark we found three periods of arborescent vegetation, corresponding to the three epochs of human development, and we know that the extermination of one species of forest tree and its replacement by another is not the work of a day. The Swiss archæologists, however, have attempted to make an estimate somewhat more definite than this.

The torrent of the Tinière* at the point where it falls into the Lake of Geneva, near Villeneuve, has gradually built up a cone of gravel and alluvium. In the formation of the railway this cone has been bisected for a length of one thousand feet, and to a depth in the central part, of about thirty-two feet six inches above the level of the rails. The section of the cone thus obtained shows a very regular structure, which proves that its formation was gradual. It is composed of the same materials (sand, gravel, and larger blocks) as are even now brought down by the stream. The detritus does indeed differ slightly from year to year, but in the long run the differences compensate for one another, so that when considering long periods and the structure of the whole mass, the influences of these temporary variations, which arise from meteorological causes, altogether disappear, and need not therefore be taken into account. Documents preserved in the archives of Villeneuve show that in the year 1710 the stream was dammed up and its course a little altered, which makes the present cone slightly irregular. That the change was not of any great antiquity is also shown by the fact that on the side where the cone was protected by the dykes, the vegetable soil, where it has been affected by cultivation, does not exceed two to three inches in thickness. On this side, thus protected by the dykes, the railway cutting has exposed three layers of vegetable soil, each of which must, at one time, have formed the surface of the cone. They are regularly intercalated among the gravel, and exactly parallel to one another, as well as to the present surface of the cone, which itself follows a very regular curve. The first of these ancient surfaces was followed on the south side of the cone, over a surface of 15,000 square feet; it had a thickness of four to six inches, and occurred at a depth of about four feet (1.14 metre measured to the base of the layer) below the present surface of the cone. This layer belonged to the Roman period, and contained Roman tiles, and also a coin.

The second layer was followed over a surface of 25,000 square feet; it was six inches in thickness and lay at a depth of 10 feet (2.97 metres, also measured to the bottom of the layer). In it have been found several fragments of unvarnished pottery, and a pair of tweezers in bronze, which to judge from the style belonged to the

* See Morlot, Leçon d'Ouverture, &c.

Bronze epoch. The third layer has been followed for 3500 square feet; it was six or seven inches in thickness, and lay at a depth of 19 feet (5.69 metres) below the present surface: in it were found some fragments of very rude pottery, some pieces of charcoal, some broken bones, and a human skeleton with a small, round, and very thick skull. Fragments of charcoal were even found a foot deeper, and it is also worthy of notice that no trace of tiles was found below the upper layer of earth.

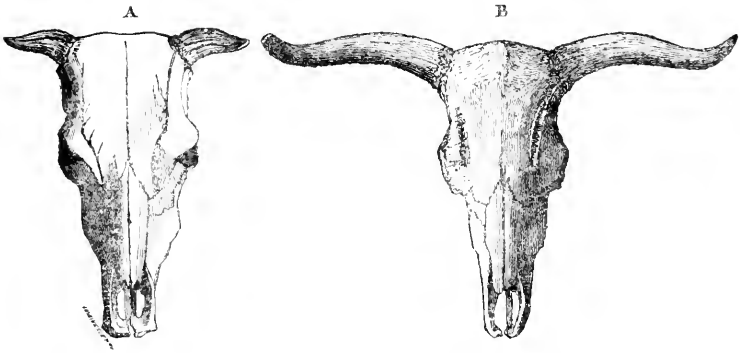
Towards the centre of the cone, the three layers disappear, since, at this part, the torrent has most force, and has deposited the coarsest materials, even some blocks as much as three feet in diameter. The farther we go from this central region the smaller are the materials deposited, and the more easily might a layer of earth, formed since the last great inundations, be covered over by fresh deposits. Thus, at a depth of ten feet, in the gravel on the south of the cone, at a part where the layer of earth belonging to the bronze age had already disappeared, two unrolled bronze implements were discovered. They had probably been retained by their weight, when the earth, which once covered them, was washed away by the torrent. After disappearing towards the centre of the cone, the three layers reappear on the north side, at slightly greater depth, but with the same regularity and the same relative position. The layer of the Stone age was but slightly interrupted, while that of the Bronze era was easily distinguishable by its peculiar character and colour.

Here, therefore, we have phenomena so regular, and so well marked that we may apply to them a calculation, with some little confidence of at least approximate accuracy. Making then some allowances, for instance, admitting three hundred years instead of one hundred and fifty, for the period since the embankment, and taking the Roman period as representing an antiquity of from sixteen to eighteen centuries, we should have for the age of Bronze an antiquity of from 2900 to 4200 years, for that of the Stone period from 4700 to 7000 years, and for the whole cone an age of from 7400 to 11,000 years. M. Morlot thinks that we should be most nearly correct in deducting two hundred years only for the action of the dykes, and in attributing to the Roman layer an antiquity of sixteen centuries, that is to say, in referring it to the middle of the third century. This would give an age of 3800 years for the Bronze age and 6400 years for that of Stone, but on the whole he is inclined to suppose for the former an antiquity of from 3000 to 4000 years, and for the latter of from 5000 to 7000 years.

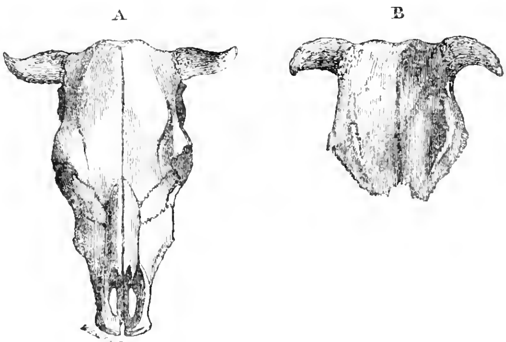
In the settlement at the foot of Mt. Chamblon we have, according to M. Troyon, a second instance in which we obtain at least some approximation to a date. The interest which attaches to this case arises from the fact that Pileworks have been found in the peat at a considerable distance from the lake, whereas it is evident that at the time of their construction the spot in which they occur must have been under water, as this mode of building would have been quite out of place on dry land. This however indicates a very considerable antiquity, since the site of the ancient city Eburodunum must have been, at that time, entirely covered by the lake, and yet the name, which is of Celtic origin, denotes that there was a town here even before the Roman period. In order, however, to form an idea of the time at which the dwellings at Chamblon were left dry by the retirement of the lake, we must have in the valley a point of determined age, to serve as a term of comparison, and such a point we find in the ancient city of Eburodunum (Yverdon), which was built on a *dune* extending from Jorat to the Thièle. Between this *dune* and the lake, on the site at present occupied by the city of Yverdon no traces of Roman antiquities have ever been discovered, from which it is concluded that it was at that period under water. If then we admit that at the close of the fourth century the lake washed the walls of the Castrum Eburodense, we shall have fifteen centuries as the period required to effect this change. The zone thus uncovered in fifteen hundred years is 2500 feet in breadth, and as the piles at Chamblon are at least 5500 feet from the water, it may be inferred that three thousand three hundred years must have elapsed since they were left dry. This Lake-dwelling belonged to the Bronze period, and the date thus obtained, agrees pretty well with that obtained from the examination of the Cone de la Tinière. M. Troyon adds that "rien ne fait soupçonner, pendant l'époque humaine et antérieurement "a notre ére, des conditions d'accroisement differentes de celles qui ont "eu lieu posterieurement aux Romains; le résultat obténu est même un "minimum, vu que la vallée va se rétrécissant du côté du lac et que "nous avons admis la présence de celui-ci au pied même d'Eburodunum "dans le IV^{e} siècle de l'ère chrétienne, tandis qu'il est probable que "la retraite des eaux n'a pas été insensible depuis le moment où les "Romains se sont fixés sur ce point."

However this may be, and while freely admitting in how many respects this calculation is open to objection, we may still observe that the result agrees in some measure with that given by the Cone de la Tinière. The ancient history of Greece and Rome, as far as it goes, tends to confirm these dates, since we know that at the time of Homer and Hesiod, arms were, in part at least, made of iron, and as we know that, at a very early period, there was a certain amount of commerce between Helvetia and the shores of the Mediterranean, we can hardly suppose that a metal so immensely important as iron, can have remained unknown in the former country, long after it was generally used throughout the latter.

Still, though we must not conceal from ourselves the imperfection of the archæological record, we need not despair of eventually obtaining some more definite chronology. Our knowledge of primitive antiquity has made an enormous stride in the last ten years, and the future is full of hope. I am glad to hear from M. Troyon that the Swiss archæologists are continuing their labours. They may feel assured that we in England await with interest the results of their investigations.



Bos primigenius. A. Skull of the existing Race, after Rütimeyer.—B. Fossil skull. Owen's British Fossil Mammals and Birds.



B. longifrons. A. Skull of the existing Race, after Rütimeyer.—B. Fossil skull. Owen's British Fossil Mammals and Birds.

B. frontosus. A. Skull of the existing Race, after Rütimeyer.—B. Fossil skull, after Nillson.

VI.—New Researches respecting the Co-existence of Man with the Great Fossil Mammals, regarded as Characteristic of the latest Geological Period. By M. Edward Lartet. (Ann. des Sc. Nat. 4me Sèrie. Tom. XV.)

The town of Aurignac, situated in the arrondissement of St. Gaudens (Haute Garonne), is placed nearly on the summit of one of five eminences, constituting a hilly range, whose geognostic formation and upheaved strata manifest its relations with the dislocated spurs of the Pyrenean system. The contour of this oreographic projection, in which the strata of the chalk and of the nummulitic or supracretaceous rock are not always inclined in the same direction, differs but little from that of the tertiary hills which rise below it to the west. The confused and uninformed traveller, consequently, approaching Aurignac from that side, would not perceive the transition which is manifested under his feet, were not his attention awakened by a sudden change in the nature of the rocks and by the evidences of dislocation presented in the road-cuttings.

The road leading from Aurignac to the little town of Boulogne in the same arrondissement, runs pretty nearly from east to west, on the southern flank of the mountain of Portel. On the opposite side, to the south, rises the mountain of Fajoles,* forming an elongated, saddle-shaped ridge, which runs in pretty nearly the same direction, and which, though of lower elevation, and nowhere precipitous, is nevertheless completely isolated from all the hydrographic influences of the district. Between these two eminences, or mountains, is a contracted valley along whose bottom runs the brook of Rodes or Arrodes, which, on reaching, a little more to the west, the foot of the mountain of Portel, turns sharply round to the north, and after running a few kilometres to the north-west joins the Louge, a small river which takes its rise on the plateau of Lanemézan.

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* In the patois of the country: *Mountagno de las Najoles*, mountain of Beeches. But at the present time not a single beech tree is to be found either on this mountain or in the surrounding country, nor does there exist any remembrance or tradition even of their formerly having flourished there. The arboreal vegetation of any region is subject to great variations in the progress of time, even independently of any change in the climatal conditions. The valuable researches of Professor J. Steenstrup on the Skövmosses, or Forest Turf-bogs of Denmark, have shown, that in that country there have been three distinct periods of arboreal vegetation since the existence of man: 1, that of the *Pine*; 2, that of the *Oak;* and 3, that of the *Beech*, which continues to the present day. The soil, in process of time, becomes exhausted of the elements more especially adapted to the nutrition of forests of one kind or another. The disappearance of this vegetation involves that of the species of animals which feed upon the foliage. The Cock of the Woods, which was common in Denmark in the Pine-period, no longer exists there. The discoveries of M. Tournal in the caverns of the Aude shows that at a certain epoch in the pre-historic period, man consumed for food the *Stag*, *Reindeer*, *Wild Goat*, *Helix nemoralis*, *&c.* At the present day the Stag is no longer found in the south of France, the Reindeer has retired to the Arctic regions of Europe, the Wild Goat is scarcely represented by rare descendants on the lofty peaks of the Alps and Pyrenees, whilst *Helix nemoralis* has entirely disappeared with the forests from that part of the country.

Following the rapid descent of the road from Aurignac to Boulogne for about a mile, (1600 metres), the traveller reaches a point whence, on the opposite side of the valley, the low ridge of the mountain of Fajoles does not rise more than about twenty metres above the stream of the Rodes. On the northern slope of this eminence may be seen an escarpment, more or less natural, of the nummulitic rock (calcaire à melonies of M. Leymerie), and on the side of this a sort of niche, or shallow grotto, whose arched entrance looks to the N.W. The floor of this excavation, which is now completely cleared out, is not more than $2\frac{1}{4}$ metres in horizontal depth, with an extreme width of 3 metres at the entrance. It is situated about 13 or 14 metres above the level of the stream. Outside the grotto, and a little below it, the calcareous soil forms a sort of platform, some metres in extent, slightly inclined towards the brook, and leaning on the south against the escarpment of the rock, the perpendicularity of which had, probably, originally been in part produced by the hand of man.

Ten years ago the existence of this cavern was unknown. Its approaches were concealed under a heap, or *talus*, formed of fragments of the rock and vegetable soil, probably thrown down solely by atmospheric agency. The place, nevertheless, was often resorted to by the sportsmen of the neighbourhood, owing to the circumstance that at a point in the outer heap of earth, pretty nearly on a level with the vault of the grotto, there was a hole, into which the rabbits, when hotly pursued, were accustomed to take refuge.

A labouring man, J. B. Bonnemaison, employed in the breaking of stones for the repair of the neighbouring road, was led to introduce his hand and arm into this hole, whence, to his great surprise, he brought out a bone of considerable size. At once suspecting the existence of a subterranean cavity, and curious to find out what it contained, he dug away part of the *talus* below the opening. At the end of some hours he came upon a large slab of stone, of no great thickness, and placed vertically in front of an arched opening, which it closed completely, leaving only a hole, resorted to by the rabbits, uncovered. When this slab was removed, he noticed a certain quantity of bones and skulls, which he at once recognized as human. The bones, which belonged to several skeletons, were found partly imbedded in a loose soil, which might have been introduced into the sepulchre at the time of interment.

This discovery of Bonnemaison's was quickly noised abroad; the curious in such matters flocked to the place, and various conjectures were formed to explain the occurrence of such an abundance of human remains in a situation so remote from any actual habitation. The older inhabitants of the district recalled the circumstance that at a remote period, a band of coiners had been surprised in the exercise of their nefarious industry, in a solitary house at no great distance from the spot. This was held sufficient to justify the popular impression that these gentry had been also guilty of numerous murders, the traces of which they had concealed by depositing the bodies of their victims in this cavity, whose existence was known only to themselves.

In order to put a stop to all these conjectures, Dr. Amiel, at that time Mayor of Aurignac, caused all the human remains to be collected, and re-interred in the parish burial-ground. But previous to this translation of the relics, he ascertained, to his own satisfaction, by counting the number of certain homologous portions of the skeletons, that they must have belonged to 17 individuals. Some of the characteristic forms found among them appeared to him referrible to females; whilst other portions, from their incomplete ossification, denoted the presence of young subjects below the age of puberty.* It should also be remarked, that among the human bones taken from the interior of the cavern, J. B. Bonnemaison distinguished several teeth of large mammals, both carnivorous and herbivorous. He also collected in the same situation, eighteen small discs, pierced in the centre, doubtless that they might be strung together as a necklace or bracelet. These discs, which were of a whitish compact substance, fell into various hands; some were sent, with some mammalian teeth, to M. Leymerie, by M. Vieu, superintendent of roads and bridges at Aurignac, whose researches in this district of the department have afforded numerous and useful materials for the study of the paleontology of the Haute-Garonne.

Shortly afterwards M. Leymerie transmitted to me the mammalian teeth, with the information respecting them with which he had himself been furnished, viz., that they had been found on the mountain of Fajoles. Amongst them I recognized the molars of the *Horse*, *Ox*, (Aurochs?) a canine tooth of the *Hyena*, another canine which appeared to me to belong the great cave *Felis*, two other teeth of a smaller carnivore, probably a *Fox*, and, lastly, the point of a *Stag's* antler.

Subsequently, on my journey to Toulouse, M. Leymerie showed me the small perforated discoid bodies, which had been sent to him at the same time with the above teeth. The hurried examination that we made of these objects, whose origin had not then been indi-

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* According to the report of Bonnemaison, the mass of human bones, at the time they were removed from the cavern, included two entire *crania*, but when M. Amiel reached the spot these were no longer so. The operations of removal, transport, and second inhumation, would necessarily occasion other alterations in bones rendered so fragile from their antiquity; but nevertheless the examination of these remains, such as they were, appeared to be very desirable. Measurements taken from the bones of so many individuals, would have afforded, to some extent, the means of deducing the average stature and proportions of this unknown race; and from the fragments of the face and skull, indications of some value, respecting the general form of the head, might also have been obtained. But unfortunately no one at Aurignac, not even the sexton, after an interval of eight years, retained any recollection of the precise spot at which these human remains had been deposited in a common trench.

cated with sufficient precision, did not allow of our ascertaining the material of which they were composed, nor of forming any opinion with respect to the purposes for which they might be intended. But M. Leymerie having been so obliging as to forward them to me at Paris, through our common friend M. Collomb, I have been enabled to determine their structure, which appears to me to be analogous with that of certain marine shells. The slightly convex face of some of the discs, though worn and half polished by artificial rubbing, still affords some traces of the projecting *costæ* of the shell of a species of *Cardium*. My first surmise to this effect has since been confirmed by the stricter examination, which M. Deshayes, at my request, has been good enough to make of one of these bodies.*

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* M. de Vibraye has recently obtained twenty-four small perforated discs of the same material and form. These were found in a cromlech in the department of the Lozère about five miles from Mende ; this cromlech, which had probably been used as a sepulchre, contained human remains, together with some bones of animals of existing species. There were also found, at the same time and place, a long flint-knife, with some spear- and arrow-heads of the same material. These latter objects, from the finish of their manufacture, and the other accessories of the burial place, indicated an epoch far more recent than that of the Aurignac cavern. Perforated beads of the same form but in different materials, are not rare in the necklaces and other ornaments found amongst the Assyrian antiquities.

It is well known, that at St. Acheul near Amiens, in the same diluvial beds that have furnished so many flint implements, there have also been collected a considerable number of beads, mostly formed of the polyparies of *Coscinopora globularis* Beads of this kind, many of which are pierced artificially, are not rare in collections, and they may be seen in the Louvre, the Cluny Museum, and at the Jardin des Plantes, alongside the flint implements brought from St. Acheul. I had noticed in the Assyrian Museum in the Louvre, similar beads which had been found in the excavations at Khorsabad, on the supposed site of the ancient Nineveh. Having obtained from M. Barbet de Jouy, one of the keepers of the Louvre, permission to make a closer comparison between the Khorsabad beads and others recently brought by M. de Vibraye from St. Acheul, we thought it better, in order to give an authoritative support to the surmise we had entertained, to refer the matter to M. Milne-Edwards, Member of the Institute and Dean of the Faculty of Sciences. The result of the examination made by this competent judge was to show an identity of form and species between at least one of the perforated corals brought from the ruins of Nineveh, and those found in the *diluvium* at St. Acheul.

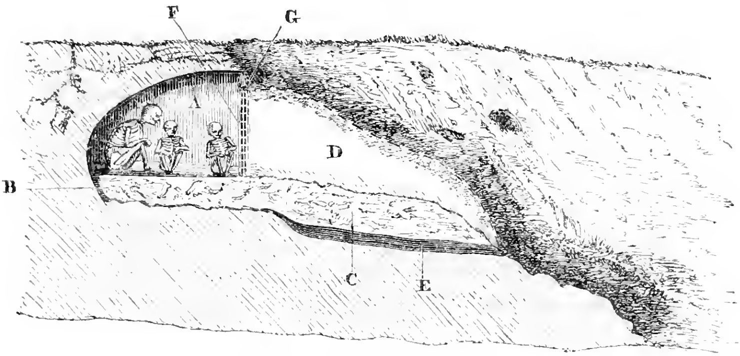
[These bead-like Foraminifera, *Orbitolina concava*, according to Mr. Prestwich, (Phil. Trans. Vol. 150, p 290), occur abundantly in the Chalk, and they are found some whole and some perforated, so that the latter condition can no longer be regarded as artificial.—Eds.]

M. de Longperrier had also pointed out to me a complete identity of form between the obsidian-knives of Mexico, and those of the same material found by M. Place in the foundations of Nineveh, where they had probably been deposited as a kind of votive offering.

At the time of the conquest of Mexico, Fernando Cortez observed that the native barbers cut the hair and beards of their customers with razors made of obsidian. Fragments of the same mineral and fashioned in a similar manner, have been collected on the field of Marathon, and may be seen in the Museum of Artillery, in the same glass cases with the flint arms of ancient Gaul. Thus we perceive the same form employed in the same manner, at extreme geographical distances apart, and at very considerable chronological intervals. "Man," says M. Troyon, (Habitations lacustres, &c.) "placed under analogous circumstances, acts in an analogous manner, irrespective of time or place."

All remembrance of Bonnemaison's discovery was nearly lost, when, passing through Aurignac in October, 1860, the circumstances attending it were related to me by M. Vieu, with details not before given, and which led me to decide upon visiting the place. I went there, accompanied by three workmen, one of whom was the original discoverer of the cave.

The sepulchral vault, in the partially cleared state it had been left by him, was at that time, on the level of the floor, $2\frac{1}{4}$ metres deep, and $2\frac{1}{5}$ metres high, measured at the centre of the arched entrance, which, as has been before stated, looked towards the N.W. The accompanying wood-cut represents a section of this cavity, or grotto, as it was at the time of my visit, and before the removal of



the layer *B*, composed of loose earth and fragments of rock, in which I still found several human bones imbedded, together with flint implements, worked portions of Reindeer's horn, and a considerable number of mammalian bones, in a state, comparatively speaking, of remarkable preservation.

In the figure, the layer *B* in the interior of the grotto is represented as continuous with the external layer *C*, in which the very numerous mammalian bones were all found broken, or even comminuted, and moreover sometimes burnt or gnawed by carnivorous animals. When I inquired of Bonnemaison whether, at the time he discovered the cave, the continuity of the interior layer *B* with that on the exterior marked *C*, were not interrupted by the vertical stone slab, by which the entrance was closed, he was unable to give any positive reply. The two parallel dotted lines therefore, indicating in *F* the place occupied by the slab, have been continued only to the surface of the layer as it existed at the time of my visit. If the stone slab had been preserved, it would have been sufficient to put it in its original place to ascertain whether it extended below the level of the bone layer, but unfortunately Bonnemaison had found it convenient to break it up for road material. However this may be, the perfect state of preservation of the bones imbedded in the interior layer of the grotto, denotes that the carnivorous animals, the Hyenas amongst others, had at no time been able to get in. It may be supposed that at each occasion of a burial the slab was removed for the moment, and replaced as soon as the ceremony was finished. The most rational explanation that can be offered of the presence of the remains of animals within the sepulchre is, that they had been introduced as part of the funeral rites,—a proceeding of which analogous instances may be found in many of the sepulchres of primordial times.*

As regards the posture of the skeletons, and the direction in which they lay, I was unable to obtain any information from their discoverer. It is evident that the floor of the grotto was not wide enough to allow the bodies of seventeen individuals to be placed side by side in the extended posture, and that its height was insufficient to admit of their being heaped one upon another. But the semicircular configuration of the sepulchre affords good ground for the supposition that the attitude given to the bodies was that which is well known to have been adopted in many of the sepulchres of primitive times; that is to say, with the body in a sitting or crouching posture, and bent downwards upon itself. This practice would not only economize the space occupied by each individual, but would also, according to some archæologists, realize the symbolic thought of restoring to the earth,—our common mother,—the body of the man who had ceased to live, in the same posture that it had before his birth, in the bosom of his individual mother.† It is for this reason, that in the figure of the cavern I have represented three skeletons in the crouching posture, warning the reader, at the same time, that the representation is altogether hypothetical.

Having noted these particulars respecting the circumstances connected with the first discovery of the sepulchre, I proceeded to the examination of the disturbed layer of loose earth remaining in it. The first strokes of the pickaxe disclosed a tooth and several human bones, after which was turned up an implement or weapon, made of Stag's or Reindeer's horn, in the form of a slender tapering spike, about 9 inches long, and carefully rounded. The lower extremity was about half-an-inch wide, and bevelled off on each side, as if intended to be fitted into a handle; the point was broken off and could not be recovered. Close to this were found half of a Horse's jawbone, some teeth of the Aurochs, the lower jaw of a Reindeer, and

* This kind of votive offering is remarked in the sepulchral monuments of the so-termed Druidical, or Celtic type, as well as in the more recent tumuli of Gaul, both before and after its subjugation by Rome. I have even been able to trace, in a sepulchre evidently not more ancient than the 10th century of our era, a continuation of this ancient custom of burying with the defunct his horse, arms, objects of affection, broken earthenware, trophies of the chase, and the bones of animals both wild and domesticated.

† This attitude of the body bent upon itself, has been noticed in most of the primordial sepultures of the north and centre of Europe, and it has been also observed in the foundations of Babylon. Diodorus Siculus informs us that it was practised by the Troglodytes, a pastoral people of Ethiopia. In more recent times it is seen in use among various peoples in America, and some of the South Sea Islands.

some entire bones of the great cave Bear, (*Ursus spelæus*), Fox, &c., &c. Outside the cave, where the heap of fallen earth *D* still remained, and whose upper border is indicated by a dotted line, I noticed, at the base, at *E*, a blackish layer, evidently composed of ashes, and of fragments of charcoal and of earth like the surrounding vegetable soil. On breaking with a hammer the surface of this layer of ashes and charcoal, I detached some taurine teeth (Aurochs), teeth of the Reindeer, and some fragments of bone, blackened by the action of fire.

Upon this, the methodical and complete exploration of all the layers, more or less compact or loose, and both within and without the cave, was at once undertaken. The work, which was performed by intelligent men, and constantly under my own superintendence, was completed on two occasions, with an interval of several days. The following are the results obtained:—

The lower layer *E*, composed of ashes and charcoal, taken as a starting point among such a complexity of circumstances as are evidenced in this locality, indicates in reality the presence of man and the existence of a fire-place or hearth, around which it must be supposed he made his repasts. This hearth was several square metres in extent, and constituted a sort of platform formed of the nummulitic rock, fragments of which had been laid so as to level the natural inequalities of the surface; which here and there presented a good many very thin plates of fissile sandstone, most of which were reddened by the action of fire. The nearest locality at the present day, where this fissile stone is found, is a distance of some hundreds of metres on the other side of the valley, at the foot of the mountain of Portel.

The layer of ashes and charcoal, whose proportionate thickness is exaggerated in the figure, was not in reality more than from six to eight inches thick, and it gradually thinned off towards the entrance of the grotto, into which it did not extend. There were found in it a very great number of teeth, principally of herbivorous animals, together with many hundreds of fragments of their bones. Some of the bones were carbonized, and others simply reddened from having been exposed to a low heat. The greater number did not appear to have been subjected to the action of fire. The majority of the fragments were those of long bones having medullary cavities, and of these, almost all appeared to have been broken in a uniform manner. A great many of those which had not been exposed to fire bore the marked impress of the teeth of a carnivorous beast, which had left only the thick and compact shafts of the great bones of the Aurochs and Rhinoceros. The discovery, among the very ashes of the fire, of the coprolites of the Hyæna showed that it was that powerful carnivore which had doubtless taken advantage of the absence of man to devour the remains of his repasts. It is also to the voracity of the Hyenas that we may attribute the almost complete absence, either on the hearth or in the ossiferous deposit about it, of the vertebræ and other spongy portions of the herbivorous bones.

Besides the peculiar mode in which they are broken, denoting that it had been done for the purpose of extracting the marrow,* there may be sometimes observed, on the surface of the bones, scratches and shallow cuts, which appear to have been caused by the edge of some instrument employed to remove the flesh.

In fact, we collected among the very ashes on the hearth a hundred pieces of silex, some of no definite form, but the greater number fashioned after the type so universally met with and designated by archæologists under the name of "*knives*." It would appear that a portion at least of these implements had been manufactured on the spot, as we found, in the neighbourhood of the hearth, the nuclei of the blocks from which splinters of various dimensions had been struck off. We also found, in the same situation, a stone of a circular form, flattened on two sides with a central depression on each, and constituted of a rock not found in this region of the Pyrenees, and which, from the explanation of its object given me by M. Steinhauer, Conservator of the Ethnographic Museum at Copenhagen, was used for renewing, by skilful blows, the edges of the flint knives. The central depression on each flat side was intended for the fingers and thumb in the required manœuvre.† We also procured from among the ashes two portions of silex broken so as to have numerous facets, which have been regarded by archæologists as missiles [sling-stones], and which are rendered more destructive by the numerous angles presented on the surface.

Besides these flint arms and knives there were also found, both in the ashes and in the superjacent ossiferous layer, many other instruments of divers forms, and made for the most part of the more compact portion of the Reindeer's horn. Some of these are in the form of arrow-heads, simply lanceolate, and without wings or recurrent barbs, such as are found in arrow-heads of a more recent period. All are broken immediately below the widened base of the lance-shaped portion. Some of these arrows appear to have been reddened by the action of fire, as if they had been left in the flesh of the animal when it was cooked. One of the largest among them exhibits, on its two opposite surfaces, some impressions in the form of a cross, which, though with some hesitation, may be regarded as having been caused by the teeth of a carnivorous animal in its endeavours to draw the arrow from the wound (??). One of these bone-

* Travellers relate that among people who live chiefly on the products of the chase, the marrow of the bones of the Herbivora is highly appreciated and sometimes reserved for the chiefs. Among the Laps and Greenlanders the marrow taken warm from the animal is held one of the greatest delicacies, and is presented as a mark of honour, according to M. Morlot, to the visitor and Government officers.—*Morlot*, *Etudes geologico-archeologiques en Danemarck et en Suisse.*

† Implements for the same purpose have been figured in the "Atlas of Antiquities of the Stone Age of Denmark," by M. Worsaae. M. Alphonse Milne-Edwards has also informed me that he saw similar implements in one of the museums in Holland recently visited by him.

implements, in the form of a very slender and sharp-pointed bodkin, appears to have been made from the horn of the Roebuck, which is far more compact and harder, than the horn of the Stag or the Reindeer. It is in a very good state of preservation, and would still serve to make holes in the skins of animals for the purpose of joining them together with a coarse kind of suture. This implement was found in the ossiferous layer above the ashes.

Another instrument, also of Roebuck horn, has an equally sharp point, but is not so tapering that it could serve for a needle or awl, and it might be asked whether it could not have been employed for the purpose of tatooing (?).

Other implements of various dimensions and in the form of a thinnish blade, represent, according to M. Steinhauer, the polishers, made of Reindeer-horn, used by the Laplanders to smooth the coarse sutures of their skin garments. In support of this supposition it may be noticed that on one of these instruments, the marks of repeated friction may be observed on both sides.

Another instrument, of pretty nearly the same shape, appeared to me intended for quite a different purpose. On one side, the surface presents all the roughness of the Reindeer's horn, but it has nevertheless been carefully polished, and it is sensibly curved and concave in a longitudinal direction. The opposite side is convex and polished throughout.

Another blade of Reindeer horn which is unfortunately broken at each end, exhibits, on one side which is carefully polished, two series of equidistant transverse lines, separated by an interval in the middle of the fragment. On each edge, also, may be observed a series of shallow notches at pretty regular distances apart. These marks and notches suggest the notion that they might be intended to represent numeral signs expressive of various values, or perhaps belonging to distinct objects.

Another portion, of which I am unable to explain the use, is a portion of Reindeer's horn, in the middle of which, at the point where an antler sprang from the stem, is an oval hole or perforation, whose side is marked with grooves resembling, except that they do not run in a spiral direction, the worm of a screw. This fragment was found in the layer of ashes.

The handle of some implement made of Reindeer's horn was found in the interior of the cave, beneath the space where the bodies had been deposited, and in close juxtaposition with several flint implements, worked with more care than those left in the fireplace; a circumstance leading to the supposition that all these choicer objects had formed a sort of votive offering. The handle in question presents, near the base, the mark of the place whence the lowest, or brow antler had been removed, in order to render the grasp more convenient; higher up, is the truncated base of the second antler, which is hollowed out, for some unknown purpose; and at the end of the stem portion, is the principal opening for the fixing of the weapon into the handle, and which is continued to the base of the horn. One of the flint implements above alluded to is a knife manufactured with particular care, and appearing never to have been used.

One of the most curious of the relics discovered in this exploration is the canine tooth of a young Great Cave Bear (*Ursus spelæus*). The crown has been entirely deprived of enamel, afterwards thinned on the two sides, and a groove running along the concave border simulates a sort of buccal commissure, or the opening of a bird's beak; an oblong fossette visible above and a little behind this, in the situation that would have been occupied by the eye, and surmounted by a superciliary line, completed an ill-defined resemblance to some animal form, perhaps a bird's head. The maker, or, as one might say, the artist, who certainly had at his disposal large canines of the same species of Bear, chose that of a young individual, no doubt because the still existing pulp cavity enabled him to complete the perforation with less trouble. The tooth, in fact, is perforated from end to end, so as to admit of its being suspended by some means. It was found very near the entrance of the cave, and exactly at the spot where Bonnemaison, after the removal of the stone slab, had subsequently collected the rubbish from the interior. It had probably been originally interred with one of the bodies as a token of affection, or as an amulet, and was overlooked when all the human remains were removed by M. Amiel.*

It has been remarked that some of the flint implements must have been manufactured on the spot. The same may be said of some articles in Reindeer horn; for we collected, partly among the ashes, partly in the superjacent layer of rubbish, the remains of the horns of that animal, from which the antlers and other portions, likely to be made useful as implements, had been removed.

The experience acquired by this primitive people had even thus early taught them that the shed horns, which at the present day are preferred by cutlers, are better nourished and more compact than those taken in the growing state from the head of the living animal. A single horn of a young individual was found, which had been cut off immediately after the death of the animal, doubtless that its solitary point might be used. It was still attached by the base to the frontal bone, and at and below the seat of fracture the striped lines of numerous cuts made with the blunt edge of a flint tool may readily be perceived.

Among the ashes we also found the disjointed laminæ of the molars of the Elephant (*E. primigenius*). In these laminæ, from which the enamel is detached, the ivory appears to have been very much altered by the action of fire. It is impossible to surmise the purpose for

* In the sepulchres of the ancient Livonians, we are informed by M. Frederick Troyon, that pierced teeth of the Bear are found, which had been worn no doubt as charms or amulets.

which these were intended; but there can be no doubt that the teeth had been thus disjointed purposely, for in the rubbish above the ashes we found the basal portions of two molars of the Elephant from which it was clear that the upper portion, in which the laminæ are longer and wider, had been detached. Particles of charcoal are still adherent to one of these fragments. This is all that we discovered of Elephant's remains.*

The portion of the ossiferous rubbish *B*, comprised between the fire-place, or inferior layer of ashes and charcoal, and the rubbly mass of vegetable earth above, which, before Bonnemaison's discovery, concealed the entrance of the cave, was nearly a metre in thickness. In it were found, as in the ash-layer, many bones of Herbivora, always broken and comminuted in the same manner, and some also gnawed by Hyænas. In the same situation, likewise, we met with scattered particles of charcoal; the bones of the Carnivora were tolerably abundant. These were often entire, and, when broken, the fracture did not present the uniform character so remarkable in the herbivorous bone; and none of the carnivorous remains were gnawed, or exhibited any marks of the teeth of the Hyæna.† Nor on these bones could any of the scratches or incisions made with cutting instruments be perceived, which are so often noticed in the herbivorous bones.‡ In explanation also of the presence in this situation of a considerable quantity of the remains of Carnivora of different sizes, it may be suggested that these animals served principally to furnish skins and furs for clothing and the protection of man against the weather. Nevertheless it should not be forgotten that in the interior of the cave, among the human skeletons and in the soil beneath them, the

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* It may be asked, why, if Elephants existed at that period at the foot of the Pyrenees, arrows or other implements made of the ivory of their tusks are not met with. "The Ethiopians in the army of Xerxes," says Herodotus, "used long arrows made of cane, pointed, instead of iron, with a sharp stone. They had also javelins armed with the horns of the Roe-deer (?) pointed and fashioned like the head of a lance." Elephants nevertheless existed in Ethiopia, as is proved by the circumstance that certain nations in that country were termed Elephantophagi. The Phœnicians, moreover, fetched ivory from Ethiopia, with which they traded amongst other nations. But the Ethiopians, like the sub-pyrenean people, had the common sense to perceive that ivory was more difficult to work, more brittle, and less durable than the horns of the various species of *Cervus*.

† This circumstance, made me think that in the wild state the Hyena might have a repugnance to feeding on the flesh of Carnivora; but M. Jules Verreaux who, when at the Cape of Good Hope, fed domesticated Hyænas with the flesh of the dog, has assured me that Hyænas when retiring in troops into caverns, sometimes devour that of their comrades who may fall sick. Mr. Brown, in his journey to Darfour, relates that when an individual in a troop of Hyænas is wounded, the rest fall upon and devour him. Dr. Buckland also was of opinion that in the ossiferous caverns in England, even the bones of the Hyæna had been gnawed by their congeners.

‡ In this respect, however, an exception must be made in the case of two fragments of a young *Ursus spelæus*, on one of which more especially (part of the pelvis) may be seen numerous streaks, which it might be supposed had been produced by the repeated action of a tool employed to remove the flesh.

bones of Carnivora were the most numerous; whence it may be supposed that these animals entered largely into the funeral rites, of which analogous instances may be seen in sepulchres of a more recent period.*

One circumstance struck me as remarkable: that although we collected a great many lower jaws, almost entire, of Carnivora, and, in the interior of the cave, some of herbivorous animals, not a single upper jaw in the entire state, nor any considerable portion of the cranium of any of these animals were met with. Must we conclude that the crania in general had been broken to pieces for the extraction of the brain? The North American Indians, according to Hearne, as quoted by M. Morlot, prepared the skins of animals with a lye composed of the brain and marrow. "The Samoiedes," says Pallas, "split up the bones of the Reindeer, in order to devour the marrow quite fresh and raw. Their favourite food consists of the brain taken raw and steaming from the skull; and they also devour in the raw state, the young horns of the Reindeer, when they are beginning to sprout."

In the soil within the cave at *B*, were discovered, as has been said, several human bones which had been left buried in it, after the removal which had been effected, several years before, of the skeletons interred in the burial ground of Aurignac. It was in the same situation that were found the most highly finished flint implements and the finest specimen of worked Reindeer's horn, as well as an almost entire horn of that animal. The only bones of Herbivora that we obtained in a good state of preservation, were also procured in the same deposit. The carnivorous bones constituted the majority, and amongst these, those of the Fox were the most numerous, after which came those of the Great Cave Bear (*Ursus spelæus*). Of this species, one specimen must have been introduced entire, since we found in very close contiguity, the various bones of its skeleton. Amongst the individuals of this great species of Bear whose remains had been conveyed into the cave by the hand of man, one must have been a female in an advanced stage of gestation, for in the loose earth outside the cave we met with several remains of a fœtus nearly at the period of birth. Whilst the bones of the Herbivora found outside the cave were all broken and comminuted, burnt and gnawed, both those found in the ashes, as well as those lying in the layer of earth above the ash-layer, the bones found in the interior had, on the contrary, been well preserved, and, in particular, showed no mark of their having been attacked by the teeth of Carnivora. Whence it may be concluded that these parts of animals had been introduced into the sepulchre for a special purpose; and, at the same time, that the entrance had been constantly closed against the Hyænas.

* The Laplanders of the present day are not so dainty as we may suppose the aborigines of Aquitaine to have been, for, according to J. Acerbi, (Voyage au Cap Nord) they eat indifferently the Bear, Wolf, Fox, Otter, and Seal.

The general assemblage of the Mammalian remains collected at Aurignac, shows that the Carnivora, in number of species, were almost equal to the Herbivora. Subjoined are lists of both, with an approximate valuation of the number of individuals referrible to each species.

1. Carnivora.

	Number of individuals.
1. *Ursus spelæus*	5 — 6
2. *Ursus Arctos?*	1
3. *Meles Taxus*	1 — 2
4. *Putorius vulgaris*	1
5. *Felis spelæa*	1
6. *Felis Catus ferus*	1
7. *Hyæna spelæa*	5 — 6
8. *Canis Lupus*	3
9. *Canis Vulpes*	18 — 20

2. Herbivora.

1. *Elephas primigenius*, two molars.	
2. *Rhinoceros tichorinus*	1
3. *Equus Caballus*	12 — 15
4. *Equus Asinus?*	1
5. *Sus Scrofa*, two incisors.	
6. *Cervus Elephas*	1
7. *Megaceros hibernicus*	1
8. *C. Capreolus*	3 — 4
9. *C. Tarandus*	10 — 15
10. *Bison europæus*	12 — 15

Among the Carnivora, *Felis spælea* was represented only by a single canine and a premolar bearing the mark of a fracture caused by some violence. From this it may be presumed that the body of the animal was never conveyed to the spot, and that the teeth had been brought with a special intention, and the rather so because both were collected within the sepulchre, and one of them (the canine sent to M. Leymerie) beyond (à travers) the human bones at the first discovery of the place by Bonnemaison.

As the two molars of the Elephant are also the only relics of that species, their being brought by man to the place where they were found, may also be referred to some customary purpose. And the same may be said of the two incisors of the Wild Boar, likewise the only relics of that species discoverable among such a considerable heap of bones.*

* In the lower grotto of Massat, another ancient station, where man has left numerous relics of his feasts, the Boar is also represented only by a single molar. Certain nations of antiquity had, at an early epoch, a marked repugnance to the

I have omitted to enumerate in the list of Herbivora two half-jaws of a Field Mouse (Campagnol), and the calcaneum of a Hare, which may have been accidentally introduced independently of human agency.

It is well known that an aversion to the flesh of the Hare, is still more general than that against pork. The Hare was regarded as impure by several of the nations of antiquity. Cæsar (*De Bell. Gallic.* lib. v. c. 12) states that among the inhabitants of Britain the use of its flesh as food was forbidden.* The Laplanders at the present day always regard it with horror, and among several nations of our part of Europe the flesh of the Hare is still despised. The remains of the Hare and Rabbit are very abundant in the ossiferous breccias and in many of the caves in the Pyrenees; but I have met with no traces of their existence in the lower grotto of Massat, nor have their remains been noticed in other caverns which appear to have been inhabited exclusively by man. The bones of the Hare are not mentioned among those of the numerous animals recognized in the Danish Kitchen-middens,† nor have any been found below the lacustrine habitations of Switzerland belonging to the various ages of Stone, Bronze, and Iron.

With respect to the Horse, it appears from the broken and comminuted state of his bones, resembling that in which those of the ruminants are found, that his flesh entered largely into the food of the aborigines of Aurignac. Nevertheless, at Massat, a station a little less ancient, the bones of the Horse are entirely absent, whilst in the cavern of Bise, which was used as a habitation by man at a period when the Reindeer still lived in the south of France, the broken bones of the Horse were, according to M. Tournal, equally abundant with those of the ruminants. The Sarmatians, says an ancient historian, were distinguished from other nations, and *in particular from the Celts*, by their taste and predilection for the blood and flesh of the Horse, and for Mare's milk. The Horse is wanting in the Stone age in Switzerland and in Denmark. Nevertheless, in Switzerland, in the 10th century of our era, horse-flesh was served at the table of the monks of St. Gall, at a period, when amongst other European nations its use as food was forbidden under pain of excommunication.

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flesh of the Wild Boar or of the Pig. Their flesh, it is well known, was excluded from the diet of the Egyptians and of the Jews, who, nevertheless, had domesticated the species. The Scythians, according to Herodotus, abstained from the flesh of the Hog, and the Gallo-Greeks held it in equal aversion. How can the fact be explained, then, that the ancient Gauls, who had affinities with both those people, used pork as a considerable part of their food? Observations made in the ancient stations of the aborigines of Denmark, and beneath the lacustrine habitations of the Stone period in Switzerland, have shown that those primitive races also fed largely upon the flesh of the Wild Boar.

[* Though he states, nevertheless, that the Britons bred the Hare, Fowl, and Goose, though forbidden to use them as food, "animi, voluptatisque causâ."]

[† Vid. Nat. Hist. Rev. 1861, p. 489.]

The Rhinoceros appears also to have been eaten by the Pyrenean aborigines. Some molar teeth, and a certain number of bones belonging to a young individual, were found at Aurignac in the layer of earth above the ashes. All the vertebræ and the spongy parts of the long bones had disappeared, devoured without doubt by the Hyænas; but the thick and compact portions of the shafts of the long bones were left. They are broken in the same manner as those of the other Herbivora, and several fragments still bear the traces of cutting instruments. Another proof, moreover, that when the carcase of this young Rhinoceros was brought there, it had been recently slain, is afforded by the circumstance that its bones, after they had been broken by man, had afterwards been gnawed by the Hyænas, which would not have been the case had they not been still fresh and filled with their gelatinous juices.*

The rarity of the common Deer and of the Irish Elk, represented at Aurignac, each by the remains of a single individual, might be explained perhaps by the great abundance of those of the Reindeer. We know that in a wild state, antipathies exist between certain closely allied species, or sometimes between species belonging to the same genus, which lead them to inhabit perfectly distinct districts.

The Aurochs and the Reindeer, then, are the species which have figured the most often in the feasts of whose relics we find only what was spared by the Hyænas. The situation of the hearth, on a platform overlooking the valley and stream of the Rode, allow also of the supposition that a great part of the bones might have been thrown to the bottom of the valley, whence they would afterwards be removed by the current of water, or decomposed by atmospheric agencies.

The long bones of these ruminants, so rich in marrow, have all been broken for its extraction. Not one has been forgotten; every bone, down to the first phalanges of the Stags and Reindeer, which, like the long bones, contain a medullary cavity, has been carefully opened. But the way in which this has been done is neither so methodical nor so elegant as that noticed in the Danish kitchen-middens, the bones in which have all been split with remarkable dexterity, in such a way as to expose, at a single blow, the whole of the marrow they contained: as may be seen for instance in the cannon-bone, or metatarsus, of the Aurochs, and of the Deer. At Aurignac, as well as at Massat, this mode of fracture is rather rare,

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* Several African nations eat the flesh of the Rhinoceros, and amongst others the Hottentots. "The Shangallas," says Bruce, "are very fond of its flesh, although it is very hard, almost tasteless, and with a strong musky smell; the most delicate part in their estimation is the sole of the foot, which like that of the Elephant and Camel, is of a cartilaginous and soft substance." According to M. Boitard (Dict. Univ. d'Hist. Nat.) the Indians hunt the Rhinoceros for their horns, and to eat their flesh. The Chinese are of opinion that after swallows-nests, the eggs of the lizard, and puppies, there is nothing so delicate as the tail of the Rhinoceros, and a kind of jelly made from the skin of its belly.

and, in general, badly executed. This may be owing perhaps to the want of appropriate tools, which have not been found at either place, whilst the Danish aborigines were provided with them in abundance. At Aurignac, therefore, and also at Massat, the long bones are rarely split longitudinally; sometimes the ends have been broken off, but more often the bones appear in some way to have been broken and reduced to fragments by blows from a stone; and in these two situations we have found, in the neighbourhood of the remains of the banquet, the blocks and pebbles, which may have served for this operation.

It may be asked, how is it, that with arms in appearance so inefficient as those we have described, the aborigines of ancient Aquitania ventured to attack animals of the size of the Great Cave Bear, Rhinoceros, &c.?*

It may be presumed, that, like the ancient Germani spoken of by Cæsar, the primitive inhabitants of the Pyrenees were acquainted with the art of constructing snares for these great animals, and of catching them in pits, concealed under the leaves and branches of trees. And besides this, their accurate knowledge of the most vulnerable points in the bodies of the animals, and the precision of their aim, either with the arrow or dart, might to a certain extent compensate for the imperfection of their rude weapons.†

Such is the general statement of the observations it was possible to make during the complete and careful exploration of the Aurignac station. The circumstances to which they relate are complex; and their succession also indicates a considerable lapse of time. The first traces of living creatures met with in the loose and, speaking geologically, comparatively recent deposits, are those of man, proving that he had made a fireplace on the platform outside the little cave, whilst the thickness of the layer of ashes upon this site shows that it was inhabited for a long time, or, at any rate, that it was frequently visited.

The complete absence of any trace of fire in the interior of the grotto, and the state of comparative preservation of the bones found

* In spite of all the attention which I have devoted to the examination of the bones found at Aurignac, and to the other circumstantial evidences afforded at that place, I have failed to detect the faintest indication of the existence of the *Dog*, that habitual companion of man in the chase, in all climates and in every state of barbarism. Under the piles belonging to the stone age in Switzerland, the remains of a diminutive race of Dogs have been met with. In studying the fauna of the Danish kitchen-middens, Prof. Steenstrup has satisfied himself, from the way in which certain bones have been gnawed, that the Dog must have been the latest companion of the aborigines, and he has even found reason to believe it may sometimes have been eaten by them. At Massat (Ariége), a station far more recent than that of Aurignac, I have myself fancied that I could perceive indications of the presence of the Dog, from the way in which some of the herbivorous bones had been gnawed.

† The Shangallas, according to Bruce, kill the Rhinoceros with the worst arrows it is possible for a people making use of arms at all to have; and they flay it afterwards with knives no better than their arrows.

therein, denote that the cave, closed against all access from the exterior, must have been consecrated to human burials.

The fragmentary condition of the bones of certain animals, the mode in which they are broken, the marks of the teeth of the Hyæna on bones necessarily broken in their recent condition, even the distribution of the bones and their significant consecration, lead to the conclusion that the presence of these animals, and the deposition of all these remains, are due solely to human agency. Neither the inclination of the ground, nor the surrounding hydrographical conditions, allow us to suppose that the remains could have been brought where they are found by natural causes.

The large amount of the remains of animals which had served as human food, and their presence at different levels, would indicate that successive assemblages had gathered at this spot. These assemblages probably took place on each occasion of the burial of the various individuals interred in the grotto. And it is highly probable also that the station ceased to be frequented when the sepulchral cave, being fully tenanted, would no longer afford space for further inhumations.

The gentle and prolonged action of simple atmospheric agencies, would be sufficient, in course of time, to account for the detachment of fragments from the escarpment of the adjacent rock, and the gradual accumulation of loose fallen earth, by which the site of the fire-place outside, and the slab closing the opening of the sepulchral cave, would be entirely covered.

The antiquity of the sepulchre cannot be ascertained either from tradition or history, nor from numismatic data, no document of this kind relating to it having been met with.

Regarding the subject archæologically, we perceive, in the absence of any kind of metal, and the common employment of implements and weapons of flint and bone, sufficient indications that the station of Aurignac should be referred to that ancient period of prehistoric times, denominated by antiquaries of the present day,—the *age of Stone.*

Palæontologically, the human race of Aurignac belongs to the remotest antiquity, to which, up to the present time, the existence of man or the vestiges of his industry have been traced. This race, in fact, was evidently contemporary with the Aurochs, Reindeer, Gigantic Elk, Rhinoceros, Hyæna, &c.; and, what is more, with the Great Cave Bear (*U. spelæus*), which would appear to have been the earliest to disappear in the group of great mammals, generally regarded as characteristic of the last geological period.*

But, it will be said, how does it happen, if the sepulchre of

* The chemical examination by M. Delesse of the Aurignac bones, furnishes a further excellent means for determining the question of contemporaneity. The respective analyses which he has made demonstrate that the bones of the Reindeer, Rhinoceros, Aurochs, &c. have retained precisely the same proportion of nitrogen, as the human bones from the same locality.

Aurignac is to be referred to a period, coeval with the most ancient geological deposits in which the products of human industry have been found,—the diluvial beds of St. Acheul and of Abbeville,—that the violent phenomena of that diluvian period, and the great cataclysm* connected with those beds, have not affected the original conditions of this cavern? It is obvious, in fact, that nothing has been disturbed, and that, not only have a simple slab of stone a few centimetres in thickness, and a thin covering of loose earth, sufficed to preserve intact the sepulchre itself, but also that outside the cave, the relics of the funeral repasts and the various implements and arms left by the human inhabitants have not been disturbed.

It has been observed above that, from its isolated position in the mountain range of Aurignac, the mountain of Fajoles is completely protected from the streams and torrents of the surrounding country. Nevertheless, upon looking at the geological map of France, we find that the colour indicating the great alluvial deposits of the Garonne, Adour, &c.,† is wanting in the interval between the little valleys which commence on the plateau of Lanemézan. A very slight elevation of the borders of this plateau has been sufficient to protect the whole of the intermediate region, (more than 200 square leagues.) within which are comprised the district of Aurignac, from the invasion of this *diluvium* or Pyrenean *drift.*

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* I am here obliged to repeat what I have already said elsewhere: viz., that the grand words, *revolution of the globe, cataclysm, universal perturbation, general catastrophes, &c.*, have been introduced by a sort of abuse into the technical language of Science, seeing that they tend to give an exaggerated significance to phenomena, which geographically have been very limited in extent. These phenomena, however stupendous they may appear to us, as manifested within the limits of our sensible horizon, are reduced to very little when brought down by actual calculation to their relative importance as regards the whole surface of the globe. Everything, moreover, indicates that the successive production of these partial accidents forms part of the normal conditions of the course of nature, and that the great harmony seen in the physical and organic evolutions on the surface of the earth, has in no case been affected by them.

Aristotle fully comprehended those alternating movements of the land, which at several intervals have changed the relations of continents and seas. He also reduced to its regional proportions the deluge of Deucalion, so embellished and magnified by the fictions of poetry. This great naturalist appears to have been obliged to combat the fantastic conceptions of the *revolutionist* philosophers of his time; and the rude apostrophe which he addressed to them, "ridiculum enim est, propter parvas et momentaneas permutationes, movere ipsum totum." (Meteorol. 1. i. c 2.), might well, after two thousand years, be applied to some among us, geologists and paleontologists of the present day.

† These alluvial beds or *diluvium* occupying the bottom of the valleys of the Garonne and of the Adour, should not be confounded with the pebbles and argillaceous deposits, lying at a higher level on terraces more or less continuous, ordinarily on the left side of the course of the rivers. These deposits, in which the granitic, ophitic, and other feldspathic pebbles, are almost always in a decomposed state, belong to a more ancient period, or that of the original excavation of the valleys. At the bottom of the valleys of the Garonne and of the Adour, the granitic, and other pebbles of the Pyrenean drift, are numerous and perfectly preserved. None of the kind are met with in the little valleys descending from the plateau of Lanemézan.

In the valley of the Garonne, the Pyrenean *drift* is the geological or synchronal equivalent of the *diluvium* of the Seine and of the diluvial deposits of Amiens, Abbeville, &c., because it is in these alluvial beds, that are found the remains of *Elephas primigenius, Rhinoceros tichorinus,* and other species regarded as characteristic of the *diluvium.*

But this phenomenon of torrential recrudescence, which has produced the *diluvium,* and whose cause must be sought in a sudden return to regional conditions of extreme temperature, has been manifested, only to a comparatively very trifling extent, in all the valleys descending from the plateau of Lanemézan. It is not astonishing therefore, to find that the sepulchre of Aurignac, if it existed at that time, should not have suffered any damage from the effect of the great floods of the period, seeing that, from its comparative altitude, it was placed beyond their reach.

I would, nevertheless, go farther, and say that viewed simply under the palæontological relations manifested in it, the sepulchre of Aurignac claims a very high comparative antiquity. In fact, the Great Cave Bear, which we there behold evidently cotemporary with man, has not, so far as I know, yet been found in France in the *diluvium.* It is true, that it has been mentioned in a list which has several times been reproduced, of the fossil Mammals discovered in the diluvial beds of Abbeville ; but I have in vain tried to get at the source of the methodical determination upon which this statement rests, and from all that I have seen of its fossil remains the Bear, either from the valley of the Somme, or from the environs of Paris, belongs to a species, or to more than one species, very certainly distinct from *Ursus spelæus.* In the centre of France, and in England, all the remains of the latter species, not found in caverns, come from deposits, regarded by geologists as more ancient than the *diluvium.*

It will, doubtless, be objected to this, that the remains of *Ursus spelæus* occur very abundantly in most of the caverns of the continent, and even in some of those in England ; but, at the same time, it must not be forgotten that the date of the filling of these caverns is evidently to be placed beyond the epoch assigned by geologists to the diluvial phenomena, because in several of these caverns, at any rate, the remains of Mammals are met with, which are sometimes included in the lists of species referred to the latter phases of the tertiary period.

We see then, that if we rely solely upon the consideration of the palæontological concomitances, the result we should arrive at would be, that the sepulchre of Aurignac should be referred, together with all the circumstances accompanying it, to an epoch *anterior* to the *diluvium* properly so termed. In confining the force of this remark simply within the limits of its inductive value, I do not think I am losing sight of the reserve with which new propositions should be introduced, when they as yet repose only on negative observations.

VII.—The Sumatran Elephant. By Prof. H. Schlegel.

[The following translation from the Dutch, of a paper read by Prof. H. Schlegel, before the Royal Academy of Sciences of Holland,* gives some further details respecting the Sumatran Elephant. This species was distinguished by Temminck some years ago, from the Elephant of Continental India, and proposed to be called *Elephas sumatranus*,† but is hardly known to Naturalists of this country, except from the short notice of it communicated by the late Prince Charles Bonaparte, to one of the meetings of the Zoological Society of London, in 1849.‡—P. L. S.]

It is well known that Sumatra is the only island of the Indian Archipelago, where Elephants are found wild. Magelhaens has informed us, that the Elephants which he saw in Borneo, were introduced there, and that the animal is as little indigenous to that island as to Java.

So long as all living Elephants were treated of as belonging to one species, no one thought of comparing them together; and even after Cuvier had pointed out that the Elephant of Africa was very different from that of India, yet the opinion remained that all the Asiatic Elephants constituted but one species, though, as we shall presently show, the examples on which Cuvier established his *Elephas africanus*, differed specifically *inter se*. This idea, indeed, had gone so far that no one took the trouble to examine further the Elephants, which were brought alive from time to time from Sumatra to Java, and there kept in a half-domestic state, but people were content to refer them to the so-called Indian or Asiatic Elephant, to which also, according to Cuvier, the Ceylonese Elephant belongs.

As, however, nothing is proved by a negative, and it is of great importance in a large Museum to obtain illustrations of the Faunas of different countries, I never ceased to urge my predecessor, Heer Temminck, to obtain specimens of the Sumatran Elephant for the Royal Museum. In August, 1845, I was fortunate enough to be gratified in this respect, several examples of Elephants from the district of Palembang in Sumatra, having been liberally forwarded to the Museum, by his Excellency the Baron J. C. Baud—at that time Governor of the Dutch possessions in India. As I was unpacking them it appeared to me that they differed in several respects from the Elephant of Bengal. I occupied myself, therefore, with drawing up the characters of these two animals, compared with those of the African Elephant, and gave the results to Heer Temminck;

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* See Verslagen en Mededeelingen der Koninklijke Academie van Wetenschappen, Afd. Natuurkunde, 1861, p. 101.

† See his "Coup d'œil sur les possesions Nederlandaises dans les Indes Orientales." Vol. II. p. 91.

‡ See Proc. Zool. Soc. 1849, p. 144.

which he afterwards published,* calling the new species by the name *Elephas sumatranus*.

Since that period, several other examples of the Elephant living in Sumatra have been brought to the Netherlands, so that I have had the opportunity of examining them. Amongst these were seven skeletons, of which three are still in the Royal Museum, several skulls, a young specimen of about three feet high also now in the Museum, and a living animal about six feet high now in the Zoological Gardens, at Amsterdam. All these specimens exhibited alike the characters, in which they differed from such examples of the so-called Indian Elephant, as I have examined.

I say the *so-called* Indian Elephant, because it has not yet been settled to which species we should apply this name. The name is generally given to that species of Elephant which has been brought from Continental India, and particularly, as it appears, from Bengal to Europe. This practice we have followed, but we must nevertheless guard ourselves from believing that this was exactly the species which Cuvier described under the name *Elephas indicus*. Cuvier assigns to his *E. indicus* twenty dorsal vertebræ, and consequently a like number of pairs of ribs. This would lead us to believe that Cuvier's determination was made upon a skeleton of the species which lives in Sumatra, and not upon one of the Bengalese species, which has only nineteen dorsal vertebræ and a like number of pairs of ribs.†

The under jaw figured by Cuvier, pl. 5, fig. 3, seems, judging from the width of the laminæ of the teeth, to belong also to the Sumatran species.

The figure, pl. 1, fig. 1, is on the other hand apparently taken from a skeleton of the Bengalese Elephant, since it has only nineteen dorsal vertebræ and as many pairs of ribs, and this is perhaps also the case with the figure of the skull, pl. 4, fig. 1, and that of the under jaw, pl. 5, fig. 2.

The supposition that both the other skeletons, examined by Cuvier, belonged to the second Asiatic sort is fully established by what he says, pp. 66, 67.

He says here, that he has examined three skeletons of the Indian

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* Coup d'œil, II. p. 91.

† It is very curious that Cuvier seems to have quite overlooked the differences in the number of dorsal vertebræ and ribs, not only in both the Asiatic but also in the African Elephant, for otherwise he could hardly have avoided alluding to them. The chapter of his *Ossemens fossiles* (I. p. 12), in which he speaks of the skeleton of the Elephant, has the heading "Description generale de l'osteologie de l'Elephant, principalement d'apres l'Elephant des Indes," and it seems from the particulars here mentioned, that his principal object was the comparison of the skulls of the African and Indian Elephants; on the other hand that he confined himself to the consideration of the skeleton of *Elephas sumatranus* of Ceylon, while his figure of the skeleton represents that of the Bengalese Elephant. Again, (p. 241) he says, *l'Elephant* (thus speaking generally), *a une vertèbre dorsale et une paire des côtesa plus, i. e.* than the Mastodon, which, according to him, has only nineteen.

Elephant. One of these, which, according to Cuvier, belongs to the variety called *Dauntelah* by Corse, was sent to the Museum at Leyden, in 1815, six years before the appearance of the second edition of the "Ossemens Fossiles," (see that ed. p. 66), where it exists at the present day. This skeleton agrees in all particulars with the Elephant of Bengal, having only nineteen dorsal vertebræ and the like number of ribs. The description which Cuvier gives of his *Elephas indicus* seems, therefore, to have been based exclusively upon his two other skeletons. Both of these, as he himself informs us, were from Ceylon. He tells us this, in the Annales des Sciences Naturelles, (1806, p. 148), speaking of the male which he identifies with the variety, *Mooknah* of Corse; and he says the same (Oss. Foss. p. 67) of the female, which he considers as belonging to the variety *Komarea* of Corse, adding that these were the skeletons of two Elephants brought from Ceylon to the Netherlands in 1786, and afterwards taken from thence to Paris.*

Hence it appears very clear that Cuvier described his *Elephas indicus* from specimens of two different species, one of which agrees with the Elephant of Bengal, whilst the others have all the characters of the Elephant of Sumatra. Since, therefore, both the latter skeletons attributed by Cuvier to Ceylon, presented the characters of the Elephant of Sumatra, it appeared to me to be probable that the Ceylonese Elephant belonged to the Sumatran species, and not to that of Bengal—the so-called *Elephas indicus*. This conjecture has been now wholly unexpectedly confirmed through a fortunate conjunction of circumstances, in a manner which leaves no further doubt on the subject. The celebrated traveller DIARD, advanced in years, but still endued with that untiring zeal and youthful activity by which science and our National Museum have profited so largely, during his long service under the government of the Netherlands, passed three months in Ceylon, in 1838, on a journey undertaken with the object of investigating the system of cultivation, and employed his leisure time in collecting the animals of the island. During some Elephant-shooting expeditions, he obtained a male and female Elephant from seven to eight feet high, and besides these two young specimens, which he placed entire in casks filled with arrack. The

* In the Paris Museum at the present moment, as I learn by a friendly communication of Dr. Pucheran, there are, besides the skeletons of the two Ceylonese Elephants, brought from Holland to Paris in 1795, and examined by Cuvier, a third sent by Duvaucel from Bengal. M. Pucheran confirms the fact, that both the Ceylonese elephant-skeletons have twenty dorsal vertebræ and twenty pairs of ribs. He finds, however, the same number in the skeleton from Bengal. From this one might be led to suppose, that the Ceylonese Elephant is also found in Bengal. But I think it would be rash to consider this fact established by a single observation, as all the skeletons of Bengalese Elephants which I have examined have had, without exception, only nineteen dorsal vertebræ and nineteen ribs. It is more likely that Duvaucel's skeleton was taken from a Ceylonese Elephant; examples of this sort being, as we shall afterwards show on the authority of Heer Diard, often brought living to Bengal.

ship in which most of H. Diard's specimens were sent to Europe, received so much damage at sea near the Mauritius, that the goods were mostly trans-shipped, and sent in another vessel to Europe. It thus happened that she did not arrive in the Netherlands until two years after she had quitted Ceylon, and then with the news that the cask containing one of the young Elephants had been obliged to be thrown overboard, having become decomposed. A better fate awaited the second cask, containing the other young individual, which had been destined for Professor Owen of London; and this and the skin and skeleton of the old male Elephant, as also the skull of the old female reached us well preserved. These are now in the National Museum at Leyden, and, as an accurate investigation has convinced me, differ in no respect from our examples of the Sumatran Elephant, thus belonging to this species, and differing in the following particulars from *Elephas indicus.*

The Elephant of Sumatra and Ceylon, (*Elephas sumatranus*) has small ears like *E. indicus*, and approaches this species also in the form of its skull, and the number of the caudal vertebræ; but the laminæ of its teeth are wider, and in the number of its dorsal vertebræ and pairs of ribs it differs from both the other known species. As far as we know, there are seven cervical, three lumbar and four sacral vertebræ in all the species of *Elephas* alike. *E. sumatranus* and *E. indicus* agree in the number of caudal vertebræ, which is usually thirty-three, but in very young examples sometimes only thirty. In *E. africanus*, on the other hand, the tail never contains more than twenty-six vertebræ. Finally, the numbers of dorsal vertebræ and pairs of ribs are different in each of the three living species of Elephant, being in *E. africanus* twenty-one, in *E. sumatranus* twenty, and in *E. indicus* nineteen.

It is also remarkable, that the number of true ribs is alike in all the species, that is, only five; whilst in the three species, as above given, the corresponding numbers of false ribs are fifteen, fourteen and thirteen. Hence it follows that the augmentation of these parts in the different species, takes place in the direction of the hindermost dorsal vertebra and pair of ribs.

The laminæ of the teeth afford another distinction, which, however, is less apparent to the eye than that taken from the number of the vertebræ. These laminæ, or bands, in *E. sumatranus* are wider (or if one may so say, broader in the direction of the long axis of the teeth) than in *E. indicus.* In making this comparison one must remark that the distinction is less evident in younger individuals, and that there are met with in all species of Elephants, within certain definite limits, remarkable individual differences in respect of the width of these laminæ.*

* The differences which we pointed out as existing between the skulls of the two sorts of Asiatic Elephants, in Temminck's Coup d'œil, (II. p. 9, note), seem, now that we have examined a greater number of examples, not to be constant.

In their external form also the two Asiatic Elephants appear to present some differences. Heer Westerman, Director of the Gardens of the Zoological Society of Amsterdam, which has for several years possessed two female elephants of middling age, one from Calcutta and the other from Sumatra, informs me, on this subject, that the Sumatran example is more slender and more finely built than the Bengalese, that it has a longer and thinner snout, and that the rump at the end is more broadened and covered with longer and stronger hairs, in which respect it reminds one rather of the African than the Indian Elephant, and lastly that the Sumatran animal is more remarkable for its intellectual development than the Indian.

The last mentioned observation agrees in a remarkable way with what Heer Diard has lately written concerning the Elephant of Ceylon. He says, on this matter, "l'Elephant de Ceylon se distingue de celui des Indes par une aptitude d'intelligence instinctive, celle de facile éducabilité : aussi ces elephans de Ceylon, de tout temps recherchés par les Princes de l'Inde se trouvent l'être encore aujourdhui plus qu' aucun autre par les Anglais pour les differens services auxquels on les employe. J'ai eu l'occasion d'observer plusieurs grandes troupes de ces animaux et une particulièrement, qui avait fini par se laisser prendre dans une grande enceinte établie par les ordres du Gouvernement, qui à cette époque où la guerre de l'Inde etait encore loin d'etre terminée faisait tout ce qu'il est possible pour recruter un certain nombre de ces animaux afin de les diriger vers le Bengale."

When we collect what is known respecting the distribution of both species of Asiatic Elephants, it seems that this animal is met with eastward of the Indus throughout the whole of Hindostan, Bengal, and the wide districts of Further India to Siam and Cochin-China, and also on the islands of Ceylon and Sumatra; that one of the species, *E. sumatranus*, has only yet been met with on the islands of Ceylon and Sumatra,* whilst the so-called Indian Elephant has been brought to Europe exclusively from Continental India.

So far as I can discover, the greater number of Elephants brought to Europe from Continental India, have been obtained from Bengal. It remains therefore a question, whether all the Elephants of Continental India belong really to one species, or whether, in these widely extended regions, there may not be different species of Elephants, and the Elephant of Trans-gangetic India may not perhaps belong to *E. sumatranus*. A similar question may be asked with respect to the Elephant of Southern India, compared with the *E. sumatranus* of Ceylon, since these districts approach one another very nearly. We have, it is true, no more reasons for answer-

* The whole area of the distribution of the Asiatic Elephants is, on the globe, embraced in a district of the form of an elongated quadrangle of 40 degrees in length and 25 in breadth, of which about half is taken up by sea. It lies between 65° and 105° E. L. and from N. to S. extends from about 35° and 25° N. to 5° S.

ing these questions in the affirmative than the negative, but they must be determined by ascertaining the facts, in order to know the exact boundaries of the range of *E. indicus*.*

If, as we have reason to believe is the case, the Elephant of Southern India agrees with that of Bengal, then the phenomenon that the Ceylonese animal belongs to another species, and that species the Sumatran, is certainly very remarkable. The Fauna of Ceylon shows, it is true, in some respects, differences from that of Southern India; one of the most noticeable of which is, that not one of the Monkeys living upon this island is identical with those of India. Nevertheless the Fauna of Ceylon agrees much better with that of India than with that of Sumatra, where not only entirely different species, but even other forms of Monkeys occur (*e. g.* the Orang-outang, several Gibbons, amongst which is the abnormal *Hylobates syndactylus*, the *Galeopithecus*, *&c.*) and which island besides produces, to mention some of the larger species, a *Rhinoceros*, the Indian Tapir, a very different species of *Bos* and of *Moschus*, an Antelope, the *Argus*, *Polyplectron*, several very peculiar species of Hornbill, (*e. g. Buceros bicornis*, and *B. galeatus*), and many other species and genera, which are not met with in Ceylon. It would be, however, anticipating the progress of science, when, as now, so small a quantity of incomplete materials are before us, to make comparisons between the Faunas of these countries, and it would be still more precipitate to attempt to draw general conclusions therefrom.†

If we take into consideration at once the size of the laminæ of

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* The works of Naturalists and travellers throw no light upon this subject. Corse (Phil. Trans. 1799, p. 245) it is true, tells us that the Bengalese distinguish three races of Elephants—*Mooknah*, *Dauntelah* and *Komarea;* but the distinctions which he gives of these races, seem to refer exclusively to the lesser or greater size and the form of the tusks. But we know how much the tusks of this animal vary according to the sex and the individual, and that these teeth sometimes, even in old females, acquire a considerable size.

† I think the attention of Naturalists ought to be turned also to the Elephants of the different parts of Africa. We meet, among the skulls from this Continent, with some which, as regards the extraordinary shortness of the tusk-jaw-bones, are proportionately shorter and much broader than is generally the case. Such a skull is figured by Cuvier, (Oss. Foss. I. pl. 4, fig. 2), whereas on the same plate, (fig. 10) the usual form of the skull of the African Elephant is represented. That this difference is not sexual I have repeatedly observed: one might therefore suppose that the individual, the skull of which has such a remarkably contracted form, belongs to another variety or species. All the South African Elephants, that I have seen, belong to the ordinary form. I do not know the locality of the short skull. It would be very desirable to compare the Elephants from different parts of Africa, in order to know with certainty whether they are all identical, or show local differences. The latter is not impossible, since most animals from the two chief divisions of Africa differ specifically from one another, or at least show differences in size, &c., as, for example, is the case with the Ostrich of Algeria and that of South Africa. In every case it is remarkable, that the area of Asia tenanted by the Elephant is ten times smaller than Africa, and that this area embraces two species, whilst the African Elephant is spread over the whole Continent—that is, over an area ten times as great as that of the two Asiatic species together.

the teeth, in the different species of Elephant, and the numbers of the ribs and dorsal vertebræ, we obtain the remarkable result that, as the latter numbers decrease, the laminæ become narrower. In *E. africanus* these laminæ are widest, and here we also find the greatest number of dorsal vertebræ and pairs of ribs: *E. sumatranus*, in which the laminæ are narrower, has twenty dorsal vertebræ and pairs of ribs: *E. indicus*, in which they are still narrower, only nineteen. In the Mammoth, (*E. primigenius*) where they are narrowest of all, the number of dorsal vertebræ and ribs, appears to be only eighteen.*

As the conclusion of this short notice, we may remark that Cuvier, by neglecting to compare together specimens of the different species of Elephants, and to attend to the numbers of their dorsal vertebræ and ribs, deprived himself of the discovery of the third living species of Elephant, and thereby missed a principal argument for his assertion, that *E. primigenius* belonged to a different species from those now in existence. Had he not lost this piece of evidence he would have obtained an overbearing argument in the last-named question, and Naturalists would have become acquainted with the existence of a third species of Elephant, half a century sooner.

VIII.—Observations on some Australian and Feegeean Heterocyathi and their parasitical Sipunculus. By John Denis Macdonald, R.N., F.R.S., Surgeon of H.M.S. "Icarus."

In two separate casts of the lead off the Bellona Reef, Lat. 21. 51. S., Long. 159. 28. E., we obtained specimens of living Polypi, referable, as Dr. Gray has since very kindly informed me, to the genus *Heterocyathus*, and on comparing them with others previously collected by me in the Feegee group, I found that they were specifically different, though obviously belonging to the same genus.

The *corallum* is simple, free, depressed, broad and flattened at the base, becoming smaller towards the *calyx* or oval disc, which is more or less oval in figure, and comparatively shallow, with a well-developed *septal system* following the regnant number six.

The septa are disposed in three sets, or whorls, according to the order of their development, viz. a primary set, which is most prominent and made up of six or twelve members, a secondary, equal in number and alternating with these, and a tertiary set, of double that number and alternating with the other two. The *primary septa* have, on either side, a thin sub-parallel lamina, with which they are blended at the *thecal* margin, being only connected with them internally by means

* That the Mastodons form, not a diverging, but a parallel series with the Elephants, seems evident from the wholly different form of their tusks, also from the fact that the *Mastodon giganteus* has only twenty dorsal vertebræ and an equal number of ribs—that is less than *E africanus*—whilst the knobs of the teeth are far larger than those of the last-named animal.

of the columella. The *secondary septa* are furnished with laminæ of the same description, which join those of the first set, at an acute angle, without reaching the columella; and the *tertiary septa* pass into this point of union, having no supplementary laminæ of their own. The two sets of plates, just noticed, present a rounded shoulder internally (more prominent in the primary ones) giving them the character of lateral *pali*, or dismemberments of the *septa*.

The *columella* is composed of a spongy tissue, with an oval and slightly convex summit.

All the plates of the disk are spongy, or minutely granular, on the surface, but compact within. The body of the *corallum* is spongy at the axis, in continuity with the *columella*, more compact below and around this, and again more porous towards the exterior, especially above.

The *loculi* are circumscribed, but not crossed by *synapticulæ* or *interseptal dissepiments*. They are just double the number of the *septa*, lying one on either side of the latter, and are thus arranged by pairs in three distinct circles; the internal corresponding with the *primary*, the middle with the *secondary*, and the external with the *tertiary* rays.

In the species taken at the Bellona Shoals the oral disk was distorted, with a central constriction, as though a process of fission had been going forward. In one specimen indeed the opposite margins of the disk had actually coalesced. The *primary septa* were twelve in number, and all the plates are so much compressed that the loculi are exceedingly narrow. The external surface of the *corallum* is beset with minute granulations disposed in broken longitudinal lines with porous channels between them; on the other hand, in the Feegeean species the disk is regular, with six *primary rays* and wider *loculi*, and the external surface of the *corallum* is coarsely granulated, without any very obvious linear disposition, as the first rudiments of *costæ*.

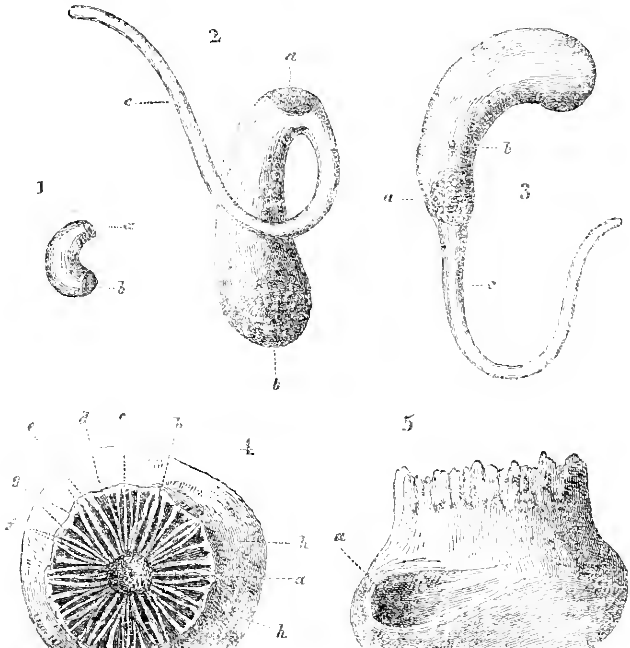
In a recent visit to Moreton Bay we dredged (in a few fathoms depth) two beautiful specimens of another species of this genus, differing from the foregoing in having well marked longitudinal *costæ*, exactly forty-eight in number, and corresponding, each for each, with all the radiating *septa* and *laminæ*, with which they are directly continuous at the margin of the disk. The principal *laminæ* are falcate towards the hollow of the cup and deeply notched, toothed and echinate, as they pass into the spongy *columella*, whose actual limit is thus rendered less definite than in the other species described.

Of the soft parts of these polyps, I can say but little. They appear to be very scanty, from the fact, that when the animals are immediately taken from the water there is scarcely anything to be seen but a brown, soft and tenacious matter, filling up the crevices of the skeleton above described, and all the prominent points and ridges become quite bare. The whole surface of the *corallum* is covered over with a thin *ectodermic* layer, which however is much worn at the base. In the fragments removed very cautiously with a knife, I could recognise what appeared to be portions of simple tentacula, muscular fibres and a fibrous matrix, brown pigment cells, the usual yellow or amber-tinted spherical globules of the subjacent parts, and ciliated epithelium, from the lining of the common cavity. The analogy of other cases suggests the probability that the tentacula correspond with the outer whorl of loculi.

The most remarkable circumstance connected with these polyps, is the invariable presence of a little solitary *Sipunculus* in a beautifully excavated burrow at the base of the *corallum*. The uniform position of the opening and sinistral direction of this burrow, first observed in dead specimens, led me to suppose that it was in some way connected with the economy of the polyps themselves, but having discovered its occupant to be one of the coral perforating *Sipunculidæ*, which abound in the South Seas, the riddle was quickly solved. The body of one of these parasites, taken from a Bellona Reef specimen, is about $\frac{3}{4}$ of an inch in length, terete, but gradually increasing in diameter from before backwards, and exhibiting a permanent curvature forwards, corresponding with that of the burrow.

The crested proboscis is about three times the length of the body, and crowned with simple ciliated tentacula. On the dorsal surface, immediately behind the base of the proboscis, is a little oval and brownish callosity, answering the purpose of an operculum, when the animal is retracted into its cell, and close behind this disk is the anal aperture. The posterior extremity of the body is furnished with a similarly constituted, but slightly conical, shield. As the opercular disk meets the rest of the dorsal surface, at an angle more or less obtuse, the proboscis appears to hold a subterminal ventral position, and protrudes itself somewhat perpendicularly to the axis of the body. The surface of the latter is beset with minute asperities, disposed serially, or irregularly scattered. These become larger and more numerous towards the dorsal region, and more definitely aggregated at the extremities; they constitute the before mentioned opercular and caudal disks. As they extend themselves on the proboscis they grow smaller, and begin to assume a more orderly arrangement, and finally form into closely set rings of minute and recurved hooks, reaching to the base of the oral tentacula. This parasite is evidently closely allied to the little animal from the Indian seas, named *Lithodermis cuneus*, by Cuvier, and which was the only species known to him.

In the Coral borers, which are nearly identical with the little animals here noticed, I found that the œsophagus was encircled by a nervous collar, with a cephalic enlargement on either side, from which tentacular nerves arose, and, in contact with which, dark eye specks were distinctly visible; there is also a single ventral nervous chord, giving off lateral nerves at stated intervals, but without any very apparent ganglionic dilatations. I observed, moreover, that the cavity of the body was lined with a ciliated membrane, which was reflected round the larger branches of a transparent (probably water) vascular system running along the spirally coiled intestine, with its singularly constructed central suspensory ligament. All this militates against the supposed *Echinoderm* nature of *Sipunculus*, and give it radiating affinities with the *Annelida*, *Polyzoa* and *Tunicata*, though perhaps only of a representative kind. The simple anatomy of the larval form, the *Atlas* of Peron, if it be not indeed a permanent one, is also of great importance in this connexion.



REFERENCES.

1. *Sipunculus Heterocyathi*, (natural size) *a*. Opercular disk. *b*. caudal disk.
2. Ventral view enlarged. *a*. Opercular disk. *b*. caudal disk. *c*. proboscis.
3. Dorsal view enlarged. *a*. Opercular disk. *b*. anus. *c*. proboscis.
4. Corallum, seen from above, enlarged. *a*. Columella. *b*. primary. *c*. secondary and *d*. tertiary rays. *e*. primary. *f*. secondary and *g*. tertiary loculi. *h.h.h*. Openings communicating with the burrow.
5. Lateral view, shewing *a*. the aperture of the burrow.

[The case of parasitism here described has an especial interest if viewed in relation to the apparently anomalous characters of the palæozoic *Pleurodictyon*, which we are much inclined to regard as a coral perforated in a similar manner.—EDS.]

IX.—On the Myology of the Orang Utang. By William Selby Church, B.A., Lee's Reader in Anatomy, Christ Church, Oxford.

(*Continued from Nat. Hist. Rev. for* 1861, *page* 516.)

The *Flexor Longus Pollicis* appeared at first sight to be a portion of the *Flexor Profundus*, but its origin was distinct, as it arose from the radius, and remained distinct from the *Flexor Profundus* throughout its whole course. It went to the index only in the Orang: and, as it passed through the annular ligament, it sent off a slip to the tendon of the *Flexor Profundus*. The tendon of this muscle was supplied with a *Lumbricalis* muscle, inserted as in man: each of the branches of the *Flexor Profundus* were also supplied with a good-sized *Lumbricalis* muscle. In the Gorilla, the *Flexor Longus Pollicis* sends a small tendon to the thumb, though the mass of the muscle has there become a flexor of the index. (Duvernoy, l. c. p. 106.) In the Magot and *Cebus*, these muscles become fused on the palm of the hand, forming as it were a common *Flexor Profundus*. In the Magot, the radial portion, or *Flexor Pollicis*, went chiefly to the index, and a slip from the ulnar portion, or *Flexor Profundus*, supplied the chief portion of the tendon going to the pollex. In the *Cebus*, the same fusion of the muscles took place: but the radial portion was much the stronger, and supplied the thumb with a tolerably strong tendon, as well as the index and middle fingers, the ulnar portion supplying the third, fourth and fifth digits with tendons.

The arrangements of the *Lumbricales* in these Monkeys was peculiar. They formed a fleshy mass on the palmar surface of the fused tendons: the first and second arose together from the tendon of the index, and partly from that of the third digit and the slip supplying the thumb: the third and fourth arose together from the tendons of the third and fourth digits. They were all inserted on the radial side of the first phalanx of the fingers.

Vesalius* states that the *Flexor Longus Pollicis* is present in the tailless apes, but that it is only a branch from the *Flexor Profundus* in the tailed ones.

The *Flexor Sublimis* is subject to many slight variations in man, but in these Monkeys it presented almost the same appearance that it normally does. The *Flexor Profundus* frequently has a distinct head coming from the internal condyle of the humerus, and fusing with the rest of the muscle lower down. (Theile.†) The *Flexor Longus Pollicis* has been noticed double: one part going to the thumb as usual, the other joining that tendon of the *Flexor Profundus*, which supplies the index. (Theile.‡) And a more frequent anomaly is the presence of a second head from the internal condyle of the humerus, or the receipt of fibres from the *Flexor Profundus* or the *Sublimis*, which would appear to parallel the fusion of the *Flexor Pollicis* and *Profundus* met with in the bulk of the Quadrumana. Mr.

* Vol. i. p. 254. † Ency. Anat. tom. iii. p. 246. ‡ Ditto, p. 249.

McWhinnie* mentions, on the authority of Gantzer, a fascicle going from the *Flexor Pollicis* to the tendon of the index. It is remarkable also that the *Palmaris Longus*, which is so frequently absent in man, should be present in most of the Quadrumana.†

The *Abductor Longus Pollicis* or *Extensor Ossis Metacarpi* was present, as also the *Extensor Secundi Internodii Pollicis*, but the *Extensor Primi internodii* was absent. The tendon of the *Extensor Ossis Metacarpi Pollicis* was split into two portions, the larger being inserted into the *os trapezium*, and the smaller into the metacarpal bone. In man a small slip of the tendon normally goes to the *os trapezium*.‡ As no portion of the tendon went to the first phalanx, I see no reason for considering the anterior portion of the tendon as the homologue of the *Ext. Primi Internodii*, as is stated by Vrolik in the article "Quadrumana," in the Cyclopædia of Anatomy and Physiology. Exactly the same arrangement was found in the *Cebus*; but in the Magot, the anterior portion was the larger, and the smaller portion was inserted into a sesamoid bone, and not into the trapezium. Both muscles exist in the Chimpanzee (Vrolik, p. 20), and in the Gorilla (Duv. p. 97).

The *Extensor secundi internodii* was very weak: it arose from the ulna and the interosseous ligament in front of the *Extensor indicis*. Duvernoy mentions finding it proportionately as large in the Chimpanzee as in man, and as being smaller and weaker in the Gorilla.

The *Abductor Pollicis Brevis* consisted of three distinct thin muscular layers, which were inserted together into the base of the first phalanx. The innermost layer arose from the os trapezium, the other two from the annular ligament.

The *Opponens Pollicis* and *Flexor Brevis Pollicis* presented no points of interest: the *Opponens* was very weak and small, the *Flexor* of tolerable size. The *Adductor Pollicis* was very large, arose from the palmar ligament, which was prolonged down the whole length of the metacarpal bones of the third and fourth digits, and was inserted into the under side of the first phalanx of the thumb. The *Adductor* was with difficulty divisible into two portions, one coming from the palmar ligament, the other from its metacarpal prolongations; the division between the two was not nearly so evident as in the adductor of the hallux. In the Magot the *Adductor* possessed two distinct heads, the longer of which came from the external palmar fascia, the shorter from the os trapezium. The *Opponens* was relatively stronger than in the Orang. The *Abductor* was formed on the same plan. In both the Cebus and Magot I found a thin

* Mr. McWhinnie, Varieties of the Muscular System. London Medical Gazette, January 1846.

† Henle, l. c., p. 196, mentions the following important variety of the muscle in man. "Instead of the *Flexor pollicis longus*, the indicator portion of the *Flexor digitorum profundus* receives a slender head from the common origin of the superficial muscles."—[EDS.]

‡ Ellis, Demonstration of Anatomy, p. 33, 5th edition.

muscular layer, arising from the palmar ligament which formed three small muscular digitations, which were inserted into the radial side of the first phalanx of the fourth and fifth digits, and the third into the ulnar side of the first phalanx of the index. A similar muscular expansion was found in the feet of these monkeys.

The *Palmaris Brevis* was, I think, absent, but as the animal had been skinned before I examined it, the muscle may have been cut away. Dr. Traill found none in the one he dissected. In the Chimpanzee it is present (Vrolik, l. c. p. 20). It was remarkably large in the Magot, arching over the whole of the carpal portion of the hand, reaching from the external side of the little finger to the internal side of the thumb; it was present also in the *Cebus*.

The *Abductor*, *Flexor Brevis* and *Opponens Minimi Digiti* presented no peculiarities worth notice.

The Dorsal *Interossei* presented the same general appearance as in man, only differing in the greater development of the *Abductor Indicis;* but the palmar set differed considerably, being seven in number; the index possessed two, the radial one being a broad flattened muscle, which arose from almost the whole length of the metacarpal bone of that finger, and was inserted into the upper and inner side of the metacarpal of the pollex;† the one on the ulnar side arose from the under and inner surface of the metacarpal of the index, and was inserted into the first phalanx of the same finger; the middle and ring fingers had each two and the little finger one, similar muscles. In both the *Cebus* and Magot the dorsal muscles resembled man's, but the palmar ones closely resembled those of the Carnivora; they were also seven in number, and arose from the palmar ligament, as well as from the metacarpal bones, which they completely hid from view.

The hand of the Orang and of the Chimpanzee appears at first sight to be less perfectly organized than that of some of the other Quadrumana, owing to the total absence of any long flexor of the thumb; the absence of this muscle permits of a greater independence of motion in their thumbs than in any of the other monkeys, in which the long flexor exists as a portion of the *Profundus*. In the Orang and Chimpanzee the great development of the *Abductor*, and the well marked *Flexor Brevis* in some degree make up for the absence of the long flexor. The double adductor has been observed in man (M'Whinnie).

Wagner, when speaking of the hand of the Quadrumana, says: "The individual mobility of the fingers is much more limited than in man, and this is more particularly the case with the thumb."* This is perfectly true of lower Quadrumana, as is shown in the case of the *Cebus*, but I think in the Baboons and Magots the greater development of the muscles of the thumb† proves that they can move the

* Elements of the Comparative Anatomy of Vertebrate Animals. R. Wagner, p. 18. Translated by Tulk.

† This appears to correspond with the *Musculus interosseus volaris primus*—(a fourth palmar interosseus) described by Henle, l. c., p. 228, as constant in the human hand.—[Eds.]

thumb independently, and are capable of seizing an object in the same way as the Orangs and Man, *i.e.* with the fingers on one side and the thumb on the other.

In the Chimpanzee and the Orang this freedom of motion has been obtained at the expense of the strength of the thumb, in which point they are very inferior to Man or the other Quadrumana.

The hand of the Orang contrasts unfavourably with that of the Chimpanzee, owing to the absence of the *Extensor Primi Internodii Pollicis* and the *Extensor Proprius Indicis.*

In the rudimental thumb of the *Ateles* all these muscles exist, showing that its development is merely arrested and not suppressed.

The Muscles of the Posterior Extremity.

The *Iliacus, Psoas Magnus* and *Psoas Parvus* presented much the same appearance as in man; they are flatter, and in accordance with the elongated shape of the pelvis, longer; beneath these muscles a small one was found, mentioned by Professor Owen,* as present in the Orang, but not in the Chimpanzee, which arose from the ileum in close connection with the *Rectus Femoris*, passed over and was attached to the capsular ligament of the femur, and was inserted into the trochanter minor.

The *Tensor Vaginæ Femoris* was absent; it is present in the Chimpanzee, small and narrow in the Gorilla (Duvernoy, l. c. p. 83), and relatively stronger than in man, in the Magot; it is well developed in the *Cebus.*

The insertion of the *Sartorius* was one inch below the head of the tibia, on its inner surface; this muscle was well developed.

The *Pectineus* in the Chimpanzee† gives off a slip to the origin of the *Sartorius.* In the Magot this muscle was very strong, arising from the whole of the anterior edge of the pubes, covering in the origin of the *Adductor Brevis*, and verging on the *Gracilis.*

The *Gracilis* was proportionately much stronger than in man, and took its origin from a wider space on the pubes. In man its origin covered the space of two inches only, while in the Orang it covered one and a half inches; it was inserted together with the *Semitendinosus*, but below the *Sartorius*, partly into the tibia and partly into the superficial fascia of the leg; its insertion extended half way down the tibia, which bone measured six inches, whereas in man, where the tibia measured $14\frac{1}{2}$ inches, the insertion of the three muscles, *Sartorius, Gracilis* and *Semitendinosus*, only extended three and a half inches below the head of the tibia.

The *Semitendinosus* was fleshy throughout and, at its lower end, the muscular fibres bifurcated to form two tendons, the superior one being inserted immediately below the upper part of the *Gracilis*, one and a half inches below the head of the tibia, while the other became

* Proceedings of the Zoological Society, Vol. i. p. 69. † Ibid. Vol. i. p. 68.

continuous with the fascia of the leg, three inches below the head of the tibia.

In the Chimpanzee, Vrolik states that the tendon is partly inserted into the inner tuberosity of the tibia.

In the Magot these muscles were very large, especially the *Gracilis*, which covered a space of $1\frac{3}{8}$ inches on the pubes. They were implanted, together with the *Sartorius*, one inch below the head of the tibia, and not one below the other, neither did they send any fibres to the fascia of the leg.

The *Semimembranosus* took its origin by fleshy fibres alongside of the *Semitendinosus*, and remained fleshy throughout; it was inserted as in man. This muscle was very large in the Magot, and was inserted by a small and strong tendon an inch and a half in length into the head of the tibia.

The *Biceps Femoris* differed widely from the corresponding muscle in man. It consisted of two distinct muscles; the superior, or ischiatic portion arose from the tuberosity of the ischium, and passed down the outside of the thigh, to be inserted into the heads of the fibula and tibia. This portion gave off a strong muscular slip which was inserted into the lower third of the external surface of the femur. This slip is not mentioned by Professor Owen, neither does it occur in the Chimpanzee.

The second, or femoral, portion arose from the outer surface of the femur, extending from two and a quarter inches below the great trochanter to within the same distance of the external condyle of the femur, and formed the lower portion of the outer hamstring. Before its insertion into the fibula and anterior fascia of the leg, it gave off a slip which was inserted into the posterior fascia of the leg. In the Gorilla, the two heads of the *Biceps* are distinct, but very similar in disposition to those of man (Duvernoy, l. c.). In the *Ateles*, the *Biceps* is figured by Cuvier, Pl. 59, as resembling man's. In the *Cebus*, the femoral portion was entirely wanting; the ischiatic portion was very strong, and gave off a slip to the femur, as in the Orang; a small, but strong, tendinous band went to the head of the fibula, while the rest of the muscle became continuous with the fascia of the leg. In the *Cebus* also, I found, beneath the *Glutæus Maximus*, a thin tendon, which arose from the fascia surrounding the root of the tail, and became a thin muscular band as it descended along the inner surface of the biceps, and was inserted into the external fascia of the posterior part of the leg, much in the same manner as the slip given off from the short head in the Orang.

In the Magot, the *Biceps* was single, and wanted the slip going to the femur: it was remarkably broad and thick, having a uniform breadth of two inches; and was inserted partly into the head of the fibula, but chiefly into the fascia of the leg.

The short head of the *Biceps* is often wanting in man,* in which

* Encycl. Anat. Tom. iii. p. 305.

case the *Biceps* would closely resemble that of the bulk of the Quadrumana. Mr. M'Whinnie mentions, on the authority of Saltzmann, a muscular slip given off from the Biceps, and having a tendinous insertion on the outer part of the leg between the *Gastrocnemius* and *Soleus.*

The low insertion of the *Biceps* and of the *Gracilis*, *Semitendinosus* and *Semimembranosus*, together with the greater size and the presence of fleshy fibres throughout the whole length of the two latter muscles, point directly to scansorial habits of the Quadrumana, and must tend to relieve the strain caused by the weight of the body on the knee during climbing; and in the Orang, where the insertion of these muscles was remarkably low, they must prevent the knee from being straightened, and so incapacitate the animal for assuming the erect posture.

The *Glutæus Maximus* was weak, and had a small origin; it did not reach to the spine of the ilium, and it was inserted into the fascia lata and the linea aspera, without sending any fibres to the great trochanter. The *Glutæus Medius* was largely developed, as appears to be the case generally among Quadrumana.

The *Glutæus Minimus* appears to be differently described by various writers. Professor Owen* mentions its presence, but does not describe its origin; while the muscle described as the *Glutæus Minimus* by Dr. Traill, I have regarded as the *Gemellus superior*, which arose not only from the spine of the ischium, but from the posterior edge of that bone as well. In the *Cebus*, the *Glutæus Minimus* is large, and arises from the dorsum and posterior edge of the ilium. The muscle described by Dr. Traill as the *Musculus Scansorius*, and mentioned by Professor Owen† as the *Invertor Femoris*, was very well developed in the Orang, but appeared to be wanting or merged into the *Glutæus Minimus* in the Cebus; it arose, in the Orang, from the whole of the anterior edge of the ilium to within three-fourths of an inch of the acetabulum, and was inserted into the front of the great trochanter: the same disposition of this muscle was found in the Magot.

The *Pyriformis* was large and well developed, but narrower than in man; in both the Magot and *Cebus* it had begun to be fused with *Glutæus Medius;* this is occasionally the case in man, when the *Pyriformis* is largely developed.‡ The *Gemelli* were large, especially the *Gemellus Superior*, which arose not only from the tuberosity of the ischium, but from the elongated ilium, also covering a space of one inch and a quarter; its tendon was quite distinct from that of the *Obturator internus*, which was also of large size.

In the Magot the *Gemelli* and the *Obturatores internus* and *externus* were present, but rather small; the large size of these muscles in the Orang, together with the presence of the small muscle

* Proceedings of the Zoological Society, Vol. i. p. 68. † Ibid.

‡ Mr. Hallett, Ed. Med. and Surgical Journal, 1848.

described with the *Iliacus* and the *Invertor femoris* may perhaps be owing to the freedom allowed the hip joint by the absence of the ligamentum teres, which the Orang alone of the Quadrumana wants.

The *Adductor* muscles were of coarse texture, and split into numerous bundles. In the Magot the *Adductor Longus* formed a distinct belly, partly inserted into the tibia (Vid. Cuvier, l. c., Pl. 31-32).

The *Tibialis Anticus* was relatively stronger than in man; it arose from the tuberosity and anterior surface of the tibia, for a space of three inches and a half, and its tendon was split into two portions, the posterior and larger, being inserted into the cuneiform bone, the anterior and smaller, into the base of the metatarsal bone of the hallux. In this instance there was no division of the muscle into fascicles, as described in Article Quadrumana in the Cyclopædia of Anatomy and Physiology, and in the Proceedings of the Zoological Society, therefore I think there is no reason to consider the anterior division of the tendon as belonging to the *Abductor Hallucis Longus*, especially when we observed a similar arrangement in the *Abductor Pollicis*, and that, in man, a small slip of tendon normally passes on to the metatarsal of the great toe.*

In the Chimpanzee, Professor Owen states that the tendon is inserted into the scaphoid. In the *Cebus* the muscular belly is divided into two fascicles, which may be regarded as the *Abductor Hallucis Longus* and *Tibialis Anticus*. In the Magot the same arrangement is found.

The *Extensor Proprius Hallucis* was remarkably weak and slender; it arose from the upper part of the fibula and the interosseous ligament, and was inserted as in man. Cuvier has figured, l. c. Pl. 19, an extensor of the index distinct from the *Extensor communis;* it was absent in this instance, and neither Professor Owen nor Duvernoy mention it.

The *Extensor Communis Digitorum* resembled man's. The *Peronæus Longior* arose from the head of the fibula, the outer and back part of that bone and the intermuscular septum, for a space of three inches, and was inserted into the metatarsal bone of the hallux, acting as a powerful flexor of that digit. The *Peronæus Brevior* arose together with the preceding muscle, and was inserted into the metatarsal bone of the fifth digit; it was a much more fleshy muscle than the *Peronæus Longior*, and remained fleshy on the posterior surface almost to the point of its insertion. The *Peronæus Tertius* was absent.

In the Magot and *Cebus* the *Peronæi Longior* and *Brevior* resembled those of the Orang, only differing in their greater relative size, but both of them possessed a *Peronæus Tertius*, which consisted of a thin muscular layer lying beneath the *Peronæus Brevior*, and terminating in a very fine tendon, which passed through a slit in the tendon of the *Peronæus Brevior* on a level with the cuboid bone, and

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* Ellis's Demonstration of Anatomy, Edit. 5, p 754.

ran along the superior surface of the metatarsal of the little finger, to be inserted with that of the *Extensor Communis Digitorum.*

In the Magot the *Peronæus Tertius* became tendinous very high up the leg, passed down, closely applied to the posterior part of the *Peronæus Brevior*, accompanying the tendon of the latter muscle until its insertion, and did not pass through a slit in it as in the *Cebus.*

The *Gastrocnemius* was remarkably thin and weak, causing the absence of any calf to the leg; this muscle is stated by Duvernoy to have remained distinct from the *Soleus* in three specimens dissected by him, but in this instance the two became fused, three inches above the point of insertion.

The *Soleus* was intimately connected with the external head of the *Gastrocnemius*, and arose from the head of fibula, by a very narrow tendon, receiving no fibres from the tibia and not even encroaching on the *Popliteus* or *Flexor digitorum.*

In the *Cebus* the *Soleus* was much larger, but had only a single origin from the head of the fibula. In the Magot both these muscles were much larger, forming quite a calf to the leg. The *Soleus* remained distinct for a much longer period than in the Orang, and it arose by two heads, one from the fibula, the other from the external condyle of the femur.

The *Plantaris* was wanting; as stated by Duvernoy and Dr. Traill, it is present in the Chimpanzee and wanting in the Gorilla, (Duvernoy, l. c. p. 93). It was well developed in the Magot, arising in conjunction with the external head of the *Gastrocnemius;* it was absent in the *Cebus.* This muscle appears not to be as often absent as it is usually supposed, not one case being met with by Mr. Hallett.

The *Popliteus*, which was not found by Dr. Traill, was present in the Orang, and also in the *Cebus* and Magot, being very large in the latter animal. The most striking points in the muscles of the posterior extremity were the weakness of the *Glutæi* muscles, and the striking development of the *Gracilis, Semi-membranosus* and *Semi-tendinosus.* The abductors were very similar to man's, but were, perhaps, slightly stronger, while the *Quadriceps extensor* was much weaker. The leg of the Orang contrasted with that of the Magot most strikingly. In the latter animal the muscles of the posterior region were developed so as to form a large and well-shaped calf, while the excessive development of the *Tibialis Anticus* gave quite a deformed appearance to the anterior region, the large development of these muscles seeming to point to the terrestrial habits of this animal. The *Peronæus tertius* was absent in the Orang, and is frequently wanting in the human subject; and the *Peronæus Brevis* is subject to many variations in man, presenting abnormal conditions once in every five subjects examined by Mr. Hallett.

The *Flexor Longus Digitorum* had not such a large origin as in man, it extended down the tibia to within $2\frac{1}{8}$ inches of the lower end of that bone, while in man it reached to within 3 inches. The muscular fibres did not terminate in a tendon until the muscle had passed the inner malleolus; consequently instead of occupying the groove together with the *Tibialis posticus*, it lay on the external surface of the groove. It broke up into three tendons distributed to the second, the fourth, and little toes. The portion for the second toe was supplied with two *Lumbricalis* muscles, inserted into the tibial side of the first phalanx of the second and third toes; the tendon of the little toe was also supplied with a *Lumbricalis* muscle inserted into the tibial side of the first phalanx of that toe. The tendon of the fourth toe is perforated by the *Flexor hallucis*,* while those of the second and little toes perforate the tendons of the *Flexor brevis.*

In the Orang it sent no slip to the tendon of the deep *Flexor (Flexor hallucis).* In the *Cebus* this muscle is small, the largest portion of its tendon going to the little toe, and forming a perforating tendon; the smaller portion mainly joins the slip of the *Flexor hallucis*, which goes to the hallux, and it also sends small tendinous slips to the other divisions of the deep flexor, as the *Flexor hallucis* might well be called. In the Magot this muscle is of considerable size, and is largely supplied with *Lumbricales*, which form a fleshy mass on the surface of the tendon, and are inserted into the inner and dorsal surface of the first phalanx of the second, third and fourth toes on the tibial side; the one going to the little toe usurps the office of the *Flexor brevis pedis*, and is perforated by the tendon of the *Flexor communis.* This muscle sends a small tendinous slip to the tendon of the *Flexor hallucis* which supplies the hallux, and has also other tendinous connections with that muscle, but does not fuse with it as completely as the *Flexor pollicis* does with the *Flexor profundus*, in the hand.

The *Flexor Longus Hallucis*, arose by two heads, the long head arising from the external condyle of the femur, together with the external head of the *Gastrocnemius;* the short head arose from the posterior and inner surface of the tibia to within an inch and a half of its distal end. It formed a large tendon which bifurcated and went to the last phalanx of the middle and fourth toes, the tendon of the latter perforating a branch of the *Flexor communis*, and that of the middle toe a branch of the *Flexor brevis.* Both of the tendons were supplied with a good sized *Lumbricalis* muscle, which was inserted into the tibial side of the first phalanx of the respective toes. No slip whatever went to the hallux. In the Gorilla a very strong tendon goes to the hallux as well as to the third and fourth digits (Duvernoy, l. c. p. iii). In the *Cebus* it supplies the second toe, as well as the third and fourth, and sends a strong branch to the hallux. In the Magot the same arrangement obtains. The *Tibialis Posticus* was remarkably weak in the *Cebus:* in the Orang it did not present much difference from the corresponding muscle in man.

Very great weight has been laid upon the great development of

* And therefore probably represents a division of the *Flexor brevis.*—[Eds.]

the *Flexor Hallucis* in man, and the absence of any slips to the other toes, but many instances are recorded, in which the tendinous band which unites the *Flexor hallucis* to the *Flexor communis*, was prolonged, forming two tendons accompanying, but distinct from, the tendons of the *Flexor Digitorum* which supply the second and third digits; in fact, so common is this, that Vesalius has figured it, (Pl. 14), and mentions it as no rare occurrence (p. 295), as also does Theile.* Now this distribution of the tendons is exactly what is met with in the bulk of the Quadrumana, excepting that in them, the branches usually go to the third and fourth digits. Another point in which the foot of the Quadrumana resembles man, is in the course taken by the *Peronæus longus*, and I might add, also, the distribution in some of them (the *Inuus* and *Cebus* for instance) of the *Peronæus tertius*.

The portion of the *Extensor Brevis Pedis* which went to the hallux might almost be regarded as a distinct muscle, for, owing to the position of the hallux, its fibres scarcely mix at their origin with those of the rest of the muscle.

In the *Cebus* and Magot, owing to the hallux being almost in the same plane with the other digits, the hallucal portion resembled the other digitations of this muscle.

The dorsal *Interossei* differed in no respect from the corresponding muscles in man, excepting that one on the tibial side of the index had a second head attached to the hallux, exactly corresponding to the *Abductor indicis* in the hand.

This head from the hallux was not present in either the *Cebus* or Magot, and accords with the greater freedom permitted to the hallux in the Orang, for in the Orang the hallux can be flexed independently of the other digits, and, in fact, it presents the closest resemblance to the pollex.

The *Abductor Hallucis* arose from the calcaneum and the internal annular ligament, and chiefly differed from that of man in the large size of its origin from the annular ligament. In the *Cebus* and Magot it arose by two distinct heads from the calcaneum and the plantar fascia. In the Orang it had an insertion into the metatarsal bone as well as into the first phalanx.

The *Flexor Brevis Pedis* arose by two distinct heads, separated by the plantar nerves; the upper and smaller head arose from the ligament covering the astragalus, and from the inner margin of the groove on that bone which transmits the *Flexor Longus Hallucis*; the lower and larger head arose from the calcaneum. This muscle divided into two portions, and was inserted by tendons which gave passage to the deep flexor, into the second phalanges of the second and third toes. Dr. Traill describes it as going to all four digits. In the Chimpanzee and Gorilla it goes to the second and third digits only (Duvernoy, l. c.). In the *Cebus* and Magot it arose by a single

* Encyc. Anat. Tom. iii. p. 323.

head from the calcaneum, and supplied the index only, being a *Flexor proprius* of that digit. The portion of this muscle going to the little toe in man is not unfrequently wanting, and its absence is compensated by either a branch from the *Flexor communis*, or by a muscle resembling a *lumbricalis*,* just as in the Magot.

The *Abductor Minimi Digiti* arose from the calcaneum, and formed a strong tendon inserted into the proximal end of the first phalanx of the fifth digit. In the Magot this muscle was inserted into the proximal end of the fifth metatarsal bone, its office being usurped by the strongly developed *Peronæus tertius;* in the *Cebus*, however, in which the *Peronæus tertius* is developed, this muscle was of considerable size, and was inserted in the usual manner.

The *Flexor accessorius* arose by a single fleshy head from the under surface of the calcaneum, and broke up into a broad tendinous expansion, which was inserted into the tendon of the *Flexor communis* which supplied the little finger, and into a very fine tendon which accompanied the tendon of the *Flexor communis*, and after giving passage to it by a slit, was inserted into the second phalanx of the fifth digit, thus usurping the office of the *Flexor brevis*, and acting instead of the *Lumbricalis* described in the Magot. In the *Cebus* and Magot the *Flexor accessorius* clutched on to the tendon of the *Flexor communis* as in man.

The *Flexor Brevis Hallucis* arose from the internal cuneiform bone and the plantar fascia, and possessed two small bellies, the external of which was inserted into the first phalanx, the internal into the metatarsal of the hallux. In the Magot the inner belly formed a separate muscle, very much resembling an interosseous muscle; it arose from the external cuneiform bone and was inserted into the sesamoid bone of the fibular side of the hallux.

The *Adductor Hallucis* was very large, and divisible into two muscles. (*Vide* Cuvier, l. c., Pl. 16, where he considers the *Flexor Brevis* as a third adductor.) Beneath what Cuvier terms the *Adducteur oblique*, which I have described as the *Flexor brevis*, a strong fleshy muscle is found, arising from the anterior border of the peroneal sheath, from the head of the metatarsals of the third digit, and from the upper part of a strong band of ligament, which stretched across from the head of the third digit to be inserted into the distal end of the metatarsal and proximal end of the first phalanx of the second digit. This portion is called by Cuvier *Adducteur opposant des quatrième et cinquième doigts.* Arising from the lower portion of the ligament just described is a thinner muscular layer, inserted over nearly the whole length of the metatarsal bone of the hallux: this is described by Cuvier as the *Adducteur transverse.*

In the Magot the *Adductor* was very powerful, especially the upper portion, which arose as in the Orang, but gave off a slip to the metatarsal of the hallux. The inferior portion was also strong, though

* Enc. Anat Tom. iii. p. 439.

the ligament which stretched across the plantar space was not so strong as in the Orang, and thinned out at its lower edge into a thin fascia. Arising from this ligament, in the Magot and *Cebus*, were three muscular slips, which were inserted by short and flattened tendons into the tibial side of the first phalanx of the fourth and fifth digits, and into the fibular side of the same bone in the second digit; thus exactly paralleling the arrangement found in the hand of these monkeys.

The *Transversalis Pedis* did not exist in any of the three monkeys. It is mentioned by Duvernoy as being represented by ligament in the Orang. It has been noticed to be wanting in man.*

The *Plantar Interossei* presented a wide difference from those in the human subject. The first digit has one on the fibular side; the third and fourth digits, one on each side; and the fifth digit, one on the tibial side. They are large muscles, and not only occupy the space between the bones, but also lie beneath them, covering them in on the plantar surface; each muscle is inserted into the upper part of the bone of the first phalanx of its respective digit.

In the Magot, the *Interossei* differ from the Orang, none of them having any dorsal origin; they therefore appear all to belong to the plantar group. They are eight in number, and arise from the sheath of the *Peronæus Longus*. The fifth digit has one, the rest two. The muscles are inserted into the sesamoid bones and head of the first phalanx of the digits. The middle digit has a third, which, perhaps, ought to be regarded as coming from the under part of the fascia, sending the muscular slips before described to the second, fourth and fifth digits, rather than from the sheath of the *Peronæus*. Its insertion is also different from the others, being inserted into the upper and outer side of the first phalanx of the third digit. The second, fourth and sixth interossei are the largest, and are visible on the dorsal surface between the metatarsal bones.

If now we briefly review the chief points of difference between the muscular systems of the Quadrumana and of Man, we find in the muscles of the trunk few points of interest. The abdominal muscles are much thicker and stronger, to support the weight of the intestines when the animal is on all fours. The cervical muscles also are stronger; but, with the exception of the digastric, differ very little from man's. The digastric presents an intermediate condition in the Orang, the chief insertion being into the angle and inner surface of the jaw, corresponding to the usual insertion in the Quadrumana and lower animals; but it sends forwards a slender tendon lying on the inferior surface of the mycohyoid muscle to be inserted, as in man, at the symphysis of the jaw. The presence of the *Clavio-trochelien* appears to be almost equalled in man by the division of the *Levator Anguli Scapulæ* into several distinct portions, and their occasional insertion into the spine instead of the angle of the scapula.

* Mr. M'Whinnie, on the authority of Boehmer.

I was unable to find any record of a slip being given off in man from the *Latissimus dorsi** to the *Olecranon*, though it frequently sends one to the *Pectoralis major* on its posterior surface, or to fuse with the *Coraco-brachialis* at its origin.† In man, the *Pectoralis major* occasionally sends a slip downwards to the internal condyle of the humerus. The variations of the extensor and flexor muscles of the hand have been already described; but I cannot agree with Wagner in saying "that the *Flexor Brevis* is fused with the *Abductor*, and that the *Flexor Longus Pollicis* is only a tendon of the *Flexor Profundus*;"‡ as in all three of the Apes dissected the origin of the *Flexor Longus Pollicis* was distinct from that of the *Profundus*. In the posterior extremity, the *Biceps* appears the most subject to variation of any of the muscles, with the exception of the *Peronæus Tertius*, both in man and the Quadrumana. In the foot of the Quadrumana, which is too often regarded as approaching more nearly to the structure of the hand than of the foot in man, owing, I think, to too great stress having been laid on the opposability of the hallux and the length of the phalangeal bones, we find that in the Orang alone is the hallux independent in its motions; in all the rest, even the Chimpanzee,§ it is supplied with a flexor tendon in common with some of the other toes, thus approaching nearer to the organization of the foot in man. The other muscles of the foot are strictly homologous with those in the human foot, and only analogous to those in the hand.

The *Peronæus Longior*, the *Extensor* and *Flexor Brevis*, and the *Flexor accessorius* are found in the Quadrumana as in man, modified in their distribution so as to suit the habits of the animals, but performing similar functions, and having the same homological relations. In the *Interosseous* muscles we see an approach to the Carnivora; more especially in the Magot, which has sesamoid bones developed on all its toes. Wagner (l. c.) states that the interosseous muscles of the posterior extremity are arranged like those of the same name in the human hand; but I think, from the descriptions before given, they will be seen in all instances to resemble rather the Carnivora. The anatomy of the Quadrumana, as mentioned by Vrolik, forms a most interesting connection between the Bimana and the lower animals, especially the Carnivora, as they possess so many points of resemblance to both orders.

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* Vide Editor's Note on the Latissimus dorsi, p. 542 of the preceding Number of this Review.

† Encyc. Anat. Tom. iii. p. 124.

‡ l. c. p. 19.

§ Vrolik, p. 20.

X.—Anatomical Notes.—By Professor Hyrtl, of the University of Vienna.

(Continued from Nat. Hist. Rev. for 1861, *p.* 324.)

5. *Pneumatic Processes of the Occipital Bone.*

Some time since I directed the attention of anatomists to a very interesting and anomalous process of the condyloid portion of the occipital bone (Wiener. Medic. Wochenschrift, 1860, N. 45).

This process is situated between the articular process of the occipital bone and the mastoid process of the temporal. It presents an elliptical form, the long axis of which is vertical, and its circumference is about that of the tip of one of the fingers. The process is not solid, but consists of many cells, which are in direct communication with the "air-containing" cells of the mastoid process. Hence I have called these processes "Pneumatic."

Since the notice above referred to was written, two additional instances of the occurrence of this process have presented themselves to me. One was given me by a student, who found the skull in a large bonehouse in a burying place, in his native town in Bohemia. The other was observed in a female skull, from my dissecting room. In both of them the processes are as large as a hazel-nut, and they are covered by so thin a layer of compact osseous structure, that the internal arrangement of the air-containing cells can be easily distinguished. In the female skull referred to, the cells of the pneumatic process extend as far as the *condyloid* process of the occipital bone, where they lose their partition walls and unite to form a single rather large cavity.

It is a curious fact, that the cells of the *pneumatic* process communicate with those of the *mastoid*, passing, as they do, across the *mastoid suture;* but there are many similar cases in Comparative Anatomy, where the pneumatic cavity of the frontal bone extends (across the *coronal* and *lambdoid suture)* to the occipital bone (*Elephas* and almost all other Pachydermata).

These pneumatic processes have been since observed by several of my fellow-anatomists, who have, in sundry communications to me, confirmed my observations in this matter; and I doubt not but that every Craniological Collection of any extent will likewise afford evidence of their existence.

I can boast of the possession of a very large series of crania, as for a long time past all the skulls of the subjects of my dissecting rooms are carefully prepared by maceration, and the number so prepared varies each year from 200 to 300, yielding thus an abundant supply for the hunting out of anatomical curiosities.

A careful investigator will not confound the new process with the *paramastoid* process, which is very often present in skulls. This latter is a strong process, with a thick layer of compact substance, containing no cells (simply common reticular substance), and is most commonly united to the lateral part of the *Atlas* by synostosis.

I cannot give a better proof of the difference between the two processes, than by stating that both these processes are to be seen in a skull in my collection (No. 711).

These processes are of no practical interest, but they are worthy of notice in a morphological point of view. Some of the older anatomists tell us of "a double mastoid process"—mistaking, I think, the pneumatic process for a secondary mastoid.

6. *On "Endless" Nerves.*

There has been of late years a very great excitement among physiologists, in reference to experiments as to the functions of nerves. Careful anatomical investigation as to their origin and distribution has, I fear, been thrown somewhat into the back ground. I do not speak of the subject of the microscopical investigation of nerves, but of their origin and distribution, such as can be determined by simple dissections.

Now-a-days many are inclined to regard human descriptive anatomy as a science already completed, and fancy that to it only trifling details can be added; but this is far from the case, and I would that the scalpels of the anatomist would work a little closer and finer, and that they would try to emulate, as it were, some of those high powers of our microscopes; for, in the minute anatomy of parts, very much remains to be done. To proceed, however, to the subject matter of this note. I think the commonly used term, anastomosis, is capable of a stricter interpretation than is generally given to it. As when a nerve *A*, as the text-books say, anastomises with *B*, we want to know whether a branch of *A* goes to *B*, or a branch of *B* to *A*. In a great number of anastomoses, it is true, we have clear evidence on this subject. Others will, doubtless, follow.

But we would further inquire: What does a branch, coming from *A* to *B do, when united with B?* The text-books tell us that the branch coming from *A* to *B* will remain with *B*, or will separate from it, and go to nerve *C*.

"That, in some cases, the branch coming from the nerve *A* to *B* will, *passing* along *B*, *return* to its nervous centre," is the newly established fact, which I wish to call attention to now.

When a nerve returns to its origin, it has no peripherical end, and it may, perhaps with convenience, be called ατελης, just as engineers and mechanics call a circular cord "ein Seil ohne Ende."

Such nerves occur in the ansa hypoglossi, in the anastomoses between the branches of the spinal-nerves in the upper and inferior extremities. When an accessory obturator* nerve exists, the *greater* part of its fibres will be found to return with the *true* obturator nerve, with which it anastomoses, to the spinal marrow. The palmar

* Adam Schmidt, Nervi Lumbales.

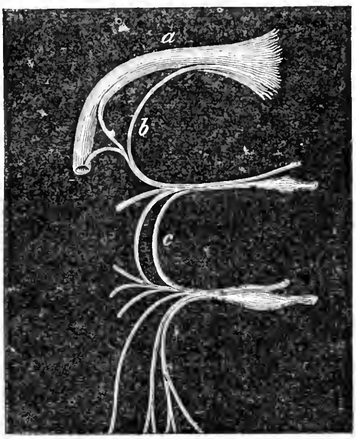
and plantar nervous arches afford also opportunities of witnessing these nerves without end. They are likewise met with in the loops of the anterior branches of the spinal nerves; in the anastomoses of the right and left Hypoglossus; in the fleshy portion of the Genio-hyoid muscles. That is to say, I have found such returning nerves in the localities referred to.

It will be the labour of years, if not of a life, to discover all the anastomoses which possess or are destitute of these "regressive" fibres.

These nerves not being lost in the substance of muscles, nor in sensorial surfaces, may merit the paradoxical appellation of 'endless nerves.'

To thoroughly investigate this very important fact in anatomy, I should suggest the co-operation of a number of practical anatomists, who would undertake to investigate* such and such anastomoses, and who would give in an annual report of the result of their joint labours. I will, in the course of this winter, take my share. The returning branches are sometimes in such thick bundles that they can, by a careful dissection, be easily traced onward.

It may be the case, indeed is so, in some of the instances alluded to, that a few of the returning fibres from *B* pass toward *C*, and continue onwards to the periphery; but even then a certain amount of nerve fibre does undoubtedly run backward to the nervous centre from which they emanated.



In the Chiasma opticum, fibres have been observed by Hannover, Mayo, and others, running from one nerve bundle to another, and forming a *loop*, which is 'a nerve without end.' These instances show that the thing is not quite new.

The annexed woodcut exhibits this form of recurrent anastomoses in *a* Hypoglossus. *b*, branch from *a*, meeting the first cervical and proceeding back again. *c*, branch from first cervical proceeding back along second cervical.

7. *On Portions of Lungs destitute of Blood Vessels.*

When I obtained the Professorship of Anatomy in the University of Prague I published a little treatise, entitled "Strena anatomica

* By means of the scalpel more than by any efforts at 'microscopising.'

de novis pulmonum vasis in Ophidiis viviperinæ repertis." This treatise was printed for the use of my class, but was never published; so the anatomical world took little or no notice of it. In it I stated that in the genus *Coluber*, the middle portion of the lungs neither received vessels from the pulmonary arteries nor gave branches to the pulmonary veins; but that it received arteries from the aorta and sent veins to the vena portæ, the posterior part of the lungs having no supply of blood-vessels at all.

Lapse of time and further investigation have brought me many additional proofs of the correctness of this statement, which I can now announce with certainty to occur in all snakes. From the spot, where the interior surface of the lungs loses its reticulated appearance (as is the case with the posterior two-fifths of the sacciform lungs) every vestige of circulation is absent. The very finest injection fails to penetrate this portion, which is positively deprived of blood-vessels.

I find that the longer the body of the snake, the longer is the bloodless portion of its lungs.

The interior surface of the lungs of the thick-bodied venomous snakes is, throughout its entire length, covered with hexagonal cells, and these are well supplied with both arteries and veins. This is also the case with the snake-like Scincoids (*Pseudopus anguis*); in all other snakes only the anterior two-fifths of the lung is provided with cells whose arteries come from the pulmonary artery, and whose veins go to the pulmonary vein; the third fifth receives its arteries from the aorta, sending its veins to the vena portæ; whilst the remaining two-fifths receive no blood-vessels at all.

When a lung like this is inflated, it will be found that this lower portion expands to double, or even triple, its former size, while the anterior part expands to not more than one-half its original diameter. This posterior portion of the lung, which is quite incapable of respiration, may, therefore, be regarded as a *reservoir* of air, which is probably consumed when external circumstances, such as fright, hybernation, &c., prevent a regular respiration.

Every snake, when frightened or surprised, is known to inflate its body to a very considerable degree, and to give utterance to a peculiar hissing sound, which I think is neither a sign of terror nor anger, nor produced by expiration, as the cry of other animals, but is the necessary physical result of the creature taking in rapidly a large supply of air in case of necessity—this air, passing through the small glottis, causing the sniffle.

When I referred to the middle portion of the lungs, as receiving branches from the aorta and giving branches to the vena portæ, these vessels must not, for a moment, be confounded with the common nutrient blood-vessels of other lungs, as in mammalia, where they are well known as the arteriæ et venæ bronchiales; for, were these vessels in the snakes only nutrient, then would not the anterior part be deprived of them.

The aorta contains mixed blood; when this blood, therefore, is so brought to the lungs, the venous portion of it is oxygenated, and then this oxygenated product goes to the vena portæ. This is an extraordinary fact, and cannot, I think, be physiologically understood, so long as we know so little of the chemistry of the production of bile in reptiles.

In all those genera of short-bodied snakes, where the pulmonary branches of the aorta are wanting, there are, in addition to the pulmonary vein to the auricle, three to five small pulmonary veins going direct to the vena portæ. The necessity for arterialized blood in the organ supplied by this vein is therefore placed beyond a doubt.

8. *On the Radial Artery in the Cheiroptera.*

A very curious anatomical fact, and one not devoid of physiological interest, is to be found in the membranous expansion of the 'wing' of the bat. It consists in the immediate transmission of arterial blood into a venous trunk, without the intervention of capillary vessels. This I have found to be the case in the following genera:—*Plecotus*, *Vespertilio*, *Rhinolophus*, *Pteropus*, *Noctula*.

Inject a bat, through the aorta, with a coarse injection material (specimens from abroad, which have been long preserved in spirits, require a somewhat finer material), which you are sure will not too easily enter the capillary system. The wings ought to be extended, so as to facilitate the passage of the fluid through the brachial artery into the arteries of the arm and hand. Even should the injection meet with but a very second-rate success, still it will be found that a large vein will be also filled. This vein runs along the free margin of the fold of the integument, and extends from the shoulder joint to the carpus.

This vein is the somewhat modified vena cephalica of man and the other mammalia. A very careful investigation as to where the artery ends and the vein begins, shows us that the radial artery, which tends towards the metacarpal bone of the thumb, describes a circle round the base of the thumb, from its palmar to the dorsal side, and is, on reaching the back of the hand, reflected towards the forearm, as a vein (vena cephalica) which takes its way between the two layers of the before alluded to fold of the integument to the arm-pit, where it terminates in the vena axillaris.

Before becoming a vein, the radial artery sends off the requisite branches for the nutrition of the parts in connection with the elongated metacarpal and phalangeal bones; but, at the same time, its real termination is not to be sought for in the capillary system, but in the peculiar manner I have just referred to; for, owing to having used a coarse injection, *no* capillary vessels have been filled, and yet, notwithstanding, a venous trunk (larger than the vena brachialis itself) is filled up with the injection material, throughout either the whole or entire of its length (reckoning from the thumb).

If the arm be allowed to remain folded, the result will not be satisfactory, as many of the arteries of the arm will probably be bent on themselves, there being articulations in the osseous system of the extremity; but if the unfolded wing be tied down to a slip of wood, the more favourable position of the trunk and branches of the brachial artery will cause the injection seldom or never to fail.

The immortal discoverer of the circulation of the blood, in whose lifetime the existence of the capillary system was not known, surmised that part of the arterial blood passed to the veins "per porositates carnis," and part by a *direct* "anastomosis" between arteries and veins. His spirit may, perhaps, rejoice that the latter of these suppositions has now, at last, been proved to have been not a merely arbitrary surmise.

Microscopic observers of the circulation in the transparent membranous web of the bat's wing have mentioned, that the veins in certain distinct localities of the wing may be seen to pulsate like arteries. I shall feel happy if this short note of my researches may explain the true reason of this hitherto unexplained phenomenon. Though pulsation extends not to the capillary vessels, yet physiologists will admit that it must extend to a vein, when that vein is the *immediate prolongation* of an artery, and the trunk of a vein pulsating will, in all probability, cause some of its smaller branches to do the same.

9. *On the Ophthalmic Vein joining the Portal System.*

In the tailless Batrachians a very considerable addition to the number of vessels going to the vena portæ is to be met with. Among others, the *ophthalmic vein* sends its blood to the portal system. If the main trunk of the vena portæ of a frog or toad be injected—(it is better to open the vein where it passes through the pancreas; the attachment to this gland serving to keep the vein open; the injection must be thrown towards the intestines, *not* towards the liver)—it will be found that all the veins of the pharnyx and of the roof of the mouth have been filled, and hence must, therefore, have belonged to the portal system. These veins form a most complicated network, the main trunks of which are of considerable diameter, so that one might fancy they saw a cavernous structure. The capillary vessels of the mucous membrane of the mouth and pharynx join these venous trunks without any sensible diminution of their calibre (as is the case in other organs), and in addition, they are joined by two large veins, which come out of the floor of the orbital cavities, and are the *true ophthalmic* veins. The injection, if successful, has entered them, and has filled, likewise, the choroid, iris, and the vascular hyaloid.

It may be mentioned here, that the above alluded to insertion of capillary vessels into large venous trunks is by no means restricted to the mouth and pharynx. In the testes and ovaries the same thing occurs, for the capillaries of these organs meet large venous blood-vessels which surround the germinal follicles in the ovary, or the perfectly closed spermato-genetic cells in the testicle, and this is not only the case among the Frogs, but prevails, without exception, throughout the whole classes of the Reptilia and Amphibia.

10. *On some additions to our knowledge of Retia mirabilia.*

I have just concluded a memoir on recently discovered "Retia mirabilia" in Mammals and Birds, which is for presentation to the Imperial Academy of Science, and which will probably be published in the Transactions of that learned Society. But as I cannot hope that its publication will take place for some time, I give the following brief epitome of its contents, but refrain from giving the descriptive particulars in detail. In Birds these Retia mirabilia occur only in the Tibial artery (Tibio-tarsal artery) of long-legged species —they are not found in any of the short-legged species—this conclusion is the result of the investigation by means of injection of more than fifty genera. The rareness of injected preparations of birds, will add somewhat to the value of my memoir; one great merit of which will consist in a series of splendid drawings from nature. It may be of interest to append the names of some of the more remarkable. Among the Cursores, I found the most complicated and richest Rete mirabile in the *Apteryx australis*, where it extends from the foreleg to the middle of the elongated tarsus; it covers the main trunk of the tibial and tarsal artery, crossing and recrossing it, so that, to the casual observer, it would appear as if the artery split up into so many branches, and that these composed the rete, but on closer examination the tibio-tarsal artery will be seen threading its way underneath the densely compact mass of the rete, and emerging, undiminished in its size, from its inferior end. In the Ostrich (*Struthio*); *Rhea; Dromaius;* Casuarius; *Leptoptilus; Phœnicopterus; Ardea; Ibis religiosa* (Sacred Ibis), and many others belonging to the Ardeidæ, the rete is found only in the foreleg. In the Ostrich and its congeners the rete is very small, consisting of a few (2-4) elongated and very slender branches, which are so closely applied to the chief trunk of the tibial artery, that their discovery and isolation require a good eye and sharp instruments. In the *Apteryx* the numerous vessels that enter to form the rete never return to unite with the tibio-tarsal artery, from which they originally sprung. When they cease to surround and accompany that artery, they unite to newly formed arteries, providing for the deficiency of the collateral branches of the main artery, which latter are totally wanting from the commencement of the rete. I lay some stress on the fact that the main trunk of the anterior tibial* artery and its prolongation as tarsal is only destined to supply the toes, the rest of the soft parts of the foot receive their blood from the various newly formed arteries, into which the rete mirabile branches off at its inferior

* The posterior tibial is wanting.

boundary. The tibio-tarsal rete mirabile of this wingless bird is therefore *unipolar*. In the fully developed rete of Struthio and its congeners it is however *bipolar*; each of its few constituent branches, inserts itself into the trunk of the tibialis some inches above the tarsal point.

I have also recorded the attempt at formation of rete mirabile in short-legged birds, and among them a very singular case in *Aptenodytes* (*Spheniscus*).

Among the mammalia the number of hitherto known* retia mirabilia and plexuses has been considerably increased; the arteries of the anterior and posterior extremities of many Pachyderms are provided with them, as I have observed in the Peccary, Tajacu, *Phacochœrus*, Tapir, *Hyrax* (*capensis* and *syriacus*), and in the common pig. I have little doubt but that anatomists, who are so very fortunate as to live near the Zoological Gardens, London, or the Jardin des Plantes, Paris, will be able in time to include among the number, the names of such grand animals as *Elephas, Rhinoceros* and *Hippopotamus*, which, like many other prodigies of 'ferax monstrorum Africa' (Plin.) will never come within my reach.

Among the true Quadrumana, there is no rete mirabile, but a strange tendency towards the formation of one is to be found among the thumbless apes, as in *Ateles*, where it manifests itself in the divided aspect of the elsewhere single and undivided arteries.

In the Prosimii, the collateral branches of all the main trunks jut out like a series of rays, so that a number of them have quite the appearance of tufts of tassels, a disposition which was discovered by Johannes Müller in other animals, and denominated by him, 'Rete mirabile unipolare diffusum,' (as in *Thynnus*); this curious origin of numerous side branches in the form of tufts or tassels, occurs in *Lemur, Galago, Lichanotus*, whilst in *Tarsius spectrum* and *Stenops gracilis*, true plexiform retia mirabilia occur in the brachial and the crural arteries.

Hitherto retia have not been found among the Carnivora; the first instance I saw was in the genus *Viverra*, where it occurs in the cutaneous branches of the crural artery; it accompanies the saphenous nerves, and forms a very slender and pretty rete saphenum, which extends through the leg as far as the ankle. In the Marsupials plexiform retia mirabilia are deficient in the limbs, but they are found well developed in the palatin and inferior maxillary arteries.

The special function of these retia appears still to be buried in obscurity, but still it may not be useless to collect thus a larger series of facts: some day or other, doubtless, they will be weighed in the balance of physiological reason.

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* Since the time of Carlisle (Phil. Trans. 1800), who discovered them in the arm of the Sloth, they have been observed (by Vrolik) in *Stenops*; (by Baer) among the Whales; (by Rosenmuller) in the Seal; (by Allman, Rept. Brit. Assoc. 1844) in *Dasypus*, and (by myself, Proceed. Imp. Acad. Vienna, vols. v. vi.) in *Myrmecophaga, Manis, Chlamydophorus, Ornithorhynchus*, and *Trichecus*.

11. *On intervertebral Synostoses and Suturæ in Fish.*

I have collected together from almost every quarter of the world, a large series of fish skeletons, numbering several hundreds. When surveying from time to time my treasures, I have been struck by the many examples occurring among them, of what, if it occurred in the human subject, would be considered a disease: I refer to the osseous union of a greater or lesser number of vertebræ into a solid mass, with the total disappearance of all intervertebral articulations, and of every vestige of cartilage or articular cavity, so that every trace of mobility has gone.

The number of coalesced vertebræ is from two to six, and this synostosis takes place more frequently in the tail than in the trunk of the fish. When one remembers that the locomotive powers of a fish chiefly depend on the extreme flexibility of its vertebral column, one would think that the diminution of this flexibility by the abolition of the intervertebral articulations, would not only cause some inconveniences to the creature, but even endanger its existence. This is, however, obviated by the fact that the confluent vertebræ are not larger than the non-confluent ones, their length being so much reduced, that the five coalesced vertebræ are not longer than one and a slight fraction of a non-coalesced one. It is a very remarkable sight to see such a synostotic series of vertebræ in the tail of some powerful fish; and this too, not by any means the result of pathological deformity, there being no callosity present to suggest a mechanical injury, and no deposits of calcareous matter to induce us to regard the synostoses as a senile metamorphosis; for it occurs in both old and young individuals, and in those of both sexes. The union is oftentimes so perfect that it is only by the presence of the two superior or inferior spinous processes, that we perceive that it has taken place; the intervertebral foramena appear never to be perfectly obliterated, though they are exceedingly diminished in size.

The synostosis is, without doubt, of a physiological character, and it must take place very early in life, when the length of the bodies of the vertebræ is so short, that two, three, four, or five such lengths is equal to the length of a single vertebra of a fully grown-up individual. When the increase in length is stopped, the increase in circumference continues, as in the non-synostosied vertebral bodies. This synostosis does not appear to occur in any of the short-bodied fishes. It does not occur in the short-bodied Sparoid, Moenoid, nor Squamipennate fish, nor in any Labyrinthoid, but in most of the other families it occurs the oftener, the longer the fish. In the Eel tribe (especially *Gymnotus*), in the *Mormyrus* (*κατ' ἐξοχην Gymnarchus*), two, three, and even four portions of the vertebral column are affected with this vertebral synostosis.

Another instance of solid and immovable vertebral union is to be found in the genus *Ostracion*, the body of these curious fish being walled-in by such a thick and almost enamelled carapace of solidly wedged plates, that it is only the end of the tail that appears beyond this strong coat of armour. The vertebral column has no mobility whatever, and is quite destitute of muscles; the bodies of the vertebræ are not anchylosed, but they and their superior arches are so firmly united by sutures, that flexion or extension between them, or throughout the whole length of the column, is perfectly impossible. This is, perhaps, the only instance of true suturæ between vertebræ to be met with in the animal kingdom.

12. *On the Arteria mediana linguæ.*

There is a small artery of this name, which has been overlooked by all anatomists. Ordinary injection materials will not be fine enough to demonstrate it, but the material which I make use of in my microscopic injections, answers however admirably. During the many years I have been engaged in the preparation of anatomical injections, I have met with this artery so often, as to be able to exhibit a series (numbering some dozens) of specimens, in which it may be seen in its different stages of evolution. From this little troop of human tongues we derive the following information:—

The Arteria dorsalis linguæ supplies the basal portion of the superior surface of the tongue, that portion between the papillæ circumvallatæ and the epiglottis, it then spreads itself into a number of branches, each of which is very fine and superficial; the posterior branches of the one side, meet with the branches from the other in the median line, at the base of the tongue; a median artery is formed after the same manner, as the two vertebral arteries unite to form the basilar artery in the cavity of the skull.

The Arteria mediana linguæ runs forward to the point of the angle formed by the two converging lines of the papillæ vallatæ—here it either ends or divides, and surrounds the larger papillæ, and is then continued on as a single vessel, which continues its onward course to the top of the tongue. This artery is of very small size, but it is situated so superficially, as to be easily seen without any preparation. It is contained *in* the mucous membrane of the tongue, not *below* it, as in all the other arteries of this organ. When the artery, in a well injected tongue, is not at once apparent, a little manipulation will soon reveal it. There are tongues whose surface is not very rich in filiform papillæ, and these too, very short, so that the tongue resembles a close cut-velvet; such tongues will show this artery without any help from the scalpel; but when the filiform papillæ are very long and densely set (such tongues are called in German, "pelzige Zungen"), the artery may be best seen and dissected out by dividing the papillæ in the middle line of the tongue by a pin, or better by shaving the surface of the tongue with a razor.

Perhaps I have dwelt too long on a vessel, which, if wounded, would not yield three drops of blood; but every anatomist likes to deal sometimes in trifles, and the smaller the organ discovered by our application, the more satisfaction have we. Should science attend only to discoveries that may be saleable in the market of practical life, where would she be standing in the present day ?

Among my anatomical preparations of tongues, there is one of *Cynocephalus Hamadryas*, and one of *Tapirus Americanus*, in which the arteria mediana linguæ is of very considerable size, and extends throughout the length of the tongue to apex. In *Cynocephalus*, it here divides into two branches, which connect themselves with the foremost twigs of the arteria profunda linguæ. I find this vessel also in the tongue of *Aquila fulva*.

13. *On the Rami perferantes of the anterior Tibial and Peroneal Arteries.*

When an isolated injection of the anterior tibial artery is made (the trunk on the dorsum pedis must be ligatured, to prevent the filling of the tibialis posterior by the large anastomosis between these two vessels, in the first intermetatarsal interspace) some small arteries will be discovered filled in the deep layer of the calf of the leg. According to the ordinary ideas, the anterior tibial artery is only destined for the muscles, &c. on the forepart of the leg, but on a closer examination, some four or five small branches will be found, which perforate the interosseous ligament at almost equal distances, and reach the posterior part of the leg; they keep close to the periosteum, along which membrane they ramify, and they are joined by offsets of the posterior tibial, coming to the same fibrous membrane.

The peroneal artery is injected with the same results; its perforating branches go across, through the interosseous ligament, to the periosteum of the anterior aspect of the tibia, and ultimately anastomise with the periosteal branches of the tibialis antica; the tibialis postica does not send off perforating branches.

These communicating branches may be of some practical use in cases of ligature of either of the above-mentioned arteries: there is in my anatomical collection a preparation of the arteries of the fore-leg, where a communication is kept up between the trunks of the tibialis antica and peronea, by a very stout-looking vessel of about the calibre of a raven's quill. The anastomosis takes place about half-way down the leg, and the peroneal artery is suddenly augmented in volume at the spot where the communicating branch joins the peroneal.

XI.—Upon a non-striped Muscle connected with the Orbital Periosteum of Man and Mammals, and on the Musculus Kerato-cricoideus. By Wm. Turner, M.B. (Lond.), F.R.S.E., Senior Demonstrator of Anatomy, University of Edinburgh.*

Whilst engaged in making a dissection, in the human subject, during the winter session of last year, of the superior maxillary, or second division of the fifth cranial nerve, my attention was attracted to a pale-reddish, soft, mass, filling up the narrow chink of the spheno-maxillary fissure, and extending, from the sphenoidal fissure in the sphenoid bone, to the infra-orbital canal in the superior maxillary bone. It was evidently connected to the superior (ocular) aspect of the periosteum of the orbit, and it was pierced by the orbital branch of the superior maxillary nerve, from which, as well as from the ascending branches of the spheno-palatine ganglion, it appeared to receive its supply of nerves.† It completely shut off the superior maxillary nerve, with its infra-orbital continuation, from the cavity of the orbit.

Since the period of making the above observation, I have availed myself of several opportunities of examining the same region in other subjects, and have constantly observed appearances, of a nature similar to those just described. The amount of the reddish mass and the depth of its tint varied slightly in different instances. Frequently, it was so pale as scarcely to attract attention, which may perhaps be the reason why it has so long been neglected by anatomists. When carefully examined with the naked eye, or, still better, with a single lens, it was seen to exhibit a fibrous appearance. A small portion snipped off with scissors, teazed out with needles, and placed on the stage of the microscope, under a quarter inch objective, was observed to be composed of pale, flattened, band-like fibres, having a faintly granular aspect, and presenting indications of elongated nuclei at intervals. From these characters I had little doubt that the structure in question consisted of the non-striped form of muscular fibre.

As considerable difficulty is always experienced in obtaining for examination the contents of the human orbit, in a perfectly fresh condition, I, in the next instance, proceeded to dissect the orbits of some of the more readily obtained mammals, with a view of ascertaining if a similar structure existed in them. In the orbit of the sheep, I have most satisfactorily observed appearances which have fully confirmed the opinion of the structure already expressed. The orbit of this animal differs from that of man in possessing much less perfect walls. As a consequence of this, the orbital membrane, or periosteum, is a structure of much importance, for it stretches across the floor of

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* Read before the Royal Physical Society of Edinburgh, Dec. 19th, 1861.

† That Meckel's ganglion sends branches to the periosteum of the orbit is a fact that has long been known to anatomists, though there have been difficulties in the way of giving a satisfactory reason why such an arrangement prevails. The existence of the small muscle now described, accounts for the distribution.

the orbit from its outer to its inner wall, extends backwards to the optic foramen, and completes the boundary of the cavity at the spot where the bony wall is wanting.

If the contents of the orbit be carefully removed, and the orbital membrane examined from above, it will be seen to be a well defined structure, distinctly fibrous, and in many places having an almost tendinous-like aspect. Intimately connected with, and forming an essential part of it, is a thin layer of a pale reddish substance, which extends across the greater part of the floor of the orbit, passing backwards to the optic foramen and sphenoidal fissure. In close contact with this structure, especially at the posterior part of the orbit, is a well-marked vascular net-work, sufficiently injected with blood to be distinctly visible. This vascular plexus constitutes a small rete mirabile, connected with the ophthalmic artery. By removing a small portion of the reddish mass, teazing it out with needles under water, and examining it with a quarter inch objective, it may be seen to be composed for the most part of flat, pale, non-striped fibres, collected together in bundles, having a faintly granular aspect and exhibiting decided indications of nuclei in their interior. These bundles of flat fibres are mingled with ordinary fibrous tissue, both white and yellow, the latter becoming more distinct after the addition of acetic acid. The pale, non-striped fibres have all the characters of the involuntary muscular fibre. Being desirous however of ascertaining if these fibres could be resolved into their constituent fibro-cells, I adopted the plan which has been recommended by *Reichert*, and macerated a portion of the orbital membrane for forty-eight hours in dilute hydrochloric acid. I then found that, by the aid of a very slight dissection, the fibres readily resolved themselves into the elongated fusiform cells of which they were composed. In no tissue which I have ever examined, consisting of the non-striped muscle, have I succeeded in obtaining more beautiful and more perfect specimens of the contractile fibre-cell than in this muscle of the orbital membrane. The fusiform shape of the cells, their size, and the elongated rod-like nucleus in the centre of each cell, gave to the texture a most characteristic appearance. I may also mention, that when the orbital muscle in the sheep was examined without the addition of any re-agent, besides distilled water, a number of elongated rod-like nuclei were always met with, lying free in the water surrounding the preparation, which had evidently been loosened and detached during the dissection with the needles. These nuclei corresponded in their characters to those met with in the interior of the fibro-cells. The characters which I have now enumerated render the muscular nature of the reddish texture connected with the orbital membrane sufficiently clear.

On referring to the authorities who have written on the structure of the orbital membrane I find that the following opinions have been expressed concerning it.

Bendz,* in a paper "On the orbital membrane in the domestic Mammals," describes it as distinctly fibrous, but possessing a consi-

* Müller's Archiv, 1841, p. 196.

derable quantity of a yellowish tissue, which he considers to be elastic, interpolated with it. He regards the opinion, which had been previously advanced by *Gurlt*, that the tissue was muscular, to be erroneous. *Stannius** states that in those animals, in which the bony wall of the orbit is incomplete, the separation between the orbital cavity and the temporal fossa is mostly effected by a fibrous membrane, containing also abundant elastic tissue. He states that *Rudolphi* regarded these elastic fibres to be muscular in Bears, and that *Meckel* described a muscle in the orbital membrane of Ornithorynchus. *Chauveau*† speaks of the fibrous membrane which completes the cavity of the orbit as entirely composed of white inextensile fibres. *Gurlt*‡ considers it to be a strong fibrous membrane, with yellow elastic fibres interpolated. *H. Müller*,§ in a very brief communication, states that he has found flat muscular fibres in the inferior orbital fissure in man, and corresponding structures connected to the membrana orbitalis of mammalia.

It was supposed by those, who held that the membrana orbitalis was a highly elastic and not a muscular structure, that it was through its elastic recoil that the eye-ball was re-protruded in those animals which retracted the ball through the contraction of a retractor muscle. *H. Müller*, again, who speaks more positively than any who have preceded him, not only of the existence of a muscle, but also of the kind of fibre of which it is composed, considers that it antagonizes those muscles which retract the eye-ball into the socket, and that thus, the reprotrusion of the globe is produced, not by a mere elastic recoil but by a muscular contraction.

If this hypothesis be correct, an arrangement exists in this locality, which is certainly to be regarded as an unusual one, viz.: an involuntary muscle acting as a direct antagonist to a voluntary muscle. Whether the hypothesis be correct, or not, I am disposed to consider that the muscle has some especial relation to the vascular arrangements in the orbit. Its extension backwards to the foramina through which the orbital vessels proceed, and with which it is in immediate relation, and the very abundant vascular network found in connection with it, point, I think, to some special relation between the muscle and the vessels, a relation which is not at all inconsistent with what is known of the function of non-striped muscle in other localities.

Occurrence of the Musculus Kerato-cricoideus.—In a paper, entitled "Remarks on the Musculus Kerato-cricoideus (Merkel's muscle)," published in the Edinburgh Medical Journal, February, 1860, I directed attention to an account, which had been given by Dr. Carl Merkel of Leipsic (Stimm und Sprach-Organ, 1857), of a hitherto undescribed muscle of the human larynx. Merkel described this muscle as arising from the posterior surface of the cricoid cartilage, and extending obliquely upwards and outwards to

* Lehrbuch der vergleichenden Anatomie, 1846, p. 401.
† Traité d' Anatomie Comparée, 1857, p. 753.
‡ Handbuch der Vergleich. Anat. der Haus. Säugethiere. 1860, p. 733.
§ Siebold and Köllikers Zeitschrift, 1858, p. 541.

be attached to the posterior margin of the inferior horn of the thyroid cartilage. He stated that the muscle was not found in every larynx, and that when present it existed only on one side.

In my remarks, I supplemented the description of Merkel with some additional particulars, more especially pointing out, that, although, as a rule, the muscle only occurred on one side, right or left as the case might be, yet that a double muscle might exist. I figured an example of such a bilateral muscle, which at that time was the only one I had seen. Since then I have met with two additional cases in which a double kerato-cricoid muscle was present. One of these was especially noteworthy, for the muscle, on both sides, was more largely developed than in any previous example that had fallen under my notice. The great size of the kerato-cricoid muscle was combined with a general laryngeal muscularity. The occurrence of three examples of a double kerato-cricoid muscle, during the last two years, within my own experience, shows that the bilateral arrangement is not so unusual as was in the first instance supposed.

Note.—Since the above paper was in type, my attention has been directed, by Professor Huxley, to a communication by H. Müller, dated Dec. 15th, 1860, entitled "On the influence of the sympathetic upon some muscles, and on the extensive occurrence of unstriped muscles in the skin in the mammalia."*

As this paper throws some additional light upon the probable action of the orbital muscle I append a short abstract of it:—

H. Müller, after referring to the many puzzling questions which have arisen respecting the function of the sympathetic nerve, and its relations to the muscles supplied by it, proceeds to ask two questions:

1st. Whether and which unstriped muscles are supplied by other nerves than the sympathetic?

2nd. Whether and which transversely-striped muscles are under the influence of the sympathetic?

In answer to the first, the action of the oculo-motor nerve upon the unstriped fibres of the iris cannot be doubted: the vagus also acts upon unstriped muscles, and the experiments of Schiff have shown that the greater part of the vascular nerves are not connected with the sympathetic.

The second question may be most effectively answered by considering the effect produced upon the eye-ball by division or irritation of the cervical sympathetic. Müller, for this purpose, refers to the experiments of Bernard, R. Wagner, and Brown-Sequard; the general tendency of which is to show, that division of the cervical sympathetic produces narrowing of the palpebral fissure, retraction of the bulb, projection of the nictitating membrane and narrowing of the anterior nares and the mouth. Irritation of the nerve by galvanization, on the other hand, produces increase of the opening of

* Ueber den Einfluss des Sympathicus auf einige Muskeln, &c. Von H. Müller, "Verhandlungen der Phys. Med. Gesellschaft in Würzburg."

the lids, projection of the bulb, retraction of the nictitating membrane, relaxation of several facial muscles. Respecting the causes which produced these changes there was some difference of opinion. R. Wagner could scarcely conceive that any force, save the contraction of the two obliqui, could produce projection of the eye-ball, and yet he asks, "how could these transversely-striped muscles receive excito-motory fibres from the sympathetic?" Brown-Sequard, again, considered that retraction of the bulb, after section of the nerve, was produced by the active contraction of the retractor and recti, and that its reprojection by subsequent irritation was a reposition. Schiff regarded the projection of the bulb as due to the action of the obliqui: the movements of the lids he considered to be passive, and due to those of the bulb.

Remak, on the other hand, believed that the narrowing of the palpebral fissure was due to a relaxation of the levator palpebræ superioris, accompanied by a spasmodic contraction of the orbicularis. Moreover, he conceived that the sympathetic acted upon the voluntary muscles of the lids about the eye.

Müller considers that it is now no longer necessary to discuss the various probabilities respecting the influence of the sympathetic upon the voluntary muscles of the eye, as a complete series of unstriped muscles have now been observed, which will serve as a foundation for explaining the movements in question.

These muscles consist of three divisions:—

1st. In the orbital cavity of mammals, a membrane (membrana orbitalis), consisting of unstriped muscles with elastic tendons, exists, which, by irritation of the cervical sympathetic, projects the contents of the orbit, especially the bulb, forwards. Retraction is produced by the transversely-striped retractor. In man, the orbital muscle is much reduced in size, and the retractor is wanting, so that a distinct projection of the bulb does not follow irritation of the sympathetic, as Wagner and H. Müller himself have observed.

2nd. The projection of the nictitating membrane in mammals is mostly due to the retractor bulbi under the influence of the N. abducens. Its withdrawal depends on some unstriped muscles which are under the influence of the sympathetic. In hares, however, the withdrawal is due to a transversely striped muscle, which is not supplied by the sympathetic but by the oculo-motorius. In man, the lid and its muscles are rudimentary.

3rd. The upper and lower lid possess in man, and in very many mammals, unstriped muscles, which have the power of drawing them back. They are more feeble in the upper than the lower lid, so that by irritation of the sympathetic the latter is drawn back in a more marked manner than the former. Narrowing of the palpebral fissure, after section of the cervical sympathetic, depends upon relaxation of these muscles. Yet recession of the eye-ball may depend upon relaxation of the orbital muscle. Müller, then, concludes that the movements occasioned by experimenting on the cervical sympathetic, are not such as to entitle us to infer an influence of that nerve upon voluntary striped muscle. He also considers that the movements about the nose and mouth, said by Bernard to be produced by section of the sympathetic, if they do take place, are owing to the presence of unstriped cutaneous muscles.

Müller next inquires into the existence of unstriped muscles in the skin of the ear. He has occasionally found, on galvanizing the cervical sympathetic in cats, that a movement of the hairs growing upon the skin at the entrance of the concha, has taken place. This experiment has, however, frequently failed both in cats and other animals. A careful examination of the skin of the part did not give any indications of unstriped muscles, but very distinct muscles were seen connected to the hair follicles. He considers these experiments of interest, as they appear to indicate whence the muscles of the hair follicles receive their nerves. Owing to the movement of the hairs being limited to a very small locality, during the irritation of the sympathetic, one must suppose that only a very small part of the unstriped muscular apparatus of the skin of the cat can be regulated by the cervical sympathetic.

XII.—Note sur l'Encéphale de l'Orang-outang, par J. L. C. Schroeder van der Kolk et W. Vrolik.*

[By the kindness of the distinguished authors of this essay, we are enabled to lay it before the readers of the present number of the Natural History Review; wherein it fitly takes its place, as an important link in the chain of evidence by which the baselessness of the three assertions, that the "posterior lobe," the "posterior cornu of the lateral ventricle," and the "hippocampus minor," are structures "peculiar to" or "characteristic of" the human brain, has been placed beyond the possibility of cavil. The statements in the paper to which MM. Schroeder van der Kolk and Vrolik refer in their opening sentence, were substantially refuted in the essay "On the Zoological Relations of Man to the Lower Animals," published in the number of this Review for January, 1861; and were so obviously, either irrelevant or incompatible with fact, that we deemed them undeserving of further criticism. But, for MM. Schroeder van der Kolk and Vrolik, this singular *brochure* had an importance, which its scientific contents could not confer upon it. For though these eminent anatomists declare themselves decided opponents of all forms of the doctrine of progressive development, they are above all, lovers of truth; and therefore, at whatever risk of seeming to lend support to views which they dislike, when, in that paper and elsewhere, they found their facts denied, their words misquoted, and their very figures misinterpreted, they felt it their duty to take the first opportunity of publicly repudiating the abuse of their authority, in a formal note addressed to the learned Academy of which they are members.

As none of our readers, who are interested in the question, are likely to be unacquainted with French, we content ourselves with accurately reproducing the text and its accompanying plate; a course, which in such a case as this, has its obvious recommendations.—T. H. H.]

Monsieur Richard Owen† vient de publier un mémoire sur les caractères anatomiques du cerveau de l'homme et des singes. Pré-

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* Extrait des comptes rendus de l'Academie Royale des Sciences, *Section Sciences Exactes*, Vol. XIII. Amsterdam.

† R. Owen. On the Cerebral characters of Man and the Ape in *Annals and Magazine of Natural History*, 3d Series, Vol. VII. No. 42, July 1861, p. 456.

occupé de la question remise sur le tapis par les auteurs des *Vestiges of Creation* et de la *Natural Selection*, et animé peut-être par la polémique, qui en a été le résultat, cet éminent naturaliste a voulu prouver par des faits anatomiques, que l'espèce *Homme* n'a pas pu provenir de l'espèce *Singe*. Cherchant ces faits principalement dans la structure du cerveau, notre honorable confrère a cru de son devoir de reproduire les dessins de feu Tiedemann pour le cerveau d'un nègre* et les nôtres pour le cerveau du Chimpansé†, afin de faire voir qu'il y a une différence prononcée entre l'encéphale de l'homme le moins développé et celui de ces singes supérieurs, que l'on nomme anthropomorphes.—Ces faits, ajoute-t-il, gagnent en importance, si l'on considère qu'ils ont été publiés bien avant que la transmutation des espèces fût devene une question scientifique, par conséquent sans y avoir êgard, et probablement aussi sans que les auteurs aient songé à la possibilité qu'une telle hypothèse pût être émise un jour. Monsieur Owen nous fait l'honneur d'y joindre quelques paroles bienveillantes sur l'exactitude de nos dessins, qu'il a pu apprécier en les comparant avec les dissections qu'il a faites du cerveau du Chimpansé, de l'Orang-outang et du Gorille ; le cervelet du Gorille, que nous n'avons pas disséqué, lui paraît proportionellement plus grand que celui des deux autres anthropomorphes, et il en déduit l'étonnante force musculaire de cet animal.

Jusque là nous n'avons qu'à nous féliciter d'un accord scientifique, dont nous sommes heureux et fiers. Malheureusement un peu plus loin, notre illustre confrère paraît s'être laissé entraîner par son désir de combattre la théorie de M. Darwin, et, si nous ne nous trompons fortement, il s'est fourvoyé. Pour prouver que le cerveau du nègre s'élève sans transition et d'une manière brusque audessus de celui des singes anthropomorphes, M. Owen affirme que le lobe postérieur de l'hémisphère, la corne postérieure du ventricule latéral, et dans celle-ci l'éminence, que l'on nomme pes Hippocampi minor, qui existent tous dans le cerveau du nègre, manquent chez ces singes. Il ajoute que l'absence de ces parties offre un caractère bien tranché et même des plus importants, pour distinguer le cerveau des quadrumanes de celui de l'homme. Afin de bien préciser, il se sert des paroles suivantes, que nous avons cru devoir traduire.

" Pour les définitions concises, dont on se sert dans les systèmes zoologiques pour caractériser les groupes, il est avant tout nécessaire de bien définir les termes. J'ai eu soin de la faire dans mon mémoire sur la classification primaire des mammifères‡ d'après les différences

* T. Tiedemann. On the Brain of the Negro compared with that of the European and the Orang-outan in *Philosophic. Trans. year* 1836.

† Schroeder van der Kolk en W. Vrolik. Ontleedkundige Verhandeling over de gedaante en het maaksel der hersenen van den Chimpansé, in *Verh. der Eerste Klasse van het. Koninklijk Nederl. Instituut*, 3e Reeks, Eerste Deel, bl. 263. Amsterdam, 1849.

‡ V. On the Characters, Principles of Division and Primary Groups of the class Mammalia in *Journal of the Proceedings of the Linnæan Society*, Vol II. No. 5, June 21, Ao. 1857.

spéciales du cerveau. Le terme du lobe postérieur y avait primitivement un sens un peu vague. Avec M.M. Cruveilhier, Todd et d'autres, je ne reconnaissais pas de limite naturelle entre le lobe moyen ou temporal et le lobe postérieur ou occipital de l'hémisphère du cerveau humain. Par conséquent, je me vis forcé de prendre mon point de départ tant de la structure interne, que de la position relative des parties. D'après cela j'ai nommé lobe postérieur celui qui recouvre le tiers postérieur du cervelet et se prolonge au delà de celui-ci."

Suivant ce raisonnement nous serions coupables d'une fausse interprétation, en nommant lobe postérieur une partie du cerveau, qui ne se prolonge pas autant et qui ne contiendrait pas de corne ventriculaire postérieure.

M. Owen le dit d'une manière implicite, en ajoutant: " néanmoins " je n'ai aucun doute, que mes confrères faillibles n'aient dit la vérité, " *telle qu'ils l'entendent*, en affirmant que les singes d'un ordre supé- " rieur ont un lobe postérieur à l'hémisphère de leur cerveau, une " corne postérieur dans leur ventricule latéral et dans celle ci un pes " Hippocampi minor; mais de mon côté, je crois aussi prononcer une " vérité strictement scientifique d'accord avec les définitions de ces " parties, en affirmant qu'elles ne sont propres (*peculiar*) qu'à l'espèce " humaine."

Ces paroles, publiées au mois de Juin 1861, paraissent être une réponse à un mémoire, publié au mois de Janvier de la même année, par M. Huxley.*) Ce savant, qui nous fait l'honneur de nommer notre travail de 1849, *one of the most valuable memoirs on the cerebral organisation of the higher Apes that has been yet written*, déduit de nos observations et de nos planches justement le contraire de ce que M. Owen y a vu.

M. John Marshall, qui vient après M.M. Huxley et Owen, insiste sur cette singulière controverse, en citant nos planches " *so* " *differently interpreted just now, being equally quoted to show the* " PRESENCE *and the* ABSENCE *in the quadrumanous brain, of the same* " *parts, viz. the posterior lobes, the posterior cornu and the hippocampus* " *minor.*"† Il fait quelques reflexions sur nos dessins, sur lesquelles nous reviendrons plus tard, mais il y reconnaît toutes les parties, dont M. Owen nie l'existence chez les singes. Outre cela, il donne une belle photographie du cerveau du Chimpansé, dans laquelle il les montre toutes.

Nous devons encore citer M. George Rolleston,‡ venu après

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* Huxley. On the Zoological Relations of Man with the Lower Animals, in *Natural History Review*, No. I. January, 1861, p. 69. London.

† On the Brain of a young Chimpanzee. By John Marshall. In *Natural History Review*, No. III. July, 1861. London.

‡ G. Rolleston. On the Affinities of the Brain of the Orang Utang, in *Natural History Review*, No. II, April, 1861.

M. Huxley et avant M. Marshall, qui reconnaît ces parties et les décrit chez l'Orang-outang.

Il paraît que l'année 1861 a été funeste en Angleterre aux Chimpansés et aux Orangs, et que la question même de leur organisation cérébrale a bien vivement ému les esprits. L'accord d'opinion qui règne entre nous et ces trois auteurs nous flatte et nous honore. Nous nous réjouissons de la facilité qu'offrent les Jardins Zoölogiques établis partout aujourd'hui, et de l'excellent esprit qui anime leurs directeurs. Une erreur, qui se serait perpétuée autrefois, est maintenant bien vite éclaircie.

En comparant les paroles de M. Owen avec l'appui unanime donné à nos travaux pas trois hommes éminents, nous ne nions pas que nous en sommes extrêmement frappés et profondement affligés. D'après les louanges, données á l'exactitude de nos dessins, nous ne nous attendions pas au reproche d'avoir méconnu le caractère anatomique du cerveau des singes supérieurs ou anthropomorphes. Nous avons représenté dans nos planches les parties que M. Owen refuse au cerveau du Chimpansé; nous les avons décrites dans le texte de notre mémoire. M. Owen nous loue de notre exactitude, et par une contradiction *in adjecto,* il nie chez les singes l'existence des parties mêmes, que *de son aveu*, nous y aurions si bien décrites et si bien représentées. Si nous avons bien compris la phrase, dans laquelle il enveloppe un démenti un peu voilé, c'est sur l'interprétation qu'il nous attaque. Il s'agit d'éclaircir celle-ci et de la défendre. Cette défense est devenue d'une certaine importance, depuis que la prétendue absence du lobe postérieur aux hémisphères du cerveau des singes est devenue un des arguments, que l'on oppose à l'hypothèse de la transformation des espèces, théorie que l'on doit á M. Darwin, et qui, quoique connue seulement depuis environ deux ans, jette déjà un éclat plus vif que sa soeur aînée, vieillie sous le nom de *Vestiges of Creation.* Il y a entre elles un trait de famille; mais la cadette se glorifie d'un nom universellement respecté, l'aînée se cache sous le voile de l'anonyme. L'histoire nous apprend que de telles théories frappent et séduisent surtout les esprits jeunes et pleins d'avenir. Elles reparaissent de temps à autre et accompagnent presque toujours les tourmentes politiques et religieuses.

Une fatalité, qui s'explique par la nature même de la lutte, lui donne toujours un caractère d'animosité très vive et presque toujours personelle. Un désir trop ardent de vaincre enlève aux antagonistes l'esprit calme, qui les dirige dans leurs autres travaux. Ils ne se donnent pas le temps de délier le noeud; leur impatience leur fait croire qu'ils n'ont qu'à le couper. Une phrase très forte, par laquelle M. Agassiz définit la théorie Darwinienne en fait preuve; il la nomme une erreur scientifique, fausse dans les faits, non scientifique dans sa méthode et pernicieuse (*mischievous*) dans sa tendance. M. Darwin est un homme trop éminent pour mériter une accusation tellement formulée. On peut regretter qu'une imagination trop vive, une facilité de conception qui éblouit plutôt qu'elle n'éclaire, en le poussant dans le labyrinthe des hypothèses, lui ait fait quitter le champ des observations où l'on aimait tant à le suivre, mais on ne lui contestera jamais un talent hors de ligne, ni un savoir aussi profond qu'étendu.

Cette digression fait voir que nous ne sommes pas partisans de la théorie qui porte le nom de son auteur. Mais s'il faut la combattre, nous désirons que ce soit par des arguments à l'abri de tout reproche et par des faits clairs, évidents, irrécusables. Sans cela on court risque de faire tort au système même, que l'on veut défendre.

Nous craignons que M. Owen ne soit tombé dans cette faute.— Si nous avions commis une erreur, soit d'observation, soit d'interprétation, nous serions heureux de pouvir l'avouer, en cherchant notre excuse dans ce qu'il nomme une faillibilité que nous admettons et reconnaissons en toute humilité, et nous trouverions en même temps notre consolation dans l'idée, que cette erreur eût procuré un argument de plus contre une hypothèse qui nous déplait. Mais, à notre regret, nous ne pouvons nous exécuter avec cette bonne grâce. Nous avons revu nos dessins et nos préparations de l'année 1849. Nous reconnaissons avec M. Owen, que les dessins sont exacts. Non satisfaits de cette approbation, nous avons repété, au mois d'Août dernier, la dissection d'un cerveau d'Orang-outang, mort au Jardin Zoologique d'Amsterdam, que nous devons à la générosité de M. Westerman et à la courtoisie de notre collègue M. Van Geuns. Nous soumettons à votre appréciation, messieurs, la dissection du ventricule latéral gauche de ce cerveau, et nous osons espérer, que les anatomistes qui assistent à cette séance, n'y méconnaîtront ni un lobe postérieur à l'hémisphère, ni une corne postérieure au ventricule latéral, ni une éminence dans cette corne, éminence que nous croyons avoir le droit de nommer un indice de pes Hippocampi minor.* Quant à la définition du lobe postérieur, nous ne sommes pas d'accord avec notre honorable confrère sur l'absence de limite entre le lobe moyen et le lobe postérieur de l'hémisphère. Nous trouvons entre ceux-ci un sillon transversal, formant une ligne de démarcation, tout aussi distincte chez le Chimpansé et l'Orang, que chez l'homme. Pour voir ce sillon, il s'agit de bien enlever la pie mère, ce qui n'est pas toujours facile.

A vrai dire, ce lobe postérieur ou occipital ne se prolonge pas autant que chez l'homme ; il ne recouvre pas si bien le cervelet, du moins il ne le cache pas complètement, surtout vers les cotés : mais il n'y a rien là dedans, qui nous empêche de lui donner le nom qui

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* En parcourant le procès-verbal de la séance du 28 Sept. 1861, publié dans nos *Comptes rendus*, on verra que la présence des parties contestées y a été universellement reconnue par les anatomistes présents à la séance. Le seul doute, qui soit resté, se rapporte au pes Hippocampi minor. La préparation était déjà conservée depuis deux mois environ dans de l'esprit de vin et l'on sait que cette liqueur conservatrice raccornit toujours la substance cérébrale.

A l'état frais l'indice du petit pied d'Hippocampe était plus prononcé que maintenant.

lui est dû. D'ailleurs il ne faut pas oublier, que lorsqu'on retire le cerveau du crâne, il ne garde pas ses proportions normales. Il s'affaisse par le poids des hémisphères qui, en s'écartant, découvrent en partie le cervelet. M. Gratiolet et les auteurs Anglais, que nous venons de citer à la page 113, font ce reproche à nos planches de l'année 1849.—Ce reproche est mérité. On devrait maintenir ou remettre le cerveau dans le crâne, pour le dessiner et, en tout cas, corriger les proportions du dessin d'après un moule pris de la surface interne du crâne, méthode nouvelle, que nous devons à M.M. Wagner et Lucae et dont nous nous servirons à l'avenir. Par rapport au développement du cervelet, nous ne croyons pas faire une chose inutile en rappelant que, d'après les mesures que nous avons publiées en 1849, le cervelet du Chimpansé et de l'Orang-outang est proportionellement plus grand que celui de l'homme. Cela doit avoir une certaine influence sur la manière dont il se trouve pour une partie à découvert chez ces animaux, qui ont les lobes occipitaux moins étendus que ceux de l'homme.

L'existence de ce lobe occipital chez les singes n'est pas une découverte nouvelle dont nous puissions nous attribuer le mérite; Tiedemann l'a déjà représenté en 1821 chez le maimon (*Macacus nemestrinus*.* Cuvier dit que chez les singes, les hémisphères se prolongent en arrière, comme chez l'homme, pour y former les lobes postérieurs, qui posent sur le cervelet. Nous avons indiqué un lobe postérieur dans le cerveau presque lisse du Stenops.† D'ailleurs ce lobe ne manque pas toujours chez d'autres mammifères. Tiedemann décrit de petits lobes occipitaux chez le Phoque, et, ce qui est plus frappant encore, il les indique et il les dépeint chez le Dauphin,‡ M. Gratiolet dont personne ne méconnaîtra l'autorité, dit§ "que "dans l'homme et dans les singes, se détache de la partie postérieure "de l'arc du ventricule latéral, un prolongement un peu recourbé en "dedans, comme la corne d'ux Rhinocéros ou comme une griffe. Ce "prolongement est la corne postérieure ou occipitale du ventricule "latéral. Ce prolongement est fort remarquable; dans les singes, il "a une grandeur énorme, eu égard à l'ensemble du ventricule latéral, "dont l'arc est fort petit."

Ainsi il est évident, que nous ne sommes pas les seuls qui attribuent un lobe posterieur aux hémisphères du cerveau des singes. Si dans le règne des faits l'erreur est possible, il est heureusement tout aussi facile de la réfuter. Nous avons cru de notre devoir de défendre la science contre une interprétation fausse, dont l'invasion

* Icones cerebri simiarum et quorundam animalium rariorum. Heidelbergae, 1821.

† Schroeder van der Kolk et W. Vrolik. Recherches d'anatomie comparée sur le genre Stenops d'Illiger, dans *Bijdragen tot de Dierkunde*, uitgegeven door het Koninklijk Genootschap *Natura Artis Magistra*, I. D. Amsterdam, 1848—1854.

‡ *Untersuchungen über die Natur des Menschen, der Thiere und der Pflanzen* B. II. S. 258. Darmstadt, 1827.

§ *Anatomie comparée du système nerveux*, Tome II. p 74 et 75. Paris, 1839—1857.

la menaçait sous le patronage d'un nom justement célèbre. Mais que l'on ne s'y trompe pas. C'est à tort qu'on ira chercher dans notre réfutation un argument pour la transmutation des espèces. Il y a sans doute, avec une grande diversité dans les details, p. e. l'ordre et la forme des circonvolutions, la proportion des hémisphères, la largeur des lobes frontaux etc., il y a, disons nous, une certaine conformité générale entre l'homme et les singes; leur cerveau se rapproche du cerveau humain; l'homme n'a rien dans son encéphale qui manque absolument aux singes, mais en tout cela nous ne voyons aucune raison pour nous faire admettre que l'homme soit un singe perfectionné. Plus nous étudions l'organisation des animaux et plus nous nous sentons affermis dans notre conviction, qu'il y a parmi eux des types fixes, représentés, quoique dans beaucoup de nuances bien variées, par des animaux, qui se ressemblent sous certains rapports.

Mais nous n'y trouvons jamais l'image d'une échelle ascendante, continue, non interrompue, mais plutôt celle d'un réseau. Nous ne connaissons aucune espèce de singe formant une transition directe à l'homme. Si on voulait à toute force faire naître l'espéce homme de l'espèce singe, il faudrait chercher sa tête ches ces petits singes, qui se groupent autour des Sajous et des Ouistitis, sa main chez le Chimpansé, son squelette chez le Siamang, son cerveau chez l'Orang. Si on n'a pas égard à la différence des dents, il est évident que l'aspect général du crâne d'un Sajou, d'un Ouistiti, ou de quelqu'autre espèce congénère ressemble bien plus, quoique en miniature, au crâne de l'homme, que celui d'un Gorille, d'un Chimpansé ou d'un Orang adultes; le carpe du Chimpansé a la même nombre d'os que celui de l'homme, celui de l'Orang au contraire se distingue par ce singulier os intermédiaire, que l'on retrouve chez tous les autre singes; le squelette du Siamang par le sternum, par la forme du thorax, par les côtes et le bassin, ressemble bien plus au squelette humain, que celui du Gorille, du Chimpansé et de l'Orang; nos recherches ont montré que le cerveau de l'Orang se rapproche plus du cerveau humain que celui du Chimpansé. Il faudrait donc chercher les traits de la famille humaine chez quatre Primates différents, dont un d'Amérique, deux d'Afrique, un troisième de Bornéo, un quatrième de Sumatra; les parents primitifs de l'homme seraient par conséquent tellement dispersés, qu'il devient par là bien difficile de croire à une telle souche.

En terminant, nous prions l'Académie de vouloir nous accorder la faveur de publier dans ses comptes-rendus le mémoire et la planche que nous avons eu l'honneur de lui soumettre.

Utrecht et *Amsterdam*,
le 28 Septembre 1861.

Miscellanea.

On Dimorphism in Primula.—Mr. C. Darwin has examined the sexual relations of the two forms in the Cowslip, Primrose and other species of *Primula*, called by florists 'pin-eyed' and 'thrum-eyed.' The one (pin-eyed) with the style reaching beyond the anthers to the mouth of the corolla-tube, which is slightly widened above, stigma globular and rough, the pollen-grains small and oblong in form, and perfecting comparatively few seeds: the other (thrum-eyed) with a short style, and smooth, depressed stigma, falling short of the anthers, pollen-grains spherical, corolla-tube of uniform diameter, and perfecting a larger number of seeds than the former.

Between these forms four crosses can be tried:—viz. the stigma of the long-styled form, fertilized by its own pollen and by that of the short-styled,—and the stigma of the short-styled by its own pollen and that of the long-styled form. Fertilization by own-form pollen Mr. Darwin calls 'homomorphic,' by pollen of dissimilar form 'heteromorphic.' Experiment showed the heteromorphic (in which insect agency is absolutely essential) to be much more fertile than the homomorphic union, in which the forms were as sterile as are many distinct species when crossed. The object of the dimorphic condition Mr. Darwin considers to be to favour the sexual union of distinct individuals of the same species.

Other similar cases of dimorphism were named in five distinct Natural Orders.—*Linn. Soc. Proc.* Nov. 21, 1861.

A letter, dated Sept. 12, 1861, has been received from Mr. Mann, Botanical Collector to the Royal Gardens, Kew, giving an account of his ascent of the Peak of St. Thomas, (7,500 ft.) in the island of that name in the Gulf of Guinea.

The ascent is described as extremely difficult. Mr. Mann found a tropical forest vegetation ascending to the very summit. *Gleichenia dichotoma*, a shore plant at Fernando Po grows upon the top, and *Eläis* growing in that island only to 1000 ft. was found in St. Thomas to 3000. A Conifer (*Podocarpus*) and an *Anthocleista* were also collected, On Clarence Peak, Fernando Po (10,700 ft.) 55 temperate plants were collected by Mr. Mann at and above an elevation of 5000 ft. This indefatigable collector expects shortly to ascend the Cameroon Mountain on the main land (13,000 ft.)

Note on the Habits of Vipers.—The parental instincts of most cold-blooded Vertebrata lead them no farther than to deposit their eggs in a suitable locality. As a general rule, we may say of them, in the beautiful words of Job,

"She leaveth her eggs in the earth,—And warmeth them in the dust,
Forgetting that the foot may crush them,—Or that the wild beast may break them.
She is hardened against her young ones,—As though they were not hers."

But this rule, though general, is not without exception. The males of the genus *Gasterosteus* (Stickleback) build a nest, watch over the eggs, take care that they shall have frequent supplies of fresh water, and do not leave the young ones till they are able to take care of themselves.* Several species of Toads and Frogs attach their eggs to their bodies and so carry them about; while the fishes of the genus *Bagrus*† have a still more curious habit, for in this case the males carry the eggs about in their mouth, and retain them there till the young obtain some size. It is supposed that the eggs are disgorged when the fish is about to feed, and then are taken in again, because in the mass of eggs, one or two belonging to different species have occasionally been found. In the common Viper the young remain with their mother some time after birth, and it has been frequently asserted that on any alarm they run into her mouth for safety. Though not altogether without analogy, this habit is so extraordinary, that the statement has always been regarded with some suspicion, and the question is summed up by Dr. Bell, as follows:—

"There are on record numerous statements, of various degrees of "credibility, of the curious fact that the female Viper allows her "young ones to retreat into her stomach for safety, when alarmed by "any sudden danger. These statements generally declare that the "mother, on the occurrence of any such emergency, opens her mouth, "and that the young immediately enter it, and pass into the sto-"mach, where they remain protected until the danger be passed, or "the Viper has gained a place of safety: it is added, in many cases, "that, on killing the mother, the young have been found within the "stomach, and on being liberated, have at once resumed all their "former activity. The question has been re-opened of late by the "publication of several communications in a most respectable peri-"odical, to which the reader is referred.‡ It will be observed, that "with one exception, the writers have given their statements only on "hearsay, and that in the one case which is given from personal ob-"servation, the circumstance is stated to have occurred when the "writer was a boy. The first impression made on the mind of one "accustomed to compare evidence with probability, and to weigh "the value of assertions by the rules of analogy, is, that the mis-"take, if it be one, may have arisen from the viviparous character of "the animal; but the opinion is so general, the mass of evidence so "considerable, and the details in many cases so minute, as scarcely "to allow of the question being thus summarily disposed of; and in "this state of doubt upon so interesting a subject, it is perhaps "better to await the results of direct experiments, which might be "readily made in any locality where these reptiles abound."—*Bell's British Reptiles*, p. 69.

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* See Mr. Warington's very interesting papers in the Ann. and Mag. of Nat. Hist. for 1852 and 1855.

† Wyman, American Journal, 1859.

‡ See several Nos. of the Gardener's Chronicle, in April 1848, &c.

Though twelve years have elapsed since the above passage was written, the subject remains as doubtful as ever; fear of their poison having probably been the means of saving the Vipers from the "direct experiment" here suggested. The following letter will therefore, I feel sure, be read with interest. The writer is a great friend of mine: he is a son of Mr. George Warde Norman, one of our greatest political economists, and in his testimony the utmost reliance may be placed. He writes to me as follows:—

"Bromley Common, 23rd Oct. 1861.

"Dear Lubbock,—The following are the particulars which you requested me to send to you.

On the 2nd of September I was out shooting with our gamekeeper. In walking through a wood, the keeper, who was a short distance behind me, noticed a viper on the ground. It was a little over two feet long, but was not accurately measured. The keeper affirms that directly the viper was disturbed, he saw two young ones run into its mouth; he is convinced that he saw two, and thinks, but is not certain, that he saw three. He put his foot on it, cut its head off, and brought the body to me.

We commenced skinning it by turning the skin inside out, and drawing it off from head to tail. On partially removing the skin, we could see several young ones inside, which were all moving about and seemed as lively as possible. In order to preserve them in the condition in which they then were, we drew the skin on again and tied up the orifice of the neck. On arriving at home, I opened the body and found that all the young vipers, 11 in number, were dead, as I imagined from suffocation.

The keeper says, that he has several times before seen young vipers when alarmed run into their mother's mouth for safety.

Yours sincerely,

Philip Norman."

Assuming, as I feel no hesitation in doing, that Mr. Norman's statement is thoroughly correct, the only remaining question would be whether the young vipers thus found in the body of their mother, were the same which the keeper saw, or supposes that he saw, running into her mouth. My friend, not being an anatomist, does not venture to state that the young were in the stomach, but he feels no doubt that this was the case; and, if they had been in the oviduct some traces of the fœtal membranes would probably have been perceived. I shall be happy to forward the specimens to any Naturalist who may wish to examine them. The young ones themselves are eleven in number; between six and seven inches in length; and were about to moult, a new layer of scales being fully formed under the outer skin. I am unaware what is the condition and size of young vipers, when they first see the light, but I do not imagine that they could be of so large a size.

I cannot but express a hope that Mr. Norman, having thus shown his interest in Natural History, and his power of observing, will not allow this to be his last contribution to our science.

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Reviews.

XIII.—The Writings of M. Fabre.

Observations sur les mœurs des Cerceris. Ann. des Sci. Nat. Tome IV. Ser. 4.

Etude sur l'instinct et les Métamorphoses des Sphégiens. Ann. des Sci. Nat. Tome VI. Ser. 4.

Mémoire sur l'Hypermétamorphose et les mœurs des Méloïdes. Ann. des Sci. Nat. Tome VII. Ser. 4.

Recherches sur l'Anatomie des Organes Reproducteurs et sur le Développement des Myriapodes. Ann. des Sci. Nat. Tome III. Ser. 4.

Miss Martineau in her "Eastern Life" expresses her wonder that after a co-existence of 6000 years or more we cannot understand the language of a single animal. But how few men are there who make any effort to do so. Even among naturalists, how large a proportion catch but to kill, and study only the dead. In Entomology we have had but two Hubers, nor can we be said yet to understand thoroughly the habits of a single insect. The most startling discovery of the last few years relates to a species which has been domesticated from time immemorial. Gladly, therefore, do we welcome an Entomologist who steps boldly out of the common path; in some cases, indeed, we may feel disposed to think that M. Fabre's enthusiasm leads him to attribute to his favourites, feelings of which we can hardly suppose them capable; but we cannot criticise what we have enjoyed so much, and the error, if it be one, throws an additional charm over his writings. Out of the many species whose manners and customs are described by M. Fabre, we must confine ourselves to three; and even then we cannot in so short an abstract do anything like justice to the wit and brilliancy of the original.

In the memoir which we have placed at the head of this article, M. Fabre devotes himself to the genus Cerceris.

In the latter part of September, this insect, which is one of the solitary wasps, begins to hollow out a sort of gallery in the earth—horizontal or vertical, according to the species—and to enclose therein her progeny, together with the food destined for their future support. She shews herself in no wise particular as to the nature of the soil in which she works, provided it be perfectly dry, and exposed during a great part of the day to the heat of the sun. She takes ingenious advantage of any projection in the ground, or bunch of weeds, under the shelter of which she can pierce her gallery, and thus add as it were a peristyle to her dwelling. Though the Cercerides do not form themselves into communities, M. Fabre observes that they generally choose to live near each other, and the nests lie close together, to the number of eight or ten. It is curious to watch the labours of these insects in forming their habitations, and the patience with which they drag up successive heavy loads of sand, and eject it from the entrance of their holes. The sight of their tiny jets of sand constantly recurring attracted the attention of M. Fabre, in the first instance, to these little excavators. He watched them, resting from their labours and basking in the sun, the females often flying to the surrounding trees, pursued by the males, who hover about, idle spectators of the toil carried on before their eyes. Fights frequently ensue between them for the possession of some particular female, who sits an apparently unconcerned beholder of the struggle for supremacy, and, when the victory is decided, quietly flies away in company with the conqueror. The males, which are only half the size of the females, do not condescend even to enter the galleries which are in course of excavation; and neither by carrying a single grain of sand, nor by assisting in the subsequent troublesome task of collecting provisions for the young, do they share in the industry around them. Having completed the nests for the reception of her eggs, it now remains for the thoughtful parent to provide the nourishment requisite for her young, when they shall emerge from the shell. The victim chosen for this purpose is a large Curculio (*Cleonus opthalmicus*). On her return from a foraging expedition, the Cerceris may be seen flying homewards, heavily weighed down by her prey, which she embraces, the underside of her body opposed to that of her victim. Alighting at a short distance from her hole, she proceeds to drag the Cleonus painfully up to the entrance of its prison, often slipping back, and rolling with it down among the loose grains of sand, only to recommence undauntedly her toilsome ascent. M. Fabre had the curiosity to weigh both the Cerceris and her prey; the first averaged 150 milligrammes, the second 255; a fact which would render the flight of the Cerceris a matter of considerable surprise to any one not aware of the great muscular power possessed by insects.

Either by robbing her nest of the prey, or by attacking the Cerceris at the moment when she arrived with her booty, and forcing her by means of a straw to relinquish it, M. Fabre succeeded in possessing himself of about 100 Curculios. The insect to which he directed his attention is not the *Cerceris Bupresticida*, which attacks indiscriminately all the Buprestes, but one of its congeners, and more exclusive, apparently, in its tastes; as all the Curculios he examined belonged, with one single exception, to the same species.

It is difficult to see why, of four kinds of Cerceris, two should make choice exclusively of Curculios, two of Buprestes; thus restricting their chance of finding victims within such narrow limits: and the total want of outward resemblance between Curculios and Buprestes also raises the question why these two groups especially are selected. As, however, we shall see hereafter, this problem has been satisfactorily solved by M. Fabre.

After what has been written on the subject by M. Dufour, it is needless to state that the Curculios examined by M. Fabre, though deprived absolutely and entirely of all power of motion, were still not *dead*. In fact, from their freshness of colour, suppleness of membrane, and general internal condition, it was almost impossible to realize their being utterly incapable of the least movement. Through heat sufficient to have dried up any animal which had suffered ordinary death, through damp which would have caused rapid decomposition, M. Fabre preserved these beetles in paper cornets or in glass tubes: and after a fortnight the viscera were as fresh, the act of dissection was as easy, as they would have been in the case of a living creature. In the face of facts like these, we cannot possibly attribute this immoveable state to antiseptic agency alone. Life is there, but numbed, as it were, and paralysed: a miracle beyond the power of chloroform or æther to perform, having its origin in the mysterious laws of the nervous system.

In this state of vegetation the animal functions still faintly exert themselves: digestion continues as long as the stomach contains food. By the aid of benzine vapour and of a voltaic battery, M. Fabre succeeded in obtaining some feeble movements of the legs and antennæ, even up to the fifteenth day after this extraordinary suspension of muscular power had taken place; whereas, the same experiments, when made upon beetles *dead*, in the true sense of the word, only two hours, were productive of no result whatever.

These facts, indeed, militate strongly against the supposition that the Curculios are dead, and merely preserved by some means from natural decay. The weapon with which they are overcome is of course the venomous sting of the Cerceris: but how can this penetrate through the coat of mail worn by the Curculio? in which, moreover, there is no trace of injury or wound to be discovered after the combat is over. The key to this mystery has been obtained by M. Fabre, after an amount of patient investigation which would have wearied out a less persevering and intelligent observer.

With great difficulty, and after a long search in fields and hedges, he succeeded in capturing several live specimens of Curculio, which he placed at the entrance of their enemies' abode, in the hope of tempting the Cercerides to attack the prey thus brought to their very doors, and to perform under his eyes the act of which he had already in many cases witnessed the marvellous results. But the victims thus offered were scornfully rejected: the inglorious booty treated with disdain. The experiment of putting a Cerceris and a Curculio together in a bottle was attended with no better success. Their positions seemed reversed: the Cerceris, too overcome by fear to attempt resistance, tried vainly to escape, while her antagonist fiercely seized one of her legs between its jaws. Thus baffled, M. Fabre was struck with the ingenious idea of waylaying a Cerceris returning with her booty, and contriving to substitute for it a living Curculio. This experiment succeeded to admiration. As soon as the Cerceris perceived her prey to have slipped from her grasp, she struck the earth with her feet, and turned impatiently hither and thither: then, suddenly perceiving the living Curculio placed close to her by M. Fabre, pounced upon it, and proceeded to carry it off. Instantly, however, discovering it to be still uninjured, she placed herself face to face with it, seized its rostrum between her powerful mandibles, and pressed her forelegs heavily upon its back, as if to cause the opening of some ventral articulation. Quickly then she slid her abdomen beneath the Curculio, and struck her venomous dart sharply twice or thrice into the joint of the prothorax, between the first and second pair of legs. In one second, without a convulsive movement, without those twitches of the limbs which generally accompany the death agony of any animal, the victim dropped motionless, struck as if by lightning. The Cerceris then, turning the apparently lifeless insect on its back, embraced it as before described, and bore it away in triumph. Three times did M. Fabre repeat this interesting experiment, each time with precisely similar results. It must be clearly understood, that on each occasion he restored to the Cerceris her original captive, and took possession of that which he had himself provided, in order to examine it at his leisure. Greatly did he marvel at the dexterity with which the fatal stroke had been dealt. Not the slightest trace of a wound was to be found: not the least drop of vital liquid spilt. The puncture made by the sting of the Cerceris is indeed so microscopic, that chemistry can furnish no poison sufficiently powerful to produce with so small a quantity so startling an effect: and it is, in fact, not so much to the venom of the dart as to the physiological importance of the exact point at which it enters, that we must ascribe the cessation, so complete, so instantaneous, of all active life.

In most insects there are three ganglia, which furnish the nerves of the wings and legs, and on which the power of movement principally depends. The first, that of the prothorax, is distinct from the others in all Coleoptera; but the two last, those of the meso- and meta-thorax, though generally separate, are in some species united together. Now, it is a well-known fact, that, in most cases, the more closely the nervous system is united, *centralized* as it were, the more perfect are the animal functions, and also, of course, the more easily vulnerable. Therefore the Cerceris, whose instinct teaches her at one stroke to annihilate these functions, chooses her victims precisely from the species in which this centralization is most complete: the Buprestes, namely, of which the nervous centres of the meso- and meta-thorax are confounded in one large mass; the Curculionidæ, of which the three thoracic ganglia lie near together, the two last quite contiguous to each other.

The green larvæ found by Réaumur in the nests of his solitary wasps (*Odynerus spinipes*) were full of life, though apparently plunged by some mysterious means into a state of lethargy: the simple explanation of which is, that, in these creatures, the nervous system is more diffused over the body and consequently less affected by an attack at any given point. It is, we must remember, of the greatest importance to the Cerceris that her prey should be completely numbed and incapable of the least movement: otherwise, what would become of the precious egg laid among struggling Coleoptera? what of the tender little grub, which should emerge in the midst of their great horny claws, writhing convulsively about in a narrow cell? If she attacked feeble and apathetic larvæ, one can imagine that a less complete annihilation of muscular action would suffice; but in the case of beetles twice her own size it would be worse than useless; and she therefore picks out, with unerring precision, from the numerous tribes of Coleoptera, two of those best calculated by the peculiarities of their nervous system to be rendered thoroughly powerless.

In order completely to establish his opinion, it remained for M. Fabre to prove that he could by similar means produce a similar result. And this he found himself able to perform with perfect ease, by puncturing the insect with a needle dipped in ammonia at the prothoracic joint, behind the first pair of legs. Any corrosive liquid applied to the thoracic medullary centre would have the same effect. His experiments were made in the first instance upon Lamellicorns (*Scarabæus sacer*, *S. laticollis*); on Buprestes (*B. ænea*), and on Curculionidæ, especially on the particular species so often previously examined by him. He afterwards tried his skill upon Carabidæ (*Carabus*, *Procustes*, *Chlænius*, *Sphodrus*, *Nebria*, &c.); upon Longicorns (*Saperda*, *Lamia*), and upon Melasomas (*Blaps*, *Scaurus*, *Asida*). In the case of Scarabæi, Buprestes, and Curculionidæ, the effect of his experiments was instantaneous: all motion ceased suddenly, without a single convulsion, at the instant the fatal drop touched the medullary centre. Not the dart of the Cerceris herself could have a more prompt or lasting effect. Notwithstanding their complete immobility, M. Fabre's victims remained alive for three weeks or a month, preserving the flexibility of all their joints, and normal freshness of viscera. Digestion proceeded for the first few days, and movements could be provoked by a voltaic current. In the case of Scarabæus, however, this state cannot always be produced. If the wound made by the needle be too deep, or the drop of ammonia too large, the victim really dies, as is speedily proved by its decomposition. If, on the contrary, the puncture be too slight, the insect recovers, after a shorter or longer period of profound lethargy, and regains, at any rate partially, its pristine vigour. On those Coleoptera, the thoracic medullary centres of which are distant from each other, the effect produced by ammonia is very different. A wound which would have completely and permanently stunned a vigorous Scarabæus sacer causes only violent convulsions in a Carabus of moderate size. Gradually the insect becomes calm, and slowly regains its original condition. If the experiment be repeated several times on the same individual the same results ensue, until the wound becomes too severe, and the poor animal expires. Melasomas and Longicorns are more sensitive. The corrosive liquid plunges them instantly into a stupor, which is however only temporary; and the next day they are lively as ever. Thus, by the process so perfectly successful in the case of Scarabæi, Curculionidæ, and Buprestes, it is impossible to produce the same state of paralysis in those Coleoptera of which the three thoracic ganglia are situated at a distance from each other.

M. Fabre's second paper is as interesting as the first: it relates to the habits and metamorphoses of the Sphex in general, and of *Sphex flavipennis* in particular. He opens the subject in his own inimitable style, with a beautiful description of insect life, an abridgment of which would give no adequate idea of the richness of colouring, and felicitous arrangement of epithets which invest all the writings of this author with a peculiar charm.

Towards the end of July, the *Sphex flavipennis*, tearing open the cocoon which has hitherto enveloped her, takes flight from her subterranean abode: and during the month of August she may be observed, enjoying her brief holiday, flying gaily from plant to plant, and basking in the bright rays of the summer sun. But the preservation of her race exacts from her the sacrifice of the few remaining days of her short life, and from the beginning of September she devotes herself to labour for the good of her posterity. She is not more fastidious than the Cerceris in the choice of a site for her operations: a loose sandy soil and plenty of sun being the only desiderata. She takes no precautions for sheltering her work during its progress, and it is pitiable to observe the destruction often caused by a shower of rain, by which many a half-finished nest is washed into a heap of undistinguishable ruins.

The *Sphex flavipennis* rarely works alone: from ten to twenty individuals generally combine to excavate a gallery; accompanying their labours with a species of song, sharp and intermittent, modulated by the vibration of their wings and body. A keen enjoyment of their task seems to animate these little sappers and miners: they spring here and there with delighted activity, and in the course of a few hours a gallery is completed. When examined it is found to consist of a horizontal corridor, serving as an avenue to the hidden cells destined for the larvæ. After proceeding for a distance of two or three inches, this corridor takes an abrupt curve, and tends for a corresponding depth more or less obliquely downwards, terminating in an oval cell, placed horizontally. The sides of this cell have not been in any way cemented or plastered together: but it is easy to perceive that they have been fashioned with peculiar care, and the sand diligently smoothed and planed down, so that the tender grub shall incur no danger from the crumbling of its prison walls. On the completion of one of these little chambers, it has to be provisioned: and then the Sphex, closing it up, proceeds to hollow out another of the same dimensions alongside it. This process she repeats twice or thrice before finally filling up the entrance to her subterraneous nursery, and effacing all outward trace of its existence by smoothing and patting down the outside sand. There are thus three, sometimes four cells connected with each corridor: and as the number of eggs laid by every female Sphex is about thirty, it follows that from seven to ten galleries are required by each.

And as the energetic little insect has finished her labours before the end of September, it is evident that only two or three days can be devoted to the excavation of a gallery, to the task of furnishing the separate cells with provisions, laying an egg in each, closing the door, and in fact winding up the whole establishment. If we consider from how great a distance the Sphex often has to bring the captives of her bow and spear, and also how often rainy days must intervene to prevent her from following the chase, it is easy to see that she must toil hard to make the best of her time, and cannot pretend to give to her nest that solidity and finish which characterize the abode of the young Cercerides. For the nest of the Cerceris is the work of years, transmitted from one generation to another, added to and improved by each; while that of the Sphex resembles a tent, pitched hastily by the belated traveller, and intended only to serve as shelter for a single night. A slight variation is observable in the excavations of *Sphex albisecta* and the *Ammophila;* they dispense altogether with the horizontal corridor, digging merely a vertical passage, two or three inches in depth, connected with a single cell. Pursuing their labours apart from each other, they have obtained the name of "Solitary wasps."

Let us now, in company with M. Fabre, watch for the return of a *Sphex flavipennis* to her nest; she carries her booty, a grasshopper many degrees heavier than herself. Alighting at some distance from her nest, she proceeds to drag her victim along with her powerful mandibles. After much exertion on her part, he is placed in such a position as to touch the door of his future prison with the ends of his antennæ. The Sphex then relinquishes her hold, descends into her nest, and immediately reappearing, seizes her prey, according to M. Fabre, with a little joyful cry, and drags him down into the cell prepared to receive him. Other Hymenoptera dispense with this preliminary visit to the interior of their strongholds; the

Cerceris merely relinquishes her captive for an instant at the entrance, in order to turn round and crawl backwards—thus more conveniently pulling him after her. Why then should the Sphex persist in paying this domiciliary visit before introducing her victim? Perhaps through apprehension lest one of the Tachytes, who make use of the same kind of cells for their offspring, and are accustomed to provision them in like manner, should have taken advantage of the lawful owner's absence, to deposit an egg in the cell ready scooped out. But however this may be, the manœuvres of the Sphex are invariably the same. M. Fabre's experiments on this head are very curious. He took advantage of her momentary absence to remove the grasshopper, and place it at a few inches distance. The proprietor returned, uttering her usual cry, looked anxiously about, and finally, perceiving her prey, dragged it back to her door, and placed it again in precisely its former position; then leaving it, descended as before into her nest. The same process was repeated by M. Fabre thirty or forty times, in the hope that the Sphex, taught by experience, would cease to lose sight for a moment of her captive and convey it at once into the earth. But the perseverance of the insect triumphed over that of the philosopher; or rather, her acts not being dictated by reason, she knew not how to leave the path marked out for her by instinct.

In the case also of a *Sphex albisecta*, an inflexible adherence to settled laws in this respect was strikingly manifest, presenting a still more curious instance of the rigidity of instinct and its inapplicability to unusual conditions. Having, in the course of one of his experiments, removed her victim from the sight of a *Sphex albisecta*, M. Fabre observed the insect, after seeking vainly in all directions, descend for a few instants into her cell, and then emerging, proceed to cover up the entrance, as if her task were now satisfactorily accomplished; a striking exemplification of the manner in which acts of instinct depend one upon another, and admit of no variation, notwithstanding that their object may be entirely defeated by the alteration of surrounding circumstances. In the normal state of things, observes M. Fabre, the Sphex pursues her prey, lays an egg and closes her nest; an accident deprives her of her booty; no matter—that part of her duty is over, she therefore performs the remainder, and shuts up the unlucky egg quite unprovided for. Think of the melancholy fate entailed by maternal stupidity upon the helpless little new-born larva—fancy it emerging from the shell, in the full expectation of a satisfactory meal, and the miserable disappointment awaiting it, ending in despair and a lingering death. Many larvæ must so perish; for the case abovementioned is by no means exceptional. M. Fabre repeated the experiment several times, meeting almost invariably with the same results; and on opening the nests he frequently found cells either supplied inadequately with provisions, or containing none at all.

The rest of this paper is chiefly anatomical, and devoted to an account of the metamorphoses undergone by those larvæ which are fortunate enough on leaving the shell to find their larders well supplied; but we must pass on to give a short summary of M. Fabre's paper on the habits and metamorphoses of *Sitaris humeralis*.

This interesting beetle is parasitic on Anthophora, in the galleries of which it lays its eggs. These are hatched at the end of September or beginning of October; and M. Fabre not unnaturally expected that the young larvæ, which are active little creatures with six serviceable legs, would at once eat their way into the cells of the Anthophora. No such thing: till the month of April following they remain without leaving their birthplace, and consequently without food; nor do they in this long time change either in form or size. M. Fabre ascertained this, not only by examining the burrows of the Anthophoras, but also by direct observation of some young larvæ kept in captivity. In April, however, his specimens at last threw off their long lethargy, and hurried anxiously about their prisons. Naturally inferring that they were in search of food, M. Fabre supposed that this would consist either of the larvæ or pupæ of the Anthophora, or of the honey with which it stores its cell. All three were tried without success. The two first were neglected, and when placed on the latter they hurried away, or perished in the attempt, being evidently unable to deal with this sticky substance. M. Fabre was in despair: "Jamais expérience," he says, "n'a éprouvé pareille déconfiture. Larves, nymphes, cellules, miel, je vous ai tout offert; que voulez-vous donc, bestioles maudites?"

The first ray of light came to him from our countryman, Newport, who ascertained that a small parasite found by Leon Dufour on one of the wild bees, and named by him Triungulinus, was, in fact, the larva of the Meloe. The larvæ of Sitaris much resembled Dufour's Triungulinus, and acting on this hint, M. Fabre examined many specimens of Anthophora, and found on them the larvæ of his Sitaris. The males of Anthophora emerge from the pupæ before the females, and as they come out of their galleries, the little larvæ fasten upon them. Not, however, for long: their instinct teaches them that they are not yet in the straight path of development; and watching their opportunity they pass from the male to the female Bee. Guided by these indications, M. Fabre examined several cells of Anthophora: in some, the egg floated by itself on the surface of the honey; in others, on the egg of the Anthophora, as on a raft, sat the still more minute larva of the Sitaris. The mystery was solved. By a process of reasoning too long for us to insert, M. Fabre convinced himself that at the moment when the egg is laid, the Sitaris larva springs upon it. Even while the poor mother is carefully fastening up her cell, her mortal enemy is beginning to devour her offspring. For the egg of the Anthophora serves not only as a raft, but as a repast. The honey, which is enough for either, would be too little for both; and the Sitaris, therefore, in its first meal, relieves itself from its only rival. After eight days the egg is consumed, and on the empty shell the Sitaris undergoes its first transformation. The life of almost all insects is divided into four stages; the Egg, Larva, Pupa, and Imago: the larva, indeed, may moult several times, but the conditions of life being unaltered, the form is generally the same, and the change is only in size. Very different is the case with our Sitaris: the honey which was before fatal is now necessary; the activity which before was necessary, is now useless; consequently, with the change of skin the active, slim larva changes into a white, fleshy grub, so organised as to float on the surface of the honey, with the mouth below, and the spiracles above the surface; "grace a l'embonpoint du ventre, la larve est à l'abri de l'asphyxie." In this state it remains till the honey is consumed; then the animal contracts, and detaches itself from its skin, within which the other transformations take place. In the next stage, which M. Fabre calls the Pseudo-chrysalis, the larva has a solid corneous envelope, and an oval shape, and in its colour, consistence, and immobility reminds one of a Dipterous Pupa. The time passed in that condition varies much. When it has elapsed, the animal moults again, and once more resembles the second stage (?). After this it becomes a pupa without any remarkable peculiarities; and finally, after these wonderful changes and adventures, in the month of August the perfect Sitaris makes its appearance.

We wish that we could have done M. Fabre's paper more justice; that we could have given some specimens of his peculiar raciness of style, his wonderful power of description. But already we have been tempted beyond our limits. We can do no more than mention his observations on Meloe, and his excellent paper on the Myriapodes. All lovers of nature, however, should read what he has written, and we think we can promise them that they will not be disappointed. For ourselves, we offer our cordial thanks to M. Fabre for the pleasure which his writings have given us.

XIV.—A History of British Sessile-eyed Crustacea. By C. Spence Bate, Esq., F.R.S., F.L.S., and J. O. Westwood, Esq., M.A., F.L.S., Hope Professor of Zoology at Oxford. (J. Van Voorst.)

Recherches sur la Faune Littorale de Belgique; Crustacés. Par P. J. Van Beneden, Professor a l'Université Catholique de Louvain.

The work which we have placed at the head of the present article, and of which three numbers only have as yet appeared, will be a very valuable addition to our knowledge of the British Crustacea. The classification proposed by Messrs. Spence Bate and Westwood is as follows:—

AMPHIPODA.

Group.	Division.	Subdivision.	Tribe.	Family.	Subfamily.	
			Saltatoria	=Orchestiidæ.		Talitrus, Orchestia, Allorchestes, Nicæa.
Normalia.	Gammarina.	Vagantia.	Natatoria	=Gammaridæ	Stegocephalides	Montagua, Danaia.
					Lysianassides	Lysianassa, Callisoma, Anonyx.
					Ampeliscides	Ampelisca.
					Phoxides	Phoxus, Sulcator, Kroiyira, Westwoodia, Grayia, Monoculodes, Amphilochus, Darwinia, Urothoë, Lilgeborgia, Phædra, Isæa, Iphimedia, Otus, Acanthonotus.
					Gammarides	Gammarus, Dexamine, Atylus, Pherusa, Calliope, Eusirus, Leucothöe, Aora, Stimpsonia, Protomedia, Bathyporeia, Niphargus, Crangonyx, Gammarella, Melita, Mæra, Megamæra, Eurystheus, Amatiha, &c.
		Domicola		Corophiidæ	Podocerides	Podocerus, Cyrtophium, Amphitöe, Sunamphitöe, Cerapus, Siphonocætus, &c.
					Corophiides	Corophium, Dryope, Cratippus.
				Cheluridæ		Chelura.
	Hyperina			Hyperiidæ		Hyperia, Lestrigonus.
				Phronimidæ		Phronima.
Aberrantia.				Dulichiidæ		Dulichia.
				Caprellidæ		Proto? Protella, Caprella.
				Cyamidæ		Cyamus.

The three principal divisions of the body they call Cephalon, Pereion, and Pleon; for the parts of the mouth they propose the new name "Siagonopods," a term, however, which seems to us unnecessary; the appendages of the Pereion are with them pereiopods, and those of the Pleon, pleopods, in addition to which they give to the three posterior pairs the designation of 1st, 2nd, and 3rd uropods. The internal anatomy of the Amphipoda does not come within the scope of their work, but in addition to an excellent outline sketch of each species, they give magnified representations of the more characteristic organs. On the whole the work will be a most valuable contribution to our knowledge of the British Fauna; but we must defer any farther consideration of it till it is completed.

The volume for which we are indebted to the learned Professor of Louvain is rather a series of monographs than a complete work on the Crustacea of Belgium. The first chapters are devoted to the

Mysidæ. The development of the embryo in this abnormal family had already been shortly described, but Professor Van Beneden has here worked it out in detail, and has pointed out several interesting facts in addition to those already known.

The Mysidæ have no true branchiæ; but in connection with the heart there are, on each side, five small lateral blood-vessels, and according to Professor Van Beneden, "Ces canaux correspondent "exactement aux vaisseaux branchiaux des crustacés plus élevés, et "c'est sur leur trajet que se développent les lamelles branchiales des "décapodes en général. Il existe ainsi une petite circulation; le "sang sort du cœur et, après avoir, parcouru la place qu'occupent "les branchies dans les autres décapodes et surtout après avoir reçu "un confluent veineux des appendices céphaliques, retourne rapide-"ment au même cœur pour en être chassé de nouveau." Professor Van Beneden considers that Mysis differs from the other Crustacea in the curvature of the body of the embryo. "Il est inutile," he says, "de faire remarquer que les Mysis s'eloignent des crustacés, tant par "les premiers rudiments de l'apparition blastodermique que par la "manière dont le corps se replie sur lui même. En général l'abdomen "et la queue se plient sous le thorax et se croisent avec les appendices "cephalothoraciques. Dans les Mysis, le corps se replie en sens "inverse vers le dos, et tous les appendices, depuis ceux de la tête "jusqu'a ceux de la queue, au lieu de se croiser, sont couchés dans le "même sens." Not only, however, is this the case, as he admits in the allied genera Idothea and Ligia, but we find the same thing also in Oniscus and Asellus (Rathke Abhandlungen zur bildungs- und entwickelungs—Geschichte des menschen und der Thiere. Leipsig, 1832-1833). And it is also well shown in Zaddach's beautiful memoir on the embryology of Phryganea (Untersuchungen über die Entwickelung und den Bau der Gliederthiere. Berlin, 1854). In the Diptera and Coleoptera, namely in *Donacia crassipes* among beetles, in Chironomus,* Simulia (see Kolliker's "Observationes de primâ insectorum genesi"), and Melophagus (Die Fortpflanzung und Entwickelung der Pupiparen, Leuckart), among flies, the same phenomenon holds good; so that far from regarding it as exceptional and peculiar to Mysis, we are rather disposed to look upon it as the normal disposition of the embryo among the Articulata.

The condition and embryonic development of the organs of sensation in Mysis are especially interesting. With reference to the ocular peduncles, indeed, Professor Van Beneden says, p. 62, "Ce pédicule "(le pedicule oculaire) n' apparait aucunement comme les autres appen-"dices, et semble avoir une autre valeur morphologique;" an assertion, however, which appears scarcely reconcileable with his, almost imme-

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* With reference to Chironomus, Kolliker expressly says:—"Quando primum "corporis articulatio expressa cerni potest, primus ad octavum usque articulum in "parte abdominali, nonus ad tertium decimum in ori dorso siti sunt"—a position which is well shown in the plate.

diately following, statement, that "dans le homard. . . . . les "pédicules oculaires se développent plus tôt et indiquent plus claire-"ment que chez les Mysis leur communauté d'origine avec les "organes appendiculaires." It appears, therefore, as is indeed directly stated in p. 29, that in spite of some confusion of expression in p. 62, Professor Van Beneden does, in fact, consider the ocular pedicule as the appendage of the anterior segment. He also regards the "telson" as representing a posterior segment, and adopts, therefore, Milne Edwards' view, that the body of a Crustacean consists of twenty-one segments, in opposition to those naturalists who see only twenty.

So accustomed are we to see the organs of sensation located in the head that we cannot but feel astonished to find that the ear of Mysis is not in its head, *but in its tail.* This curious fact, which was discovered by Leuckart, has been confirmed by several distinguished naturalists, and last, not least, by M. Van Beneden, who moreover, like Kröyer, has traced a nerve from the last ganglion to the otolithe. We may find a parallel case in the little worm described by Quatrefages, under the name of Polyophthalmus, which has eyes on every segment of the body. *Amphicora Sabella* also, another worm, has, according to O. Schmidt, eyes in its tail. Moreover, among insects, the Crickets and Grasshoppers have an organ in the anterior pair of legs, which is considered by some good observers to be an ear, but which certainly is, like the remarkable organ at the base of the halteres of Flies, an organ of some special sense, though what that sense may be it is not so easy to decide.

The Professor does not always do justice to his predecessors. Thus under the Cetochilidæ he refers only to Roussel de Vauzème and Goodsir, entirely ignoring all that has since been written on this family. He mentions only one species belonging to the group, and this one he attempts to identify with the *Cetochilus septentrionalis.* His description of it, however, clearly shows that it does not belong to this family of Entomostraca at all, but is one of the Calanidæ, and belongs probably to the genus Calanus, which may at once be distinguished from Cetochilus by the position of the eyes. Many of the Calanoidea have at the anterior extremity of the cephalothorax two curious horns, which were mistaken by Goodsir for antennæ. Professor Van Beneden corrects this error, which, however, was pointed out long ago by Baird, and has been adopted by no subsequent writer. The description which he gives of the different parts is almost useless for identification, as the characters mentioned are those which are common to many species: take away the extremities of the antennæ (antennules of V. Beneden), those of the abdomen, and the posterior pair of legs; half the species of Calanus would be undistinguishable from one another. Of this our author was evidently not aware, and his attention has not been particularly drawn to the characteristic organs. Moreover, we cannot supply the deficiencies from the plate. He gives three very dissimilar representations of the antennæ; two of them, however, are small, and perhaps, therefore, not intended to be strictly accurate. Unfortunately, however, this is not the only error. In his two figures of the animal the proportions of the segments are different, the anterior cephalo-thoracic segment being absolutely longer in the smaller figure. It is, indeed, difficult to believe that the two drawings have been taken from the same species, as the abdominal segments differ not only in proportion but in number, and the length of the antennæ is by no means the same. Again, the abdomen, as represented in figure 5, differs from that either in figures 1 or 7, agreeing, indeed, with figure 7 in the number of segments, but differing in their proportion as well as in the form of the caudal lamellæ and the number of the caudal setæ. Still, the drawings are good, and apparently truthful. Some of the differences above alluded to (and which are by no means all that might have been pointed out) may be sexual characters; some may be the result of mutilation; but there are others which cannot be accounted for in this manner; and as there are many species of this group which are at first sight very similar to one another, we suspect that in Professor Van Beneden's Plate xviii., and in his description, two or more species have been confounded together.

The pretty little Isopod, originally described by Slabber under the name of Agaat-Pissebet, has been rediscovered by Van Beneden, and named by him Slabberina, after its first observer. The spermatozoa of this species (Plate XV. figure 10) are, according to the figure given, in the form of a long seta with a bundle of shorter hairs at one end. If, however, we may judge from the parallel case of Asellus, these bodies are not simple spermatozoa, but we have here another case of bimorphism in the seminal elements. In our common fresh-water *Asellus aquaticus*, the spermatozoa are of two sorts. The first are oval, or more or less elongated bodies diverging in the form of a brush from a common point of attachment. From the same point arise several long and slender setæ, which, however, are often attached together along their whole length so as to look like a single filament. We presume that the same is the case with Slabberina, and that we may add this genus, therefore, to the small but gradually increasing number of species in which the spermatozoa are of two sorts, and which are, perhaps, destined, ere long, to throw a new light on the whole subject of generation.

An interesting chapter is devoted to the Sacculinidæ. They are parasitic on higher Crustacea, and are the most degraded of their class. The sandy shores of Ostend are inhabited by great numbers of common Crabs. Three-quarters of these carry on the underside of the abdomen a little yellow ball, which is sometimes as large as a nut, and which, of course, prevents the abdomen from fitting into its furrow. This yellow globule, at first sight like nothing less than the active lively Crab, belongs nevertheless to the same great group of animals, and forms the genus Sacculina of Thompson. A second member of the same family, the *Peltogaster Paguri*, attaches itself, as its name denotes, to the Hermit Crab, whose name is, indeed, a very misnomer. The so-called happy families, which we sometimes see in our streets, offer no such odd assemblages as we may often find in and on the shell of a dead whelk. First we have the Hermit Crab himself; the margin of the shell is often tenanted by a species of Anemone (*Adamsia palliata*), while the rest of its surface is covered by a growth of the curious and pretty little polyp, known as *Hydractinia echinata*. Nor is the Pagurus the only occupant of the shell. Mr. Gosse tells us of a co-tenant in the form of a beautiful Nereid worm, which, like the preceding species, feeds on the crumbs which fall from the rich man's table. "The soft and serpent-like Annelide," we quote from Mr. Spence Bate (Zoologist, 1859, p. 6687), "smells "the repast that the master of the house is enjoying, and, like a wily "guest, takes care to be present at the meal, even though unbidden. "See! beneath the Crab the beautiful head glides out. While the "self-confident owner is devouring one piece, and in his full enjoy-"ment looking round and, perhaps, admiring the submarine scenery, "the worm attacks that which is in the other hand, and by little and "little the Crab feels it going, and makes an effort to stop it on the "way; but it evidently can be seen, by his manner, that he cannot "believe that any one would be so rude as to steal his dinner out of "his very mouth, and does not think much about the undevoured "food, but which, nevertheless, is slowly, gradually, and surely taken "away."

To this interesting group must be added the *Peltogaster Paguri*, which, when mature, has a regular oval form, and a reddish colour, due to the numerous eggs it contains. So little does it, indeed, resemble a Crustacean that we cannot wonder at the mistakes which have been made concerning its true nature. Cavolini regarded it as a sort of animal-gall, not recognizing it as an entire animal, but supposing that some other Crustacean deposited its eggs in the Pagurus. Thompson first described it correctly, and recognized its affinities with the Lerneidæ. Rathke at first placed it among the Trematodes, in which he was followed by Diesing and Dujardin, though the latter, indeed, says that it "parait être toute autre chose "qu'un trematode." Kroyer expresses no opinion as to its affinities. Steenstrup classes it with Bopyrus, among the Isopods. Lilgeborg looks upon it as a Cirrhiped. Professor Van Beneden places the Sacculinidæ in his list of Crustacea, observed on the shores of Belgium, immediately after Lerneonema, and explains their homologies as follows:—

"Que l'on se figure, en effet, des Nicothoë, dont les deux poches s'étendraient tout autour du segment qui leur donne naissance, en d'autres termes, dont le segment tout entier se prolongerait en arrière de manière à envelopper l'abdomen et la queue; il y aura un orifice postérieur d'evacuation, un véritable cloaque d'oiseau; en supposant ensuite que la tête s'allonge comme dans les Lernea branchialis et plonge de la même manière dans les chair, que les segments en arrière et en avant s'effacent pour ne plus laisser place qu'en segment sexuel, nous aurons une idée de cette transformation singulière d'un animal régulier et symétrique en sac informe et gaine à œufs."

Original Articles.

XV.—On the Desirability of an English Translation of Aristotle's History of Animals: by Rev. W. Houghton, M.A., F.L.S.

Of all the great intellectual luminaries that have enlightened the different departments of human learning, it would be difficult if not impossible to name one that can justly claim to rival Aristotle in the extent and depth and philosophic value of his writings. The Zoologist may well feel a degree of pride when he remembers that this great man was the founder of his science; for it is to Aristotle that he is indebted for the birth of Zoology; it is he who first attempted to reduce to a system the various and diversified forms of animal life which even the limited geographical knowledge of the ancients served to make them acquainted with. Truly one stands aghast when one contemplates over how wide a field of human thought the vast mind of Aristotle wandered, and how ably and comprehensively each subject is treated. The modern zoologist, knowing well how extensive an area his own particular science occupies, devotes his time and study to acquire, as perfectly as he is able, a general knowledge of the laws of the animal kingdom, and afterwards is fain content for the most part to confine himself within some circumscribed boundary, and to give his attention towards the full and exact elucidation of some particular group; but when we think of Aristotle's labours, whether in the field of Natural Science or in that of Dialectics and Logic, we can only wonder and admire, but cannot attempt to imitate. "Had this extraordinary man," Swainson* well observes, "left us no other memorial of his talents than his researches in Zoology, he would still be looked upon as one of the greatest philosophers of ancient Greece, even in its highest and brightest age. But when it is considered that his eloquence and his depth of thought gave laws to orators and poets, that he was almost equally great in moral as in physical science, we might almost be tempted to think that the powers of the human mind had retrograded, and that originality of thought and philosophic combination existed in a far higher degree among the heathen philosophers than in those who followed them."

But though all the encomiums that have been passed upon Aristotle, from the time of Cicero to our own day, are justly due, when we reflect on the time in which the philosopher lived, when Science was unaided by the modern mechanical appliances which the ingenuity and skill of man has planned and executed, we must not be led into

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* *Discourse on the Study of Natural History*, p. 6.

the error of supposing that Zoological science has made but little progress since the days of the Stagyrite, nor must we be unprepared to meet, in the Physical writings of our author, with many errors and fables,—much chaff mingled with the grain.

The following remark of Buffon can not certainly be regarded as unimpeachable now, though it serves to show how rapid a stride Zoology has made since the days of the French naturalist:—

"Aristotle's History of Animals is perhaps even now the best work of its kind; he probably knew animals better and under more general views than we do now. Although moderns have added their discoveries to those of the ancients, I do not believe that we have many works on Natural History that we can place above those of Aristotle and Pliny."—(*Hist. Nat.* i. p. 62.)

Still though it would now properly be regarded as a mark of ignorance to compare the state of Zoological science as first promulgated by Aristotle, with its more developed though still imperfect form as it has been handed down to us by Cuvier, Milne-Edwards, Owen, and a hundred other patient workers in the same inexhaustible mine, it is nevertheless true that it was Aristotle who first taught us to look to the internal structure as the only safe guide to a natural system of classification, and who by his own anatomical investigations, to which he frequently refers, led the way in which Cuvier afterwards so successfully followed.

But there is no need for me to enlarge at all on a topic with which every zoologist is familiar; the object of this paper is to call the attention of English naturalists to the desirability of having such a faithful translation of the περὶ Ζώων Ἱστορίας as shall present in an accurate form the contents of that great book. The utility of such a translation must I think be evident to every student; he will find in the Treatises on Animals that some of the same problems which have engaged the attention of modern naturalists presented themselves ages before in a somewhat similar form to the enquiries of Empedocles and other ancient philosophers. Who, for instance, can fail to discern in the following passage from the *De Partibus Animalium* the question on the theory of development, as advocated by Lamarck and the author of the "Vestiges of Creation:"—"Similarly some philosophers assert, with respect to the generation of animals and plants, that from water flowing in the body the stomach was produced, and every organ recipient of food or excrement, and that by the passage of the breath the nostrils were burst open." (Vol. i. p. 640, ed. Bekker.) The reader will find, again, in Aristotle, matter relating to "Spontaneous Generation," a theory which has recently been advocated by M. Pouchet* with considerable ability, and supported by many curious, though at present inconclusive results.

It is desirable to have an English translation of the "History of

* *Hétérogénie, ou Traité de la génération spontanée*, Paris, 1859, and *Genèse des proto-organismes dans l'air calciné et à l'aide de corps putrescible portés à la temperature de* 150 *dègres*. in Compt. Rend. Acad. Sc. Paris, 1860.

Animals," because no available good one at present exists. The whole works of Aristotle were translated into English by Mr. Thomas Taylor in 1812; but this work, which was executed for a gentleman in London of the name of Meredith, at whose expense it was printed, is so rare that few persons have ever seen it even in public libraries.* But the translation of the Natural History portion in a scientific point of view is almost worthless; a few instances taken merely from the first chapter of the History of Animals will suffice as a sample,—*ταὐτα δὲ τὰ μὲν εἴδει τῶν μορίων ἐστίν* is rendered, "but some of the parts are the same *in species*." Again, *λέγω δὲ γένος οἷον ὄρνιθα καὶ ἰχθῦν*, is rendered by this translator to express the exact opposite to what Aristotle means: thus—"I speak of those whose *genus is the same as birds and fishes*"*!* Although it is perfectly true that Aristotle uses the term *γένος* in a very indefinite sense, sometimes to denote a "class," sometimes a "genus," and any division between the two, yet he would never have asserted that a fish and a bird were to be comprehended in the same *γένος*. In the passage in question, he intended to express the *γένος* of birds as one division, and the *γένος* of fish as another. (§ 2.) Again, *ἀναπνεῖν καὶ ἐκπνεῖν*, "inspiration and expiration," is rendered "*re*spiration and expiration." The note to explain the word *ὁλοθούρια* conveys the following explicit piece of information, "a kind of spongy and marine excrescence;" the *κάραβοι* are translated "locusts," without a word of warning not to confuse the *locusta* (*Palinurus locusta?*) the Crustacean, with the Orthopterous insect of that name. And to sum up may be added the following passage in ch. 5, § 4—*Τῶν δὲ πτηνῶν τὰ μὲν πτερωτά ἐστιν, οἷον ἀετὸς καὶ ἱέραξ· τὰ δὲ πτιλωτὰ, οἷον μέλιττα καὶ μηλολόνθη· τὰ δὲ δερμόπτερα, οἷον ἀλώπηξ καὶ νυκτερίς.* "But of *birds* some are *winged*, as the eagle and the hawk; others have a dry membrane for feathers, as bees and beetles; and others have leathern wings *as the bird called alopex* [or the flying fox] and the bat." These specimens are sufficient to show that Taylor's translation cannot be regarded zoologically in any sense as expressing the meaning of his author; at the same time we have no intention to pass any judgment at all on the whole work, but these instances are cited in order to prove that a translator of a work on Natural History should have some zoological knowledge.

With respect to other translations I am only able to speak of the French one by M. Camus.† This seems to be a most creditable production; and the translator, who has taken infinite pains to get at the meaning of his author, appears, as far as my slight knowledge of his work goes, to have been successful. Perhaps to the matter-of-fact English mind, M. Camus occasionally leads one to fear he is giving us

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* I believe only 50 copies were printed; a set was sold in London a few weeks ago by Mr. Hodgson for £14. 14*s*.

† *Histoire des Animaux d'Aristote, avec la Traduction Françoise*, par M. Camus. A Paris, 1783.

a little more than Aristotle intends, but this is all. The first volume contains the Greek and the French on opposite pages; the second volume contains a Dictionary of Notes.

No doubt the translator would frequently find himself utterly at a loss to identify the names of many of the animals mentioned by Aristotle; this arises partly from paucity of description,—several animals well known to the ancients, from the very fact of their being well-known, are with much difficulty identifiable,—partly from our ignorance of the extent of the countries from which Aristotle may have received specimens; for our author, singularly enough, does not give us much information on this point. His great desire apparently was, to form a system of classification; this was just the task suited to his generalising mind, he cared more for comparative anatomy than for a knowledge of the geographical distribution of, or the particular localities inhabited by, the animals of which he speaks. Stahr, in his admirable article on Aristotle (in Dr. Smith's *Dict. of Gr. and Rom. Biog.*), has drawn attention to some passages in the writings of the Stagyrite, in which it appears that "he is fond of noticing physicians and their operations, in his explanatory comparisons." Aristotle's father was a physician to one of the kings of Macedon, and author of several works on natural science, whence can readily be traced Aristotle's fondness for subjects of this nature.

Pliny appears to be the great authority for the story that Aristotle received much help from Alexander the Great, who, says the Roman naturalist, "having a strong desire to learn the nature of "animals, entrusted the prosecution of the design to Aristotle, a man "who held the highest place in every department of learning; he "placed then under his control several thousand men in every region "of Greece and Asia, hunters, fowlers, fishers, or men who had the "superintendence of parks, of cattle, of the rearing of bees, of fish-"ponds and aviaries, so that no existing animal might escape his "notice. He obtained such information from these persons, that he "was enabled to write some fifty volumes on the subject of animals, "which deservedly hold a high repute." (*H. N.* viii. 16.) Athenæus (ix. p. 398,) asserts that according to report, Aristotle received 800 talents from Alexander to enable him to produce his work.* Now it certainly does strike one as a strange thing that there is no mention of, nor any allusion whatever to such assistance from Alexander, and there is nothing in his own writings to lead one to suppose that Aristotle had ever received any assistance at all from the King for the prosecution of this work. I cannot, therefore, help thinking that the whole story is an exaggeration, and that the greater

* The Attic talent being equivalent to £243. 15*s*, the required sum would amount to £195,000! Well may Schnitz remark "that it would be easy to show that an assessment of the whole kingdom of Macedon, even supposing that Alexander had presented Aristotle with the returns of many years, could not have supplied the sum."

part of the animals Aristotle describes, which have come under his own observation, were inhabitants of no very distant lands.

Schneider (*Epimetr.* i.) says on this subject, "I do not remember "to have discovered any trace in the History of Animals which could "induce me to believe that Aristotle was acquainted with any of the "animals from the interior of Asia and of India, which are supposed "to have been made known to him by those who accompanied Alex-"ander in his expedition." (See also the arguments of Schulz quoted by Schneider. *Epemetr.* i. p. xlv.) Of course a question of this kind is of great importance, because its satisfactory solution would seem to determine to some extent the countries, portions of whose Fauna Aristotle describes.

Hence, as was observed, the translator will often be much perplexed in his attempts to identify very many names; and it appears to me that where he is not *certain* of his identification, it is desirable to put the Greek word in Roman letters, and to leave the note to supply other information. Another caution to be observed should be mentioned. The translator should be extremely careful not to *over interpret* his author; not to use sentences or terms which modern science has stamped with some definite technical meaning, as the equivalents of the Greek, unless it can fairly be demonstrated that the expressions or terms are strictly identical in signification. The use of a modern scientific term will often be found to convey a wrong impression, if applied for the purpose of translation.

But in order to render the proposed work of real utility to the Naturalist, the translator must be able to ensure the cordial co-operation of Zoologists—the various branches of Zoology which require elucidation in the notes can hardly be ever expected to receive this adequately from one man, unless he can depend on assistance from those who have paid particular attention to the different departments. Again, the work must be done by degrees; the translation should first be made, then carefully corrected after a patient study of *all* that Aristotle has written on the subject of animals; for it is quite unreasonable to suppose that even a small portion of the 'History of Animals' can be *fully* understood and accurately interpreted until all that Aristotle has written which bears on the subject has been thoughtfully digested; the notes should be the last thing to be done.

The following translation of the first chapter of the History of Animals must therefore be regarded as provisional, and this is especially the case with respect to the notes, because there can be little doubt that a competent knowledge of the other treatises which bear on Zoology would serve to make clearer many of the names which are therein considered. The text of Schneider has been followed.*

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* *Aristotelis de Animalibus Historiæ, Libri x.* Ed. Jo. G. Schneider. 4 vols. 8vo. Lips. 1811. This is far the best edition of this work. Schneider studied Zoology, and has published some papers on the Reptilia.

It appears to me that it is desirable in the attempts at identification of the various names of animals to interpret Aristotle by Aristotle as far as possible; for when we wander off into the Zoological mazes of Pliny or Aelian, we enter a field full of fable, and one therefore from operations in which little solid aid is to be anticipated.

I should be glad to learn that this short paper is deemed of sufficient importance to stir up in the minds of Naturalists a desire to possess an English Translation of the History of Animals.

Aristotle's History of Animals.

Chapter I.

Of the parts of animals some are simple, as many, namely, as are divided into similar parts, as flesh into flesh; others are compound, as many, namely, as are divided into dissimilar parts, for the hand is not divided into hands, nor the face into faces; of these latter, some are called not merely parts but members, as is the case with all those which being of themselves entire have within them other parts, as the head and the leg, the whole of the arm and the trunk,* for these of themselves constitute entire members and contain different parts; all the dissimilar parts, moreover, are composed of similar ones, as the hand of flesh, nerves, and bones. Now some animals have all the parts the same one with another, others different. Some parts are the same in form; as, for instance, the nose and the eye of one man are identical with the nose and the eye of another, and flesh is identical with flesh, and bone with bone. Similarly in the case of horses, and as many other animals as in form we say are the same one with another, for the parts stand in the same relation each to each as the whole to the whole. Again, some parts are the same, but differ in excess and defect, as in the case of those animals whose kind is the same; by kind I mean such a difference as there is between a bird and a fish,† for of these animals each differs in its kind and in relation to its kind,‡ and there are

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* θώραξ, Aristotle in this place and in ch. 7, uses this term to denote the "trunk" of the body; in ch. 10, he applies it in a more limited sense, to signify the breast or *thorax*.

† γένος, in this passage, will thus be identical with the 'class' of modern zoologists, but the term is employed by Aristotle in no definite sense; γένος may denote either a *genus*, an *order*, or a *class*. In ch. 6, § 1. the Cephalopodous molluscs are regarded as one of the γένη μέγιστα, comprising the Classes of Birds, Fish, &c.; the Cetacea are similarly classified.

‡ κατὰ τὸ γένος καὶ πρὸς τὸ γένος. Aristotle asserts that the differences which exist between animals, as for instance between a bird and a fish, may be viewed under two aspects; there are differences between the various families, genera, or species which comprise the class, and there are differences between the classes themselves, when viewed relatively to each other. Some MSS. omit καὶ πρὸς τ. γ.; see Camus, *Animaux d'Aristote*, i. p. 487.

many forms* of fishes and of birds. Almost all the parts of animals differ one from another, according to their various capabilities of distinction, as, for instance, in colour or in shape,—in which respect some are more affected than others, some less,—or with reference to the question of many or few, large or small size, in short, in point of excess and defect; for some animals are crustaceous, others are testaceous;† some have a long beak, as Cranes, others a short one; some have many feathers, others only few; moreover, even in these last-named animals some parts are different from others, for some are furnished with spurs while others are not so provided; and some possess a crest, others do not; but to sum up, most of the parts of which the whole body is composed are either the same or they differ in their contrarieties, according to excess and defect, for one may refer the terms 'more' or 'less,' to what we understand by 'excess' or 'defect.' Again, some parts of animals are the same neither in form, nor in respect of excess and defect, but by analogy; as a bone when compared with a (fish's) spine, a nail with a hoof, a hand with a claw, and a scale with a feather, for what a feather is to the bird, that a scale is to a fish. With respect then to the parts which each living thing possesses, they may be in this way both different and the same.

Similarly also with regard to the position of the parts; for many animals possess the same parts, but they are differently situated; some, for instance, have the mammæ on the breast, others near the thighs. Again, of similar parts, some are soft and moist, others dry and hard; by moist I mean that which is either altogether so, or such as continues moist so long only as its nature admits, as blood, serum, fat, suet, marrow, the generative fluid, gall, milk in those animals which possess it, flesh, and whatever is analogous to these things; one may also mention excrementitious matters, as phlegm, and the sediments from the belly and the bladder. Dry and hard parts are such as nerves, skin, veins, hair, bone, cartilage, nail, horn, (for the part which has the same form has the same name, and in a word, is called "horn"), and as many substances as are analogous to these things.

Now, the differences which exist between living things are in reference to their modes of life, their actions, their dispositions, and their parts. We will, first of all, speak of these things in a general way, and subsequently attentively consider each particular kind. The differences in reference to their modes of life, their actions, and their dispositions are such as these,—some are aquatic animals, others are terrestrial in their habits. The aquatic animals are so in a twofold manner, some inasmuch as they spend their life and gain

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* εἶδος means literally "that which is seen," the "form or shape," like the Latin *Species*; it must not be restricted to denote what zoologists understand by the term *species*; Aristotle uses it in a more extensive sense.

† *μαλακόστρακα* is clearly the representative of the *Crustacea*; *ὀστρακόδερμα* of the *testaceous molluscs*, which are occasionally mentioned under the simple term *ὄστρεον*. See ch. 6. § 1; and Bk. V. 13. § 9.

their food in the water, and admit and eject the water, of which if they are deprived, they die, as is the case with most of the fishes; others, inasmuch as they get their food and spend their time in the water, but do not admit water, but air, and produce their young out of the water. There are many footed animals of this kind, as the otter and the *latax*,* and the crocodile,† and winged animals, as the *aithyia*,‡ and the diver,§ and footless animals, as the water-ser-

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* ἐνυδρὶς κ. λάταξ. Most commentators understand by ἐνυδρίς, the otter, (*Lutra vulgaris*); the word occurs again only in Bk. viii. 7. § 5. where it is mentioned with the κάστωρ, ("beaver"), the σαθέριον, the σατύριον, and the λάταξ, as a wild quadruped which gets its food about lakes and rivers; it is described as an animal that will bite a man, and will not let go its hold till it hears the bone crack. Herodotus (iv. 109) mentions ἐνύδριες with "beavers and other square-faced animals," as being taken about a large lake in the country of the Geloni or Budeni, (a Scythian race, who dwelt east of the Tanais (*Don*). He adds that their skins were sewn together as borders to cloaks. There can be no doubt that the ἐνυδρὶς of Aristotle denotes the otter, for besides the general agreement of its description with this animal, an additional proof may be seen in the figures of two water animals, resembling otters, with a fish in the mouth of each, preserved in the Lithostrotum Prænestinum, or the Mosaic pavement at Prænesti, and which have inscribed over them the Greek word ΕΝΗΥΔΡΙΣ. The reader may see an engraving of this Mosaic pavement in Shaw's Travels, 8vo. ed. ii. p. 294; or in the folio ed. 1738, p 25. This writer has also [*Suppl.* p. 84 (fol.)] a Dissertation on this pavement, for the history of which the reader may consult Montfaucon's *Antiquities*, vol. xiv. As to the λάταξ, it is impossible to come to any satisfactory conclusion with regard to its identity; it is mentioned again in the above-named passage, and is described as being thicker than the ἐνυδρίς, and as having larger teeth, with which it cuts the branches by the river's banks; the hair of the *latax* is said to be in appearance something between that of the seal and the stag. It is possible, as Pallas (Specileg. Zoolog. xiv. p. 42.) has conjectured, that the *latax* has been named from an ill-observed or ill-described specimen of beaver; but may we not conjecture that some species distinct from the *Castor fiber* existed in the time of Aristotle (about 2,200 years ago) which has since become extinct? This supposition is in some measure perhaps supported by the circumstance that a large extinct species of Beaver coexisted at a comparatively late period with the *Castor fiber*, at one time a very abundant European species, though now, we believe, found with modified habits, only on the banks of the Danube and in the neighbourhood of the Black Sea. Remains of its gigantic congener (*C. Trogontherium*, Cuv. *Trogontherium Cuvieri*, Fisch.) have been found at Bacton and other places in Norfolk, associated in lacustrine deposits with the remains of the Mammoth, Rhinoceros, Ox, Horse, Roebuck and other Deer, &c. But its existence was first made known by the discovery of its fossil cranium on the borders of the Sea of Azof. Is it therefore too extravagant to surmise that it might have existed, together with the Common Beaver, in that and the neighbouring regions of Asia down even to the time of Aristotle, and might have come within his ken, either by actual observation, or, it might be, by recent traditional repute? The word λάταξ etymologically points to some animal that plunges into the water with a *splash*.

† See note on Crocodiles, v. 27. § 2.

‡ αἴθυια, a word of very uncertain meaning. See note on v. 8. § 4.

§ κολυμβίς, may denote some species of 'grebe'; the term as employed by Athenæus (ix. p. 395.) with the epithet ἡ μικρὰ, points apparently to the 'little grebe' or "dabchick," (*Podiceps minor*), but Aristotle (viii. 5. § 8.) mentions the κολυμβίς with the 'swan,' 'duck,' &c., as one of the larger kind of στεγανόποδες (web-footed birds) frequenting rivers and marshes; if a grebe is intended the *Podiceps cristatus* may be the species; but as the word signifies "*a diver*," it is quite probable that it is used in no very restricted sense to denote either of the genera, *Podiceps* or *Colymbus*.

pent.* Some creatures, on the other hand, get their food in the water, and are unable to live out of it, and yet admit neither air nor water, as the jelly-fish and the testaceous molluscs. Of aquatic animals, some belong to the sea, some to rivers, some to salt-water marshes, and some to fresh-water marshes, as the frog and the *cordylus*.† Of marine animals, some belong to the deep sea, others to the shores, others to the rocks. Of terrestrial animals, some admit and eject the air, which is called inspiring and expiring, as man, and all the land animals which possess lungs; others do not admit the air,‡ although they live and get their food on the land, as the wasp and the bee and other insects. By insects I mean such animals that have incisions on the body, whether on the upper parts alone, or on

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* ὕδρος, perhaps the common ringed snake, *Natrix torquata*, which has a wide geographical range, and was doubtless known to Aristotle, though other water-loving ophidians may be comprised under the term. (see ii. 12. § 12.)

† Κόρδυλος. Commentators and naturalists have long been in doubt as to what animal the *Cordylus* represents. Its characters as given by Aristotle are the following—It is a quadruped both aquatic and terrestrial in its habits, possessed of gills, but destitute of lungs, and is the only known instance of an animal having at the same time feet and gills (*De respirat.* x.); it swims with its feet and tail, which latter organ is somewhat like that of the *glanis*, (*Silurus glanis?*) see *Hist. Anim.* i. 5. § 3; it takes its food on the land, (viii. 2. § 5.) Schneider (*Annot. ad Hist. An.* i. 5.) thinks Aristotle alludes to some genus of amphibia allied to the *Siren lacertina*, Lin., the mud eel of the U. S. of America, or to the *Proteus anguinus*. Cuvier seems to have entertained the same opinion; it must be confessed, however, that there are difficulties in the way of this explanation, for all the *Sirenidæ* are possessed of lungs as well as gills during the whole period of their existence. It is possible that the animal to which the *Cordylus* bears the closest resemblance, though the points of agreement are not altogether satisfactory, is a young specimen of eft, (*Salamandridæ*) at the period of its life when the branchiæ and feet are developed, and while the lungs are in a rudimentary state, so that they might have been overlooked. Still there is even, in this case, the following difficulty to get over, viz., that, according to our author, the *Cordylus* takes its food on the land, while the young eft, at the above-named period of its existence, is aquatic in its mode of life; but it is possible Aristotle may have observed young efts to crawl upon the ground before the entire absorption of the branchiæ, when the pulmonary apparatus was sufficiently advanced to enable them to exist out of the water, and that from lack of following up his dissections at different periods of its existence he has erroneously supposed that the young eft, with a temporary possession of branchiæ and a temporary absence of lungs, was an adult form, peremni-branchiate and always destitute of lungs. Rondelet has figured a monstrous form, which he calls Cordylus, to which the reader who is fond of the curious may refer. (*Hist. des Poiss.* p. 176.) Schneider refers to a long disputation by J. Hermann (*Comment. ad Tabulam. affinit.* p. 294.) to which we have not had opportunity of access.

‡ Comp. also *De Respiratione*, ix. 29, ed. Bekker. "That insects do not respire has been remarked by us before; this is evident in small animals, as flies and bees, for they can swim a long time if the water be not very hot or very cold." The beautiful mechanism of the tracheal apparatus whereby insects respire was, of course, unknown to Aristotle, who had no microscope. He was aware, however, of the fact that if an insect were covered with oil it would speedily die (*Hist. Anim.* viii. 26); see also Pliny, *N. H.* xi. 19, Aelian *Hist. An.* iv. 18; Basil (A.D. 329) seems to have been aware that insects admitted air through some external openings. He says that if vinegar is spread over insects that have been in oil they immediately revive, the passages being thereby opened. (*Homil.* 8 *in Hexæm.*)

these as well as on the lower parts. Of land animals, many, as was said before, obtain their food from the water, but of aquatic animals which admit sea-water not one gets its food from the land. There are some animals which, for the first part of their existence, live in the water, and then assume other forms, and live out of it, as is the case with the gnats in the streams and the *oistroi*.* Again, some animals are stationary, others locomotive; the stationary animals are in the water, but of land animals not one is stationary. Now, in the water many animals live in the condition of being fixed to something, as many kinds of testaceous molluscs; and even the sponge appears to possess some sensation, evidence of which is to be seen in the fact that, as people say, it is with more difficulty torn away unless its removal be effected by stealth.† Some animals are both fixed and free, as is the case with a certain kind of *acalephæ* so-called,‡ for some of these get free by night and take their food; and many animals are free but motionless, as oysters and the holothuria§ so-called. Some are swimming animals, as fish, and those (*cephalopodous*) molluscs, which are soft externally,‖ and crustacea, as the *Caraboi*,¶ others are walking animals, as the race of crabs, for these, though water animals in their nature, go on their feet. Of land animals, some are winged, as birds and bees, and those differ in some respects one from the other; others are footed animals, of which some are walking, some creeping, some wriggling; but there is no animal which is solely capable of flying in the same

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* This passage is regarded by Schneider as corrupt. As to the ἐμπίς and οἶστρος, see notes on i. 5. § 5.

† For the different kinds of sponges mentioned by Aristotle, see v. 14, and note. It is interesting to find Aristotle asserting the animal nature of sponges, though the evidence given as a proof thereof may not recommend itself to the zoologist; he expresses a doubt, however, in his treatise (*De partibus Animalium*, iv. 5.) whether sponges ought to be classed with animals or plants.

‡ ἀκαλήφη. The fixed acaleph is represented by our sea anemone, *Actinia;* the wandering *acaleph* by the *Medusidæ*, see iv. 7, and Pliny, *N. H.* ix. 45.

§ ὁλοθούρια, which occurs nowhere else in the *Hist. Anim.*, is mentioned again in the *De part. Anim.* iv. 5, with sponges, Pulmograde Medusæ, (πνεύμονες) "and other marine things of a like nature." It is probable that the Echinoderm of that name (*Holothuria)* may be intended, though perhaps the asteroid polype *Alcyonium* may be included. With respect to the incapability of moving ascribed by Aristotle to the holothuria and some of the testaceous molluscs, it must be remembered that our author lived in days when aquariums were unknown, and that he judged probably from the almost lifeless appearance which certain marine animals exhibit when examined out of the water.

‖ τὰ μαλάκια denote those genera of the *Cephalopoda* which have no external shells, such as *Sepia*, *Loligo*, and *Octopus*. See iv. 1. § 1.

¶ κάραβοι. It is uncertain what crustacean this term signifies. The description as given by Aristotle (iv. 2.) agrees in some respects with the *Palinuridæ*. Schneider says "de Carabo annotandum eum minime congruere cum cancro homaro Linn. quorum compararunt hucusque viri docti." He is inclined rather to refer the κάραβος to the *Cancer elephas*, Herbst. and has a dissertation on the subject in *Der Gesellschaft Naturforschender Freunde zu Berlin Magazin*. Vol. I. P. iii, p. 163. seqq.

way in which a fish is solely capable of swimming, for the skin-winged animals walk, for a bat has feet, and a seal imperfect feet.* Of birds, some are weak-footed, which on this account are called footless (ἄποδες); but this little bird (ἄπους) is strong-winged, and nearly all the birds that are like it are strong-winged, but weak-footed, as the swallow and the *drepanis*, for all these birds are similar in their habits and in their wings, and in general appearance. Now, the *apous* makes its appearance at all seasons, but the *drepanis* only when it is wet during the summer, at which time it is both seen and caught, but on the whole the bird is rare.†

Many animals too are capable of both walking and swimming. There are also the following differences with regard to their modes of life and their actions; some animals are gregarious, others solitary, both of footed, winged, and swimming animals; and some are both gregarious and solitary, and of these some live in political communities, others are not so united; as instances of gregarious animals may be mentioned, amongst birds, the family of pigeons, the crane and the swan, but of birds with crooked talons not one kind is gregarious,—

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* κεκολοβωμένος, "imperfect," or "truncated." The notion conveyed has been applied by Cuvier to one of his sub-classes, *Mutilata*, forming the order *Cetacea*.

† It is impossible to determine with satisfaction the *Hirundinidæ* of Aristotle, or to refer the Greek terms ἄπους and δρεπανίς to their respective species; the χελιδών from its being described as destitute of down or feathers on the legs, as well as from other indications, seems to denote the *Hirundo rustica*; but although many writers have identified the ἄπους with the common Swift, (*Cypselus apus*); there is, as M. Camus has well observed, some grave objections to this opinion; for Aristotle (ix. 21.) thus speaks of the ἄπους. "Now the *apodes*, which some call *cypselli*, resemble swallows (χελιδόνες), as was before observed, for it is not easy to distinguish them from swallows, except from the fact of their having rough legs; they make their nest in long hollows made of clay, (ἐν κυψελλίσιν ἐκ πηλοῦ πεπλασμέναις μακραῖς.) which have just sufficient entrance for them. They build their nests in narrow places, under rocks and caves, so as to avoid the observation both of man and animals." In some respects this passage would suit the House Martin, (*H. urbica*,) but not in all; this bird, if it is safe to draw conclusions from what we see in this country, is by no means in the habit of avoiding men, on the contrary it courts their society; nor can the nest be properly described as being 'long.' Again, the description quoted above will not allow us to identify the ἄπους with the common Swift, which neither avoids men nor builds nollow nests of clay. As to the drepanis (δρεπανίς) which word occurs nowhere else in Aristotle, so far as we have been able to ascertain; it is etymologically highly descriptive of the *sickle*-shaped wings of the 'Swift,' but it is difficult to believe that the bird should have been so rarely seen in Greece as stated by Aristotle. Is it possible that the δρεπανίς may denote the Alpine Swift, (*Cypselus alpinus*,) which, as Latham (*General Hist. of Birds*, vii. p. 324, 4to ed. 1823) says, frequents ponds and marshes for fifteen or twenty days, after which it retires to the mountainous parts to breed; "which flies so high as to be out of sight, and is known only by being heard." M. Camus identifies the *drepanis* with the Sand Martin, (*H. riparia*) and quotes the authority of M. de Montbeillard for believing these birds were taken for the sake of food which is fat and good. There can be no doubt that Aristotle was acquainted with all the above named *Hirundinidæ*, though we are unable to reconcile all his statements with the known habits of the different species. The proverb we often use, "one swallow does not make a summer," is as old as our author; see *Eth. Nic.* i. 6. ed. Bekker.

amongst swimming animals many kinds of fish, as those which they call *runners*,* such as tunnies, *palamydes*, and *amiæ*;† man is both gregarious and solitary. Political animals are those amongst whom the work of all is some one common thing, which is not the case with all the gregarious animals; such is man, the bee, the wasp, the ant, the crane; and of these some are under rulers others are without any ruler; the crane and the whole family of bees are under a ruler, but ants and an immense number of other animals are without a ruler. Some, both of the gregarious and solitary animals are resident in one spot, others are migratory; again some are carnivorous, others frugivorous, others omnivorous, others feed on particular things, as the family of bees and of spiders, for the former feed on honey and a few other things of a sweet nature, but spiders by chasing flies; and other animals feed on fish; some animals hunt; some are accustomed to lay up their food in store, others do not so; some have dwellings, others have none; of those which have dwellings, the mole, the mouse, the ant, and the bee are examples; of those which have none are many kinds of insects and quadrupeds. Again, with respect to their localities, some animals live in holes, as the lizard and the snake; others above ground, as the horse and the dog; some burrow holes, others do not; some are nocturnal, as the owl and the bat, and others are diurnal in their habits. Again, with respect to tame and wild animals, some are always tame, as man and the mule, others are wild as the leopard and the wolf, while others can

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* δρομάδες, a term of very questionable import, which is applied in a general sense to different fish; another division is characterised by an equally unintelligible name, ῥυάδες (see iv. 8, § 13; v. 9, § 6; vi. 16. § 2; viii. 15, § 2, 5, 6). Aristotle gives us no clue whereby we may be able to comprehend the meaning of these terms. Whether δρομάδες may denote the *swiftness* at which some fish swim, or whether it has reference to their migratory habits it is difficult to say; and again, whether ῥυάδες, is meant to express fish that go with the *current*, or what else, we cannot determine. M. Camus (ii. 667) says, "Cette expression (ῥυάδες) vient d'un verbe grec, qui signifie *fluere, couler*; or que peut-on entendre par des Poissons qui *coulent*, sinon des poissons *qui forment une bande qui passe promptement?*" Both the δρομάδες and the ῥυάδες are gregarious and this is all that is positively known. Neither Gesner's explanation nor that of M. Camus is at all satisfactory that ῥυάδες denotes "fish that remain in great numbers in one place."—(See M. Camus' note, lower down).

† There seems no reason to doubt that the θύννος of Aristotle is identical with the *Thynnus vulgaris*, Cuv. et Valenc. The tunny fishery of the Mediterranean is of great antiquity. The πηλαμύς which (vi. 16, § 4,) is said to be in appearance a year younger than the θύννος may perhaps denote the Bonito, (*Thynnus pelamys*) for which fish this term has been employed as the specific name by Cuvier and Valenciennes. As to the ἄμια, it may be represented by the *Pelamys sarda*, Cuv. et Valenc. Rondelet (*L'Histoire des Poiss.* p. 193) has figured this fish, and with much reason has identified it with the *amia*; the *P. sarda* having long and strong teeth, by which character it is distinguished from its immediate congeners, will suit Aristotle's description of the *amia*, which he mentions as attacking large fish. The same author, says Cuvier, had observed the length of the gall bladder which is greater than in most other fishes. It must, however, be confessed that there is some uncertainty respecting the precise identification of the two latter Greek terms.

speedily be rendered tame, as the elephant for instance. Again, (animals may be divided) in another way, for all tame races are also wild, as horses, oxen, pigs, sheep, goats and dogs. Some animals are able to make a loud noise, some are mute, others are possessed with a voice, and of these latter some have a language, others are incapable of uttering distinct sounds; some are garrulous, others are silent, some are songsters, others are unable to sing; but to sing and talk most at the season of copulation is common to all birds. Some animals frequent the fields as the wood-pigeon, others the hills as the hoopoe, others live with man as the pigeon. Again, some are very prone to venery, as the tribe of partridges and cocks, others preserve chastity, as the crow family which seldom copulate. Again, some animals are given to defend themselves, others to keep watch against the approach of danger; in the first class I include such as either attack other animals or defend themselves when injured; by the second class I mean those which have in themselves something which serves as a means of avoiding suffering.

In disposition animals differ in the following particulars; some are gentle and demure and not stubborn, as the ox, while others are passionate, stubborn, and stupid, like the wild boar; others are sagacious and timid like the stag and the hare; others mean and insidious like serpents; others liberal, brave, and noble, like the lion;* others generous, fierce, and insidious, like the wolf; by noble I mean that which is descended from a good race, by generous that which does not degenerate from its own nature. And some animals are cunning and full of mischief, like the fox; others full of spirit, loving, and fawning, like the dog; others gentle, and readily tamed, like the elephant; others are modest, and always on the watch like the goose; others are envious and fond of display, like the peacock. But of living things man alone is capable of deliberating; many animals share in memory and ability to learn, but no other being except man is capable of reminiscence.

Of each particular kind of animals, both with respect to their

* The Lion is said to be εὐγενής, the Wolf γενναῖος. The former term may be properly rendered "noble;" it is not so easy to give a suitable translation of the latter Greek word. In the Rhetoric (ii. 15, § 3), Aristotle makes again the same distinction between these two terms—εὐγενής is "that which refers to excellence of birth," γενναῖος "that which does not degenerate from its nature"—the English word 'generous,' though now not used in the sense attributed to γενναῖος, appears originally to have been sometimes so understood; its opposite quality 'degenerous' or "degenerate," implies a falling from the original healthy and vigorous qualities that belong to the genus, (*de, genus*) and in this sense the expression 'degenerate' continues to be used; and while we can speak of a 'degenerate' breed of cattle, are unable, by the employment of the simple term 'generate,' or 'generous,' to express the opposite quality of an animal perpetuating its own vigorous characteristics to succeeding generations; M. Camus renders γενναῖος by "vigoureux;" it may be remarked that the word "generous" has by some writers been applied to animals, as "a *generous* pack of hounds"—or "a *generous* stud"; we hear too "of *generous* wine." Does not this epithet imply what Aristotle means by γενναῖος, viz. "that which will not degenerate."

dispositions and modes of life we intend to speak hereafter with more precision.*

XVI.—The Atlantis Hypothesis in its botanical aspect.—By Professor Oliver.

A perusal, some few months ago, of certain passages in Professor Heer's important essay on the climate and vegetation of the Tertiary period,† induced me to investigate rather carefully the relations between the Tertiary and some existing Floras, especially with reference to the hypothesis advanced by Professors Heer and Unger, that during the Miocene period there existed an Atlantic junction between

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* Although English Naturalists appear to have given little attention to the study of Aristotle and the Natural History of the ancients generally, the subject has not escaped the notice of our German friends; on the contrary, careful enquiry would no doubt disclose much valuable pertinent matter. There are several published treatises which bear on the subject of Aristotle's Zoological Works, the titles of some of which are here added, though we confess we have only been able to consult a very few of them.

Beckmann, J., *De historia naturali veterum libellus.* Petrop. et Gotting. 1766.
Gallisch, Fr. And., *de Aristotele rei naturalis scriptore.* Lips. 1776.
Schneider, J. G., *Icthyologiæ Veterum Specimina.* Franc. ad Viad. 1782.
Proben von der Fischkunde der Alten, in Leipz. Mag. Jahrg. 1783, p. 62.
—— Petri Artedi *Synonymia Piscium Græca et Latina emendata, &c.* Lips. 1789.
—— *Ueber die von Aristoteles beschriebenen Gattungen und Arten von Krebsen.* Berl. Mag. 1807, p. 163.—*Isis*, 1818, iv. p. 1453.
Billerbeck, H. L. Jul. *De Strigibus ab Aristotele, Plinio, cæteraque Scriptorum Veterum grege Commemoratis.* Hildeshem. 1809.
Köhler, J. Herm de, *Aristoteles, de Molluscis Cephalopodibus* (περὶ τῶν μαλακίων) *Comment.* Rig. 1821.
Werber, W. J. A., *Aristoteles Verdienst um die wissenschaftliche Bearbeitung der Zoologie und sein Einfluss bis auf unsere zeit.* Isis, 1822, p. 476—492.
Titze, F. N. *Ueber die wissenschaftliche Behandlungsart der Naturkunde überhaupt, vorzüglich aber der Thierkunde:* Griech. und Deutsch, *mit Anmerk.* Leipz. 1823.
Wiegman, A. F. A., *Observationes Zoologicæ Criticæ in Aristotelis Historiam Animalium.* Lips. 1826. Isis, 1827, xii. p. 1078.
Müller, J. *Ueber den glatten Hai des Aristoteles und über die Verschiedenheiten unter den Haifischen u. Rochen in der Entwickel. des Eies.* Berl. 1842.
Franzius, A. von., *Aristoteles' Vier Bücher die Theile der Thiere. Griechisch und Deutsch und mit Sacherklärenden Anmerkungen.* 1853.
Meyer, J. B., *Dissertatio de Principiis Aristotelis in distributione animalium adhibitis.* Berol. 1854.
—— *Aristoteles Thierkunde; ein Beitrag zur Geschichte der Zoologie, Physiologie und alten Philosophie.* Berl. 1855.
Rose, Valentin., *De Aristotelis librorum ordine et auctoritate Commentatio.* Berol. 1854.
Thiel, H. *De Zoologicorum Aristotelis librorum ordine ac distributione, imprimis de librorum περὶ ζώων μορίων primo.* (Ex program. gymnas. Elisabet. 1855, Edito repetitum.) Vratislaviæ, Gosohorsky, 1855.
Lenz, H. O., *Zoologie der alten Griechen und Römer, deutsch in Auszügen aus deren Schriften, nebst Anmerkungen.* Gotha, 1856.

† "Recherches sur le Climat et la Végétation du Pays Tertiare," 1861.

Europe and America. With regard to this question I have been led to differ from these authors, and am confirmed in the view advanced by Dr. Asa Gray* in reference to plants, and previously by Mr. Darwin† with regard to animals, that the migrations resulting in a community of types in the tertiary beds of Europe and the present flora of the Eastern states of the North American continent, took place probably in a comparatively high latitude to the north of the Pacific ocean. In this short paper I propose to give the grounds upon which I think this opinion may be based. I shall embody further, some observations bearing upon the general and mutual relations of the North Temperate floras, with others of a critical character, which have suggested themselves by the comparisons I have had occasion to institute, referring to some of the determinations of fossil species in Professor Heer's "Flora Tertiaria Helvetiæ."

Had I felt myself on more secure ground in touching upon questions intimately bound up with geological problems, I might have chosen to prefix the title of Professor Heer's work to this notice, and to have aimed at a more complete review of it than, in my inability to appreciate properly some of the more strictly geological features, I can venture upon.

The data upon which my enquiries are based, are chiefly these. So far as the Tertiary Flora of Europe is concerned, I believe that the general aspect of the questions touched upon is not sensibly affected by confining myself almost exclusively to the materials furnished from Switzerland in the "Flora Tertiaria." The statistics of recent Floras rest upon Nyman's "Sylloge Floræ Europææ," Mr. Bentham's "Hand-book of the British Flora," Mr. Black's Catalogue of Japanese Plants appended to Hodgson's Japan, A. Gray's "Manual" for the Northern, and Chapman's "Flora" for the Southern United States, Webb and Berthelot's "Hist. Nat. des îles Canaries," and minor papers. The Hookerian collections have been of essential service in the comparison of specimens and of recent with extinct forms.

With regard to the basis upon which comparisons between recent and fossil (tertiary) floras should rest, I apprehend that the principal reliable results which are attainable in the present state of knowledge are, in the main, quite as likely to issue from comparisons of genera as of species. It is true, that in some cases, fossil remains suffice to enable the further step to be taken of tracing identical, analogous or representative specific forms in past and present floras; but these are rather exceptional, and from the necessity of attaching a primary importance to the character of the nervation, venation and form of leaves, which must often render even ordinal determination exceedingly uncertain, from the very fragmentary character, frequently, even of these imperfect data, and, farther, from our ignorance of types which, it may be assumed, are now extinct, I believe that we can best eliminate several sources of error by depending rather on generic than specific identifications or parallels. It may be truly

* Mem. Am. Acad. N.S., vol. vi. p. 377. † Voyage of Beagle. Ed. 1839, p. 151.

objected that the fossil is often referred first to the species, then to the genus, and not as in recent botany, first to the genus, then to the species; but recollecting how seldom fossil remains enable us to ascertain how far two forms may be removed in floral or in fruit structure, which resemble each other precisely in their leaves; seeing, moreover, that if the specific determination or analogy be correct, that of the genus must necessarily be so, while indeed, if the former be incorrect, the latter may yet hold good,—I cannot but think it the safer course in the discussion of the present question to confine myself to comparisons of genera solely. The case is widely different when we compare the species of recent floras with each other, inasmuch as here we deal usually with individual elements of a value much more nearly equal, and are thus in a position better able to appreciate the minor facts of recent migration and modification of type which such a collation might indicate, than it is possible we could be from the comparison of a recent with a fossil flora, or of two recent floras based upon their genera solely. In spite of their imperfection there can be little question, but that the most important problems of plant-distribution are to be solved only by a constant reference to fossil remains, and according as we compare existing with extinct floras of recent or of more remote geological date, shall we find that the comparison of species with species, of genus with genus, of order with order, and of sub-kingdom with sub-kingdom, have each their proper place and value in helping us to a right apprehension of the changes which in respect of plant-distribution our planet has experienced. In the case of the flora of the tertiary period, from the imperfect nature of the evidence upon which we must at present depend, and the circumstance that probably at least one-fifth or one-fourth of its generic types, referable with more or less probability to existing natural orders, are extinct or indeterminable, (exclusive of the various forms grouped under *Phyllites*, *Antholites* and *Carpolithes*), I believe that a comparison of specific forms is quite as calculated to mislead as reliably to inform; and although I regard Professor Heer's attempt to indicate the living analogues of Swiss tertiary plants in his tabulated enumeration as very able, yet I do not think the general results attained by it add to the issue of a generic correlation; while Professor Unger's catalogue of tertiary species and their North American representatives* appears to me overstrained in favour of the Atlantis hypothesis, and calculated to give a false impression. We must not, however, overlook the peculiar and qualifying circumstances, referred to above, under which the generic determination of not a few fossil species must be made:—that the reference of the fossil to a recent genus frequently depends less upon the recognition in the fossil, of any one essential character of such genus, than upon its resemblance to some single species or group of species of the genus in some one or two points of small importance, or of no importance at all, generically.

* Die Versunk. Insel Atlantis, p. 26.

The character of venation often differs very materially in the same natural genus. Take, for instance, *Liquidambar*, one of the older generic types of Dicotyledons, and compare *L. styraciflua*, *L. chinense*, and *L. Altingia*, both in respect of form and venation of the leaves. The nervation and venation in *Loranthus* is very variable; also in South American species of *Coussapoa*. Compare *C. calophylla*, Pl., *C. fontanesiana*, Trec., (*C. sylvatica*, Pl.), and *C. trinervia*, Spr. Compare also the species of *Styrax*, and such a list might be indefinitely extended.

I have not, in tabulating, restricted myself to fossil genera, the determination of which has been based upon indubitable evidence; though by attaching, in the table, p. 175, a numerical reference to several of the genera which appear doubtful, and which are remarked upon at the end of this paper, I have partly distinguished between those which, to the best of my judgment are to be depended upon, and those which should be accepted with more or less doubt. I say *partly* distinguished, for I have thus marked only about thirty genera, though I believe that fully one hundred of these generic determinations are more or less doubtful.

In the notices which follow, all reference to Cryptogamous plants is omitted; partly, because with the exception of the vascular groups, the fossil data are almost valueless; partly, because I have myself but a very limited acquaintance with the most important of the vascular orders—*Filices*, and partly, because I believe they do not afford material additional evidence affecting the principal question discussed. I have introduced several statistical items of information which do not directly bear upon the dispersion of the tertiary flora and the hypotheses of Atlantic or Pacific migration, but these have appeared sufficiently interesting on independent grounds. I cannot claim for the numerical details anything like absolute accuracy, though I believe them to be trustworthy in the main.

The Tertiary Flora of Europe; its general character, &c. This is admirably reviewed by Professor Heer in his essay on the climate and vegetation of the tertiary epoch. As this is separately published at a very moderate price I must refer to it for detailed information and confine myself here to principal features. The Swiss tertiary remains of Phænogamous plants, exclusive of "*incertae sedis*," are distributed through 80 natural orders, and about 196 genera, (Dicots. 160, Monocots. 36), of which 154 (Dicots. 133, Monocots. 21) are yet existing types. The total number of species of Phanerogamia is estimated at about 800, of which number nearly half are referred to nine or ten natural orders. These latter are as follows:—

Papilionaceæ,	species	117	Graminaceæ,	species	25
Amentaceæ,	,,	64	Coniferæ,	,,	23
Cyperaceæ,	,,	39	Compositæ,	,,	21
Proteaceæ,	,,	35	Aceraceæ,	,,	20
Lauraceæ,	,,	25			

The sequence of the above largest orders varies if the four stages of the tertiary deposits be separately considered. In the first and second stages Rhamnaceæ rank as the 6th and 5th order respectively. In the fourth stage, Proteaceæ are not included among the first eight orders, while Compositæ take the fourth place. In the third stage, the remains of but three Coniferæ are recorded. The proportion of ligneous to herbaceous species is considered to have been very large, there being upwards of 530 of the former, of which number more than one half were arborescent. 327 are reckoned to have been evergreen.*

The groups which, either in number of species or individuals, especially gave a character to the Tertiary epoch vegetation, are

Coniferae, in "Fl. Tert. Helvetiæ" referred to	9	gen.	23	species.
Palmae	8	,,	15	,,
Populus		,,	8	,,
Salix		,,	13	,,
Myrica		,,	11	,,
Quercus		,,	35	,,
Ulmus and Planera		,,	10	,,
Ficus		,,	17	,,
Platanus		,,	1	,,
Liquidambar		,,	2	,,
Aceraceae	2	,,	20	,,
Lauraceae	6	,,	25	,,
Proteaceae	10	,,	35	,,
Rhamnaceae	5	,,	25	,,
Leguminosae	26	,,	131	,,
Juglandeae	3	,,	16	,,

Prof. Heer in a chapter entitled "Comparison of Plants of the Swiss Tertiary Flora with species now existing,"† enumerates 41 species, exclusive of cellular plants, based upon both leaf and fruit or flower remains (marked * in the following list), and in a second list 30 species resting upon leaf remains only, sufficient, however, to enable him to indicate for each species a living analogue. Although I should probably differ as to the specific counterparts in some cases, there can be but little doubt as to many of the generic identifications. These genera are, **Woodwardia*, **Pteris*, **Aspidium*, *Osmunda*, **Juncus*, **Arundo*, **Sparganium*, **Potamogeton*, *Smilax*, *Sabal*, **Glyptostrobus*, **Taxodium*, **Sequoia*, *Myrica*, *Carpinus*, **Populus*, **Salix*, **Quercus*, **Ulmus*, **Planera*, **Platanus*, **Liquidambar*,

* This is Professor Heer's estimate, and I have not the means of analysing it. Dr. Hooker has directed my attention to the importance of ascertaining satisfactorily the exact proportions generally prevailing between ligneous and herbaceous plants, and the proportion of evergreens in truly tropical floras. I presume all the *Lauraceæ* to have been reckoned among evergreens by Professor Heer. He says (Recherches, &c., p. 60) "* * * les Lauriers et les Camphriers gardaient sans interruption leur verdoyante parure."—In the South United States, of the six species of Lauraceæ which occur there, four are deciduous, and in the Himalaya Dr. Hooker informs me some of the order are commonly bare in winter. To the absolute numbers given by Professor Heer, I think comparatively little value can be attached, though probably the relative proportions in, for example, his table of the sequence of orders, may be sustained.

† Recherches sur le Climat, &c. p. 55.

***Polygonum*, **Salsola*, **Laurus*, *Persea*, **Cinnamomum*, **Embothrium*, *Dryandra*, *Ficus*, **Leptomeria*, **Diospyros*, **Acerates*, *Fraxinus*, **Liriodendron*, **Acer*, *Ilex*, *Zizyphus*, *Berchemia*, **Rhamnus*, **Paliurus*, *Rhus*, **Juglans*, *Pterocarya*, **Colutea*, **Robinia*, **Gleditschia*, *Caesalpinia*, **Cassia*.**

In discussing the character of the Swiss Tertiary Flora,* its general relations to existing Floras are indicated. The methods of comparison employed, Prof. Heer says "incontestably prove that, at the Tertiary period Switzerland was inhabited by types which are now scattered over every part of the world, but of which the majority correspond to American species; Europe ranks only second, Asia third, Africa fourth, and New Holland fifth. In Europe it is the Mediterranean region; in America, the Southern United States; in Asia, Japan, the region of the Caucasus and Asia Minor; in Africa, in proportion to their area, the small islands of the Atlantic, which support the greatest number of analogous species." Speaking of the distribution in the Tertiary, as compared with the present period, of generic types, he selects Juglandeæ as offering a marked contrast between their present wide, and former restricted area. Prof. Heer limits the present distribution of ***Pterocarya*** to the Caucasus, ***Juglans*** to Persia and North America, and ***Engelhardtia*** to the Sunda Islands. Two species of *Pterocarya*, however, grow in Japan, three species of *Juglans* are recorded from the same region, where also another generic type is met with in *Platycarya* (*Fortunæa*, Lindl.), and ***Engelhardtia*** occurs in the Himalaya. *Carya* is not held to be generically distinct from *Juglans* by Messrs. Hooker and Bentham.

Viewed in respect of the species which contributed most largely to the mass and physiognomy of the tertiary vegetation, he says, "The Flora of Japan with its abundance of Camphor-trees and its *Glyptostrobi*, that of the Atlantic islands with its Laurels, the American Flora with its numerous evergreen Oaks, Maples, Poplars, Plane-trees, *Liquidambar*, *Robinia*, *Sequoia*, *Taxodium*, and ternate-leaved Pines, and finally that of Asia Minor with its *Planera* and *Populus mutabilis* occupy the first place." Without distinction of stage in the Swiss deposits, the first rank, in respect to abundance of individuals, Prof. Heer assigns to Lauraceae, second, Cupuliferae. In the first stage, Proteaceae, Rhamnaceae and Cupressineae predominated; in the second, Rhamnaceae and Palmaceae; third Proteaceae; fourth, Salicaceae, Aceraceae, Papilionaceae, Juglandeae and Sapindaceae. The climate of Europe he believes to have been, during the lower miocene, about 13°, and the upper miocene 16° Fahr. warmer than at present, while the large relative proportion of ligneous, evergreen and aquatic species, with layers of lignite, bear testimony to its ample humidity.

With a view to avoid unnecessary repetition in the following paragraphs, and to save space, I have drawn up the subjoined table, showing the distribution of existing genera of the Swiss Tertiary in the recent Floras of Europe, Japan, of Europe and Asia (including Japan), taken together, and the Southern States of America.

* Recherches sur le Climat, &c. p. 58.

Genera of Swiss Tertiary.	Europe.	Japan.	Europe, Asia, Japan.	S. States N. America.	Genera of Swiss Tertiary.	Europe.	Japan.	Europe, Asia, Japan.	S. States, N. America.
Monocotyledons.									
Arundo .	1		1		Sassafras[22] .			1?	1
Phragmites .	1	1	1	1	Cinnamomum		1	1	
Panicum .	1	1	1	1	Pimelea . .				
Oryza . .			1		Elæagnus[23] .	1	1	1	
Cyperus .	1	1	1	1	Protea . .				
Scirpus . .	1	1	1	1	Persoonia .				
Carex . .	1	1	1	1	Grevillea .				
Juncus . .	1	1	1	1	Hakea . .				
Smilax . .	1	1	1	1	Dryandra .				
Chamærops[30] .	1	1	1	1	Embothrium .				
Sabal . .				1	Banksia .				
Manicaria .					Rhopala .				
Geonoma .					Lomatia .				
Typha . .	1		1	1	Leptomeria .				
Sparganium .	1		1	1	Aristolochia .	1	1	1	1
Potamogeton .	1	1	1	1	Erica . .	1		1	
Naias . .	1		1	1	Andromeda	1		1	1
Butomus[29] .	1		1		Clethra[17] .		1	1	1
Hydrocharis .	1		1		Monotropa .	1		1	1
Iris . .	1	1	1	1	Vaccinium .	1	1	1	1
Puya . .					Diospyros .	1	1	1	1
					Macreightia[15].			1?	
Dicotyledons.					Styrax[16]. .	1	1	1	1
Libocedrus[28] .					Bumelia[14] .				1
Widdringtonia					Myrsine .		1	1	1
Taxodium[27] .				1	Porana . .			1	
Glyptostrobus		1	1		Menyanthes .	1	1	1	
Podocarpus .		1	1		Acerates[18] .				
Sequoia .					Fraxinus .	1	1	1	1
Pinus . .	1	1	1	1	Lonicera .	1	1	1	1
Liquidambar[19]		1	1	1	Viburnum .	1	1	1	1
Populus .	1	1	1	1	Gardenia .		1	1	
Salix . .	1	1	1	1	Hedera . .	1	1	1	
Myrica . .	1	1	1	1	Panax . .		1	1	1
Alnus . .	1	1	1	1	Cornus . .	1	1	1	1
Betula . .	1	1	1	1	Vitis . .		1	1	1
Carpinus .	1	1	1	1	Weinmannia[12]				
Ostrya . .	1		1	1	Ranunculus .	1	1	1	1
Corylus[31] .	1	1	1	1	Clematis .	1	1	1	1
Quercus .	1	1	1	1	Liriodendron .				1
Ulmus[31] .	1	1	1	1	Berberis .	1	1	1	1
Planera .	1		1	1	Nymphæa .	1	1	1	1
Ficus . .	1	1	1	1	Nelumbium .		1	1	1
Artocarpus[26] .			1		Lepidium .	1		1	1
Platanus[25] .	1		1	1	Clypeola .	1		1	
Polygonum .	1	1	1	1	Samyda[1] .				
Salsola . .	1	1	1	1	Terminalia[11] .			1	1
Pisonia[20] .			1	1	Combretum[11] .			1	
Laurus . .	1		1		Myrtus . .	1		1	
Persea . .				1	Eugenia[9] .			1	1
Benzoin .		1	1	1	Metrosideros .		1	1	

Genera of Swiss Tertiary.	Europe.	Japan.	Europe, Asia, Japan.	S. States. N. America	Genera of Swiss Tertiary.	Europe.	Japan.	Europe, Asia, Japan.	S. States N. America
Eucalyptus .					Pterocarya .		1	1	
Sterculia[4] .		1	1		Prunus . .	1	1	1	1
Grewia .			1		Amygdalus .	1		1	
Acer . .	1	1	1	1	Cratægus .	1	1	1	1
Negundo[6] .		1	1	1	Spiræa . .	1	1	1	1
Sapindus .		1	1	1	Cytisus[8]. .	1		1	
Kœlreuteria .		1	1		Medicago .	1		1	
Dodonæa .			1	1	Trigonella .	1		1	
Banisteria[2] .					Robinia . .	1		1	1
Hiræa[2] . .			1		Psoralea .	1		1	1
Coriaria .	1	1	1		Indigofera .		1	1	1
Euphorbia[24] .	1	1	1	1	Tephrosia .			1	1
Pittosporum[7] .		1	1		Glycyrrhiza .	1		1	
Celastrus .	1	1	1	1	Colutea . .	1		1	
Elæodendron .		1	1		Phaseolus .		1	1	1
Ilex . .	1	1	1	1	Pterocarpus .			1	
Zizyphus .	1	1	1		Dalbergia .			1	
Paliurus .	1	1	1		Sophora .	1	1	1	1
Ceanothus[13] .				1	Edwardsia .				
Berchemia .		1	1	1	Cercis . .	1		1	1
Rhamnus .	1	1	1	1	Gleditschia .			1	1
Rhus . .	1	1	1	1	Bauhinia .			1	
Zanthoxylum		1	1	1	Ceratonia .	1		1	
Ptelea[3] . .				1	Cæsalpinia .		1	1	
Ailanthus .			1		Cassia . .			1	1
Juglans . .		1	1	1	Acacia . .		1	1	
Carya . .				1	Mimosa . .			1	1

The Tertiary and existing Flora of Europe.—The genera common to the Tertiary Flora of Switzerland, and the recent Flora of Europe, as shown in the above table, are about 76 in number; (Dicots. 60; Monocots. 16) or 12 fewer than are common to the Tertiary beds and the South United States Flora, and but 1 fewer than are common to the same and Japan.

Of the characteristic orders and groups of the Swiss Tertiary the constituents in the existing Flora of Europe are—

	Gen.	Species.		Gen.	Species.
Palmæ . .	1	1	†Lauraceæ .	1	1
†Coniferæ .	7	40	†Proteaceæ .		0
Populus . .		7	Rhamnaceæ .	3	21
Salix . .		60-70	Juglandeæ .		0
Myrica . .		1	†Leguminosæ .	55	852
Quercus . .		12-15	†Aceraceæ .	1	8
Ulmus . .		3	†Amentaceæ .	11	130
Planera . .		1	†Cyperaceæ .	13	257
Ficus . .		1?	†Gramineæ .	91	554
Platanus . .		1-3	†Compositæ .	138	1400
Liquidambar .		0			

The nine largest orders of the Swiss Tertiary are marked † in the above list.

According to Professor Heer,* the recent Flora of Switzerland includes 24 natural orders with ligneous species,† of which 18 are common to the Tertiary beds.‡ These latter are—Coniferæ, Amentaceæ, Ulmaceæ, Elaeagneæ, Aristolochiaceæ, Thymeleæ, Apocyneæ, Oleaceæ, Ericaceæ, Caprifoliaceæ, Araliaceæ, Cornaceæ, Tiliaceæ, Ilicineæ, Rhamnaceæ, Celastraceæ, Acerineæ, Berberideæ. These orders include in the recent Flora 152 species, in the Tertiary 253. In Britain there are about 1230 Phanerogamia (Dicots. 923, Monocots. 307) referred to 479 genera (Dicots. 365, Monocots. 114), and 88 natural orders (Dicots. 73, Monocots. 15). About 116 species (9 per cent.) are ligneous. Of British genera about 48 are common to the Swiss Tertiary (Dicots. 37, Monocots. 11).

The Bovey Tracey fossil remains Professor Heer has shown to be pre-eminently characterized by Miocene species.§ Out of 49 species which have been discovered, 20 occur in Miocene beds on the Continent. The Bovey Flora includes the following recent genera:

Phragmites	*Laurus*	*Nyssa*‖	*Gardenia*‖
Sequoia	*Eucalyptus ?*	*Pterocarya ?*	*Vitis*
Ficus	*Eugenia*	*Vaccinium*	*Anona*‖
Quercus	*Celastrus*	*Andromeda*	*Nymphæa.*

Professor Heer points out that none of the Bovey species are common to the Miocene of Iceland, and that, excepting *Sequoia* and *Quercus*, the genera are also distinct.

In Iceland there are, according to Dr. Lindsay's list (1860), 426 Phanerogams (Dicots. 290, Monocots. 136) belonging to 159 genera (Dicots. 119, Monocots. 40), and about 48 natural orders (Dicots. 39-40, Monocots. 8). The only woody plants are birch, willow, juniper, and rose. Common to the Swiss Tertiary there are in Iceland

	Gen.	Orders.
Dicots.	12	19-20
Monocots.	6	6

The following genera occur in Tertiary beds in Iceland:—*Sparganium*, *Pinus*, *Sequoia*, *Betula*, *Alnus*, *Salix* (rare), *Corylus*, *Quercus*, *Ulmus*, *Platanus*, *Acer* (*A. otopterix*, being the commonest Tertiary tree), *Vitis*, *Liriodendron*, *Rhamnus*, *Rhus*, *Juglans*.

The Tertiary and Japanese Floras, &c.—About 71 natural orders are common to Japan and the Swiss Tertiary; of these 51 are represented by identical genera, accepting the determinations of "Flora

* l. c. p. 38.
† Exclusive of Leguminosæ, Rosaceæ, Ranunculaceæ.
‡ I have united some of Prof. Heer's Orders for the sake of uniformity.
§ Paper read before Royal Society, Nov. 21, 1861.
‖ Very doubtful, especially the last two.

Tert. Helvetiæ" for the fossil species. The total number of genera common to Japan and the Tertiary is 77, as enumerated, p 175. Nearly the same number, it has been observed, is common to Tertiary and Recent Europe. But the 77 common to Japan include 26 not in Recent Europe, and amongst these are several eminently characteristic tertiary types.

The Phanerogamia of Japan are approximately—

	Nat. Orders.	Genera.
Dicots. . .	132	543
Monocots. .	17	126
	149	669

Indigenous species hitherto published about 1550. The 10 largest Nat. Orders are—*

	Gen.	Species.
† Gramineæ . . .	56	138
† Compositæ . . .	52	95
Rosaceæ	24	75
† Cyperaceæ . . .	7	60
Ranunculaceæ . .	18	56
Liliaceæ . . .	19	52
† Cupuliferæ and Salicaceæ	8	48
†*Coniferæ . . .	16	47
†*Leguminosæ . . .	27	45
Orchidaceæ . . .	24	38

Other dominant and characteristic Japanese Nat. Orders are—

	Gen.	Species.
†*Lauraceæ . . .	11	25
Caprifoliaceæ . . .	6	26
Saxifrageæ . . .	9	25
Ternstrœmiaceæ . .	8	20
Berberideæ . . .	6	12
†*Aceraceæ . . .	2	15
Celastraceæ . . .	5	14
*Rhamnaceæ . . .	5	8
*Juglandeæ . . .	3	6
Styracaceæ . . .	3	12
Oleaceæ . . .	5	16
Euphorbiaceæ . .	15	31
*Moreæ	5	17

Of the characteristic groups of the Swiss Tertiary, in addition to those marked ‡ in the above, we have in Japan—

‡ The sequence of Orders given by M. De Candolle (Geog. Bot. 1207) appears to have been founded upon imperfect material. It is after Zuccarini.

	Gen.	Species.
Palmæ	2	5
Populus		1
Salix		11
Myrica		1
Quercus		23
Ulmus		1
Planera		0
Ficus		8
Platanus		0
Liquidambar		1
† Proteaceæ	1	1

The nine largest Orders, numerically, of the Swiss Tertiary have † prefixed in the above lists. I estimate that about 40 per cent. of the Japanese phanerogamia are ligneous species. These species are included in 238 genera.

It ought to be borne in mind that the Japanese Flora has been as yet but imperfectly explored. The area of the Islands is given at about 266,600 square miles.

The Tertiary and American States Flora, &c.—The close analogy subsisting between the Tertiary Flora of Europe and the existing Flora of the Eastern, and especially the Southern States of North America is generally acknowledged. Professors Heer and Unger have recently examined critically into this relationship, establishing it upon a wide basis of detailed comparisons. Our Table p. 175 shows that 88 genera (Dicots. 74; Monocots. 14) are common to the Swiss Tertiary and the South United States Floras; these belong to 73 Natural Orders, of which 52 are represented by identical genera.

The following genera from the above table do not occur in Japan; those, however, growing in Asia or Europe have * affixed.

Sabal	Persea	Carya
Typha*	Sassafras (* ?)	Robinia*
Sparganium*	Andromeda*	Psoralea*
Naias*	Monotropa*	Terminalia*
Taxodium ‡	Bumelia	Tephrosia*
Ostrya*	Liriodendron	Cercis*
Planera*	Eugenia*	Gleditschia*
Lepidium*	Dodonæa*	Cassia*
Platanus*	Ceanothus	Mimosa*
Pisonia*	Ptelea	

The South United States Flora includes about 836 genera (Dicots. 663; Monoc. 173), referred to 161 Nat. Orders (Dicots. 134; Monoc. 27). The total number of indigenous species is near 2530 (Dicots. 1900; Monoc. 630). Of these about 22 per cent. are ligneous.

‡ *Taxodium dubium*, Prof. Goeppert says probably occurs in the fossil state in Kamtschatka, (*infra, p.* 181.)

The largest Orders are in the

	S. States. Gen.	S. States. Species.	N. States. Gen.	N. States. Species.
† Compositæ	81	354	83	273
† Cyperaceæ	21	216	16	213
† Gramineæ	52	176	65	162
† Leguminosæ	49	145	36	91
Labiatæ	23	64	33	49
Scrophulariaceæ	23	61	26	54
Ericaceæ*	19	55	27	62
Rosaceæ	17	54	18	71
Orchidaceæ	19	51	24	111
Ranunculaceæ	17	50	21	49

In the Northern States Ranunculaceæ is the ninth order, Labiatæ the tenth.

The Orders marked † are included in the nine largest of the Swiss Tertiary. It has been observed above that out of the nine largest Japanese Orders, six were thus marked (*ante*, p. 178).

The groups which especially characterize United States forest vegetation, are *Taxodium*, Magnolias, Hickories, Walnuts, *Planera*, *Negundo*, *Liriodendron*, Maples, Oaks, &c. The largest Orders (besides the four marked above) and characteristic Groups of the Swiss Tertiary in the States are—

	S. States. Gen.	S. States. Species.	N. States. Gen.	N. States. Species.
Amentaceæ	10	41	12	62
Proteaceæ	0	0	0	0
Laurineæ	4	6	4	5
Coniferæ	8	19	8	20
Aceraceæ	2	16	2	6
Palmæ	2	4	0	0
Populus		3		6
Salix		6		19
Myrica‡		2		2
Quercus		20		18
Ulmus		4		4
Planera		1		1
Ficus		3		0
Platanus		1		1
Liquidambar		1		1
Rhamnaceæ	8	10	4	6
Leguminosæ	49	145	36	91
Juglandeæ	2	11	2	9

* Includes Vacciniceæ, Monotropeæ, Pyroleæ.

‡ Myricaceæ in Southern States, 3 gen. 4 species.
" Northern " 2 " 3 "

In the Northern States, according to Dr. Gray,* 218 (10·3 per cent.) are shrubs or woody vines, and 130 (6·2 per cent.) trees.

Mr. Lesquereux mentions the following genera as having been identified in North American Tertiary beds.† Probably Miocene plants, from Vancouver and Bellingham Bay, Washington Territory—

Populus	Ficus?	Diospyros	Salisburia
Salix	Cinnamomum	Acer	Chamærops
Quercus	Persoonia	Platanus?	Sequoia.
Planera			

From Pleiocene beds, Tennessee:—

Laurus, *Prunus*, *Quercus*, *Fagus*, identified with recent species of South Florida, and the Gulf of Mexico: and from Pleistocene beds, Kentucky,—*Quercus*, *Castanea*, *Ulmus*, *Planera*, *Prinos*, *Ceanothus*, *Carya*, *Gleditschia*, *Acorus*, all recent forms now found along the Atlantic coast. In the Vancouver beds Proteaceae are dominant.

Prof. Goeppert mentions the following genera as having been found in the Miocene beds in Aläska and the neighbouring Aleutian Islands,‡ *Caulinia*, *Salix*, *Alnus*, *Taxodium dubium*, (probably also found in Kamtschatka), *Sequoia*, *Juglans ?*, *Populus*.

Relation of the Japanese Flora, also that of the Old World generally, to the Flora of the Eastern States of North America.—The general relations of the Flora of Japan and also those of the Flora of the Northern States have been most ably discussed by Prof. Asa Gray. The former in a paper in the Memoirs of the American Academy,§ the latter in Silliman's Journal.‖ For much interesting detail I must refer to these valuable essays, from the last-named of which I borrow the following facts referring to the Flora of the Northern States, not having, myself, tabulated the recent European and American Floras with a view to bring out their analogies and differences farther than is noticed under previous heads. According to Dr. Gray there are 321 species (Dicots. 180, Monocots. 141) common to the Northern States and Europe out of a total phanerogamous Flora in the former of 2091 species (Dicots. 1490, Monocots. 601). If closely representative be added to identical species, this number would be raised to about 435, or over one-fifth of the whole, while, on the other hand, but about 114 species (of 92 genera) are represented by identical or strictly analogous species on the Oregon and Californian side. 326 Northern United States genera belong to Europe, but of these 284 are diffused over the greater part of the Northern Hemisphere.

Compared with Europe the Northern States are rich in ordinal

* Sill. Journ., Ser. ii., xxiii. 374.
† Sill. Journ. 1859, i. 359.
‡ Bull. Ac. Imp. St. Petersburg, iii. 448.
§ N. Ser. vi. 377.
‖ Ser. ii. xxii. Sept. 1856.

types, possessing 26 Nat. Orders not in Europe, while Europe has only 7 to 10 orders absent from the States. Nevertheless the European families give character to the vegetation. Dr. Gray says farther, that of these 26 orders 20 have their principal development in tropical regions, while 3 of the remaining orders have tropical or sub-tropical representatives.* This circumstance is noteworthy when we consider that the mean annual temperature of the Northern States is lower than that of Western Europe.

I find about 300 genera (Dicots. 242, Monocots. 60) are common to the Southern States and Japan. To this number the Northern States add 33 (Dicots. 24, Monocots. 9), making a total of 330—340 in Eastern North America. The Japanese orders not represented in the Eastern States are as follow, with the number of their genera and species.

Lardizabaleae	2	gen.	5	species.	Alangiaceae	1	gen.	2	species.
Bixaceae	1	,,	1	,,	Dipsaceae	1	,,	1	,,
Pittosporaceae	1	,,	1	,,	Jasmineae	1	,,	5?	,,
Sterculiaceae	1	,,	1	,,	Myoporineae	1	,,	1	,,
Elæocarpeae	1	,,	2	,,	Gesneraceae	1	,,	1	,,
Aurantiaceae	1?	,,	2?	,,	Helwingiaceae	1	,,	1	,,
Coriarieae	1	,,	1	,,	Proteaceae	1	,,	1	,,
Meliosmeae	1	,,	2	,,	Chloranthaceae	3	,,	4	,,
Meliaceae	1	,,	3?	,,	Piperaceae	1	,,	1	,,
Tamaricineae	1	,,	1	,,	Antidesmeae	1	,,	1	,,
Begoniaceae	1	,,	1	,,	Ophiopogoneae	2	,,	2	,,

About 320 Japanese genera (Dicots. 274, Monocots. 50) are absent from the States; of these the most remarkable and characteristic of the Japan Flora seem to belong to Berberideae and Lardizabaleae, Ternstrœmiaceae, Zanthoxylaceae and allies, Rosaceae, Lauraceae, and Coniferae.

A marked difference has been indicated (*supra*) between the Floras of the East and West Coasts of North America in the relatively small number of species common to these Floras as compared with the number common to the Eastern States and Europe. Dr. Gray, in his memoir on the Japanese Flora,† points out that there are fewer Japanese species represented in West North America than in Europe, while there are more in East North America than in either. If strictly identical species alone be regarded, however, the European proportion is favoured. In his table, including 580 Japanese entries,

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* The same botanist points out the almost complete deficiency of forms peculiar to West Europe in Temperate America; a deficiency remarkably contrasting with the large number of East American forms repeated or represented in Eastern Asia. The only genera divided between East North America and Europe which Dr. A. Gray can find are *Ostrya*, *Narthecium*, *Psamma*, *Cakile*, *Scolopendrium ?*

† l. c. p. 437.

there are, having corresponding representative species, in

Europe,	over 48 per cent.,	identical species	27 per cent.
West North America, about	37 „	„	20 „
East „ „ „	61 „	„	23 „

Moreover of 353 extra-European genera in the Northern States 130 are common to East Temperate Asia, while but 87 occur in West North America. About 90 genera are represented in North America and Japan which are absent from Europe, and of these 65 do not occur in extra-tropical Western North America,* where farther, no order is represented wanting in the Northern States of East America, excepting Garryaceae and Hydroleaceae, and these both occur in the Southern States.

The Atlantic Islands Flora.†—The American element in the Flora of the Atlantic Islands is very subordinate, while Mediterranean, with a proportion of peculiar or Macaronesian types, greatly predominate, the former very remarkably. The African element is, as is well known, singularly deficient. Prof. Heer points out as a trace of the connection which he conceives to have existed formerly between these Islands and the New World, the American genera *Clethra*, *Bystropogon*, *Cedronella* and *Oreodaphne*, species of which occur in the Madeiras and Canaries. With regard to these, however, it may be observed that *Clethra* is not exclusively a New World type. One species is Japanese and one or two grow in the Philippines and Borneo. The present focus of the genus appears to be in South America. But one species, *C. arborea*, grows in the Atlantic Islands, in some of which it is very abundant. As to *Bystropogon*, Messrs. Webb and Berthelot limit the genus to Macaronesian species, excluding the section *Minthostachys*, under which Mr. Bentham groups the American forms in the Prodromus. At best, this genus, as Mr. Bentham informs me, scarcely differs in technical characters from *Mentha*, though the habit of the island species is very different. Of *Cedronella*, another Labiate plant, but one species grows in the Islands, *C. canariensis*. Hasskarl describes a species from Japan. *Oreodaphne* prevails in the West Indian Islands and South America; it is unrepresented in the States; species occur, also, in South Africa, Madagascar and Mauritius. Recently Mr. Mann, botanical collector to the Royal Gardens at Kew, has sent to Sir W. J. Hooker two or three species of Laurel from the mainland of West Tropical Africa, which, although not yet determined, form a connecting link, relieving the isolation of the Atlantic species, both of *Oreodaphne* and *Persea*. I have examined the Flora of Webb and Berthelot and can find scarcely any evidence to add to that noted by Prof. Heer. The genus *Messerschmidtia*, limited by these authors to Canarian and

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* Gray, l. c. 441.

† For some excellent observations upon the general relations of the Madeira and Canary Flora, see a paper by Sir C. J. F. Bunbury, Linn. Proc. Bot. i. 1.

Tropical American forms is, according to De Candolle, but a section of *Tournefortia*, including in one subsection the Canarian plant, while other subsections include two African and an Indian species.

Of the genus *Persea*, of which one species (*P. indica*) is a dominant tree in the Canaries, Madeira, and Azores, two species grow in the Southern States, while others are found in New Grenada, Peru, and as far South as Chili. *Commelyna agraria*, *Euphorbia tenella*, and *Bidens pilosa* cannot be accepted as indigenous to the Atlantic Islands.

We may gather from the above paragraphs that a close and very peculiar analogy subsists between the Flora of Tertiary Central Europe and the recent Floras of the American States and of the Japanese region; an analogy much closer and more intimate than is to be traced between the Tertiary and recent Floras of Europe. We find the Tertiary element of the Old World to be intensified towards its extreme eastern margin, if not in numerical preponderance of genera, yet in features which especially gave a character to the Fossil Flora. I have taken occasion to show, in the above notices, that this accession of the Tertiary element is rather gradual and not abruptly assumed in the Japan islands only. Although it there attains a maximum, we may trace it from the Mediterranean, Levant, Caucasus, and Persia, in *Chamærops*, *Platanus*, *Liquidambar*, *Pterocarya*, *Juglans*, *&c.*, then along the Himalaya and through China; the Eastern Himalaya and China, indeed, forming with Japan one great botanical region. The table given at p. 175 shows that about 120 Tertiary genera are represented in Europe and Asia, including Japan, taken together, while, as stated already, but 88 are represented in the Southern American States. We learn also that during the Tertiary epoch, counterparts of Central European Miocene genera certainly grew in North-west America, amongst them, one marked genus now limited to the Japanese region (*Salisburia*). We note, further, that the present Atlantic Islands Flora affords no substantial evidence of a former direct communication with the main land of the New World, though the circumstance of an extraordinary predominance in it of the Mediterranean element tends to countenance the probability of the hypothesis of E. Forbes and others that a connection formerly existed between these Islands and some part of Western Europe.

The consideration of these facts leads me to the opinion that botanical evidence does not favour the hypothesis of an Atlantis. On the other hand, it strongly favours the view that at some period of the Tertiary epoch, North-eastern Asia was united to North-western America, perhaps by the line where the Aleutian chain of islands now extends, since there is sufficient ground to believe that the temperature in that latitude was high enough to allow the migration of types, which at the present period, are characteristic of lower latitudes.* Professor Heer himself says,† "Comme les types japonnais occupent une place importante dans notre flore tertiare, il est permis de supposer qu'à l'époque tertiare le Japon était joint au continent Américain."—The general character of the Tertiary Flora appears to me to be almost as conspicuous,—in some respects more conspicuous—in Japan than in the American States. We have shown that of the nine largest orders numerically of the Tertiary, six are included in the nine largest of Japan, and but four in the nine largest of the Southern States; while, farther, the remaining three of the nine largest Tertiary orders are much more developed in Japan than in the Southern States. They are

Lauraceæ,	in Japan 11 gen.	25 species.	In So. States	4 gen.	6 species.
Aceraceæ	„ 2 „	15 „	„	2 „	6 „
Proteaceæ	„ 1 „	1 „	„	0 „	0 „

The Japanese flora is the only one which I have found presenting such close correspondence in this respect with that of the Tertiary period. In Australia 5, India 4, Europe 3, and in the New World 4,‡ of the largest orders of each respectively, are included in the corresponding nine of the Tertiary. Nor must the large percentage of ligneous species in the Japanese (40 per cent.) as compared with the Southern United States flora (22 per cent.) be overlooked.

That the Tertiary element should be more decidedly expressed in a comparison of the genera in Eastern Asia than in the American States, is by no means required unless we can show that its development and persistence have been equally favoured by climatal and other conditions in both regions since the Tertiary period. It might have been fairly expected, moreover, that on Professor Heer's hypothesis, the North American element in the Flora of the Atlantic islands should have been more decided, favourable as would appear to be their climate to the growth of the plants of the Southern States; but we do not find in these Islands more of this element than they might have derived from Europe during a connection with it in, or subsequent to, the Tertiary period. With regard to the few American species mentioned by Dr. A. Gray§ as occurring in Western Europe, and opposed to the view that the inter-

* Prof. Goeppert says, (Bull. Ac. Imp. St. Petersburg, iii. 460, 1861), "Wenn wir nun die ausgedehnte Verbreitung der schon jetzt im Polarkreise auf den Aleuten, in Grönland, Island, Kamtschatka nachgewiesenen Flora der Miocenen formation betrachten, die sich vielleicht auch noch über das nördlichste Amerika auf Nord-Siberien und die Inseln des Eismeeres erstreckt * * * * so dürfen wir wohl annehmen, dass in jenen jetzt so unwirthlichen Gegenden zur zeit der Miocen periode ein milderes Klima, etwa eine mittlere Temperatur von mindestens 8-9° dort herrschte, um eine Vegetation zu fördern, wir sie gegenwärtig in mittleren und südlicheren Nordamerika und Europa angetroffen wird."

† Recherches, &c., p. 216.

‡ The principal orders of these four areas I have taken from Dr. Hooker's "Introductory Essay to the Flora of Tasmania," p. xxxv.

§ l. c. 442.

change of European and New World forms had taken place *via* Asia, viz. *Eriocaulon septangulare*, *Betula alba*, *Spartina* and *Subularia*,—to which I may add *Naias flexilis* (a common North American plant, but extremely rare in Europe, which I discovered in Connemara some twelve years ago), it may be observed that all of these, save the common birch, are aquatic or littoral salt-marsh plants. When we recall the observation of Mr. Darwin relative to the number of seeds often contained in the mud of ponds, &c., the wandering habits of wading birds, and the chances favouring the dispersal of aquatic species,* no argument can be based upon them of any weight compared with the preponderance of evidence in favour of an Asiatic migration afforded by the relatively large number of existing types peculiar to E. America and the eastern margin of the Old World, as compared with the few peculiar to America and Europe. Why *Betula alba* should be included among the above species I am at a loss to understand. It grows across Europe, in the Altai and Amoorland. *Subularia* also extends eastward to the Altai, according to Ledebour.

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1. *Samyda.* One species of Unger's occurs in the Swiss beds. I have not seen any true *Samyda* with the lateral veins nearly so numerous and approximate: it may be a *Casearia*, but this is extremely doubtful.

2. *Banisteria* and *Hiræa* rest upon very imperfect materials. They cannot be satisfactorily determined from Professor Heer's figures. The same is also true of *Coriaria*.

3. *Ptelea*—resting upon single foliolæ or indeed single leaves, cannot be satisfactorily accepted in the absence of the dry and easily preserved fruits. The leaflet figured as *P. Weberi* certainly much resembles a lateral one of *P. trifoliata*. The genus is placed in *Zanthoxyleæ* by Dr. Hooker.

4. *Sterculia tenuinervis*, Heer, stated to resemble *S. Labrusca*, Ung., and compared as to form and direction of the leaf-lobes with *S.* (*Firmiana*) *platanifolia*, L. resembles the trilobate form of this species very fairly. *S. platanifolia*, however, is not an American, but a Chinese and Japanese plant. *S. modesta* is very doubtful.

5. *Apeibopsis.* With fruits 5 to 16-valved, and leaves described as palminerved; but none have been certainly identified with the fruits. Notwithstanding Professor Heer's observations, I consider the affinity of these remarkable fruits yet unsettled. Probably under this generic term two or more genera may be included. Tab. cxviii., 23, resembles *Hura*; fig. 27 an *Aristolochia*.

6. *Negundo*, rests upon an uncertain identification

7. *Pittosporum.*—A determination of Ettingshausen's; very dubious, as Prof. Heer observes, as to the Swiss specimen. Judging

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* Origin of Species, p. 386. *Vide*, also De Candolle, Geog. Bot. Rais. p. 519.

from Heer's figures it differs from *Pittosporum* in the absence of the persistent base of the style, and perhaps also, of the lines of septa on the dehisced valves.

8. *Leguminosæ.*—Many of the genera must be received with much caution. I am not prepared to make any definite observation upon them just now.

9. *Eugenia.*—Excepting fig. 17, Tab. cviii. (a fragment) Prof. Heer's figures are unlike the genus, in the absence of a more decided and continuous intramarginal vein. The two species described are Unger's.

10. *Melastomites.*—Surely not Melastomaceous, failing the prominent lateral nerves which almost always reach nearly to the apex or rejoin the midrib.

11. *Terminalia* and *Combretum.*—Both of these seem to me extremely dubious. *C. europæum* is Weber's; *C. purpureum* of Vahl (*Poivrea coccinea*) with which he compares his plant, differs both in form of leaf and venation. Often the base is not at all narrowed, indeed almost subcordate, and the apex acute or subapiculate. In the absence of the easily preserved winged fruits of many of the Order, Combretaceæ must be accepted with doubt.

12. *Weinmannia.*—One species resting on leaflets only and a 5-partite flower (?) must remain dubious.

13. *Ceanothus.*—A determination of Weber's. Prof. Heer regards it as doubtful. I have compared his figure of a leaf-fragment with *C. azureus*, and I agree that it is very doubtful indeed.

14. *Bumelia.*—I have examined the species of the Hookerian Herbarium, and doubt if the fossil plant have anything to do with the genus.

15. *Macreightia.*—Thwaites finds an Ebenacea in Ceylon, with a 3-partite calyx, which he provisionally refers to *Macreightia*. *M. obovata* figured in Martius (Fl. brasil. Eben. Tab. ii.) has a calyx totally different from Heer's plant, the lobes shorter or scarcely equalling the tube. In other South American species which I have seen, the calyx is distinctly gamosepalous; least so in a species in which the calyx is very much smaller than that figured by Prof. Heer, whose plant seems indeed as likely to be a *Maba* as a *Macreightia.*

16. *Styrax.* One species.—I have not seen *S. Benzoin* (with which Prof. Heer compares a leaf which he refers to the same species as that affording his fruit) in fruit, but certainly the leaves of Malacca specimens differ considerably from Heer's fig. 11 c. Tab. ciii. in that they are not narrowed to the base, but are generally more or less ovate or ovate-lanceolate. The transverse veins connecting the secondary ones are remarkable in *S. Benzoin;* these are not represented in the fossil leaf. The fruit almost as nearly resembles that of some species of *Tilia* as of *Styrax.*

17. *Clethra.*—Founded, with doubt, on a portion of a leaf. I see nothing in *C. alnifolia* corresponding to the markings figured on

the fossil fragment. In some species the upper surface of the leaves is beset with tufted or stellate hairs.

18. *Apocynaceæ* and *Asclepiadeæ*.—Evidence does not appear sufficient to show that both orders have been met with.

19. *Liquidambar*.—Prof. Heer's figs. *b*, *c*, *d*, Tab. lxxxvii answer very well to *Liquidambar* fruits; figs. 2 *a* and *b*, of Tab. li. however may be something quite different, the carpels appearing to be almost free and superior. The figure which Prof. Heer copies, with proper acknowledgment, from Schnitzlein is worse than useless. Schnitzlein's figure seems to me to be copied or adapted from Hayne (Gewächse, xi. 25). Both botanists figure the ovules, moreover, as attached to the dorsal suture. The fruit is fairly represented by Gaertner (*De Fruct.* xc. e.) and Lamarck (copied from the former), Tab. 783, 2. The fruits of four species are in the Kew Herbarium.

20. *Pisonia*.—This appears extremely doubtful. The slender object, fig. 48, Tab. cliii. borrowed from Ettingshausen, can scarcely be a young fruit of *Pisonia*, tapered to so fine a point, without trace of the upper part of the perianth.

21. *Sassafras Æsculapii*.—A doubtful member of the genus. Apart from its entire outline, the leaf (Tab. xc. 14) seems too acute.

22. *Persea Braunii*, if a Laurel, I think as likely to find its analogue in Asia as in America. *P. Carolinensis*, has proportionally narrower leaves, and the secondary veins are hardly prominent enough. *P. Gratissima* is, in some respects, more like *P. Braunii*, but its petioles are longer. *P. costata*, Nees. is perhaps as near to it as either. I do not find the same tendency to obovate outline in *P. indica*.

23. *Elæagneæ* rest upon very insufficient data; only leaf remains.

24. *Euphorbia* is extremely doubtful, also *Euphorbiophyllum*, a genus of Ettingshausen's.

25. *Plataneae*.—Prof. Heer, speaking of the Tertiary forms of *Platanus*, (Fl. Tert. ii. 74) says that if we refer existing forms to the two species of Linnæus, that found in the middle Miocene of Radoboj (Croatia) may be compared to *P. orientalis*, while that of the upper Miocene of Schossnitz (Silesia) and of the Swiss deposits, belongs to the *P. occidentalis* series. Dr. Hooker called my attention to an observation of Miller in his "Gardener's Dictionary" (1731), which it may be worth while copying. Of *P. orientalis aceris folio*, he says, "* * although by some supposed to be a distinct species from either of the former (*P. orientalis* and *P. occidentalis*) yet is no more but a seminal variety of the first, for I have had many plants which came up from the seeds of the first sort, which ripened in the Physick Garden (at Chelsea), which do most of them degenerate to this third sort, which, in the manner of its leaves, seems to be different from either, and might reasonably be supposed a distinct sort by those who have not traced its original."

26. *Artocarpus*. (*A. oeningensis*.) This seems rather a *Ficus* than an *Artocarpus*. Unger's *Artocarpidium* would seem a very doubtful member of the same order.

27. *Taxodium.*—Prof. Heer's *T. dubium* appears to me as near to *Glyptostrobus* as to *Taxodium*, especially in the reduced squamæform leaves, which *Taxodium* (excepting *T. distichum* var. *imbricaria*, Nutt.) generally wants. The fragment, Tab. xvii. 1 and 4 (Flora Tert.) of *T. Fischeri* is exceedingly like *Glyptostrobus*, as Heer observes. In the Royal Gardens at Kew is a fine tree which I think may be the *Cupressus disticha* β. *nutans;* "foliis remotioribus subsparsis" of Aiton's "Hortus Kewensis." This tree is traditionally reported to be of Japanese origin, though on no positive authority. It differs conspicuously in the leaves, usually one-third to one-half longer than in *T. distichum*, being irregularly disposed along the deciduous branchlets, which are often 6—9 inches in length. The leaves are not at all distichous.*

28. *Libocedrus.*—In the absence of the strobili this genus must be received with doubt.

29. *Butomus.*—Extremely ambiguous, resting on two opposite carpels, each bearing a style. The only Aroid (*Aronites*) is also very doubtful, as Prof. Heer admits.

30. *Chamærops and Sabal.*—Tertiary fan-leaved species are referred to these recent genera, which are characterised thus (Flora Tertiaria, p. 85). *Chamærops.*—"Folia flabelliformia, palmato-multifida, radiis induplicativis; omnibus e rhachide abbreviata, rotunda exeuntibus; petioli aculeati v. dentati." *Sabal.*—"Folia flabelliformia, palmato-multifida, radiis induplicativis rhachis elongata, infra cuspidata, supra cristata." Professor Heer says further, in the genus *Sabal* we have an unarmed petiole, and the rhachis prolonged into the lamina, on the upper side of which it terminates in a crest, wanting in *Chamærops.* In reference to these points, I have examined several species in cultivation at Kew, and feel satisfied that Professor Heer's distinctions are not of generic value.

In *Chamærops excelsa* and *gracilis* the petioles are unarmed. The rhachis on the upper side of the fan is strongly crested in *Ch. Fortunei* and *Ch. gracilis.* In the latter species the crest projects from one half to five-eighths of an inch, perpendicular to the lamina. The petiole of *Ch. Fortunei* is scarcely armed, being serrate along the margins above. I do not find *Chamærops* to have the rhachis much prolonged into the lamina on the underside, while in some species of *Sabal* the prolongation is very marked. But this is the case in Old World palms, which may be as nearly related to the Tertiary plant as *Sabal;* for example, a palm-leaf from the Gambia, West Africa, in the Kew Museum, has the rhachis bearing a small triangular crest above, while below it is prolonged some six inches. In *Hyphaena* I have seen the rhachis in a young plant to be much prolonged both above and below, and destitute of a crest.

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* The *Glyptostrobus* of "*Flora Tertiaria*" appears near to *G. heterophyllus.* This species, however, has the squamæ of its stroboli bearing a triangular dorsal apiculus, patent or slightly recurved, and the sulci of the margin alternate with wart-like elevations. I do not observe these characters in Prof. Heer's figures.

31. I observe that the Rev. M. Lowe in his excellent Manual "Flora of Madeira" (pp. 249, 251), states it as his opinion that the leaves figured by Prof. Heer in his Memoir on the Fossil Plants of S. Jorge (Zurich, 1855), p. 28, t. ii. fig. 1, 2, under the name *Corylus australis*, are impressions of terminal leaflets of *Rubus discolor*: Fig. 3 appears to be a leaflet of *R. grandifolius*, and Heer's "*Ulmus Saberosa, Moench*," t. i. f. 24, he regards as the impression of a lateral leaflet of the same species. Tab. ii. f. 3, *Corylus australis* and f. 28, *Psoralea dentata*, Dec.? Mr. Lowe thinks most probably are also *Rubi*.

XVII.—On the Anatomy of the Short Sun-fish (Orthragoriscus mola). By John Cleland, M.D., Demonstrator of Anatomy, University of Glasgow.

[Read at the Meeting of the British Association at Manchester, September 1861.]

The singular external configuration of the Short Sun-fish naturally leads one to expect that the internal structure will present great deviation fron the ordinary arrangements of parts in fishes; and such an expectation is more than fulfilled on dissection, by the disclosure of peculiarities which extend to every system in the economy.

It is now a number of years since Professor Goodsir read a communication to the Wernerian Society on the anatomy of this curious fish;* and since then he has, at various times, had specimens dissected under his superintendance, preparations of parts preserved, and notes and drawings taken. I had the good fortune, while a demonstrator in his rooms, to make one of these dissections in 1860, and on that occasion had the opportunity of examining particularly the skeleton in the recent condition, the muscles and the viscera. In preparing the following description, drawn principally from that dissection, I have been indebted to Professor Goodsir for placing at my disposal a series of notes on the arrangement of the muscles, taken by Mr. Turner, on a former occasion, as well as a number of drawings.

External Measurements.

The specimen dissected in 1860 measured 38 inches, from the mouth to the tip of the tail. Of this distance, 7 inches belonged to the caudal fin, and 12 were in front of the pectoral; so that the trunk, behind the shoulder girdle, was only 19 inches long;

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* Read in 1840, and published in the Edinburgh New Philosophical Journal, Vol. 30. p. 188.

while, on the other hand, the greatest height, exclusive of fins, was 24 inches. The pointed dorsal and anal fins, which stood out nearly at right angles to the body, measured each 16 inches in length, and, at their broadest parts, near their bases, 8 inches, from before backwards.

Dermal Structures.

The structure of the integument, which was about an inch thick over the trunk, has been specially studied by Mr. Turner, whose description will be found below. It is separated from the muscles, and from the abdominal cavity, by a strong aponeurosis. At the origins of all the fins it becomes soft and loose, so as to allow of their free movement. On the dorsal, anal, and pectoral fins, it is reduced to a thin membrane, very difficult to detach; but on the caudal fin it retains a considerable thickness, and the caudal fin rays must be dissected out from the dense matrix of integument in which they are imbedded, before their course can be displayed.

Besides the little spinous tubercles studded all over the skin, there are several much larger sclerous tegumentary formations. Arming the prominence which projects above the mouth, are one large, and several smaller hard plates, as much as half an inch in thickness; and at the extremity of each caudal fin ray, is a half-moon-shaped plate of the same kind, thick on the deep aspect, and coming to an edge at the free margin. The deep aspects of all these plates exhibit perforations of considerable size for vessels, and an irregular arrangement of minute rounded projections. The superficial aspect of those from the head is divided into little areas, corresponding to the tubercles of the skin; that of the caudal plates presents tubercles, or spines, more irregular and prominent than those on the general surface of the body.

There is exhibited, by a vertical section of one of these plates, a closely set vertical series of large, irregular, and on all sides inter-communicating tubes, whose outlines are visible even to the naked eye, and which are imbedded in a hyaline matrix.—(Pl. V. fig. 3). These tubes are most regularly disposed towards the deep aspects of the caudal plates, and most irregularly toward the free extremities of the same. In the latter situation they are seen frequently expanding into large irregular dilatations, into which several of them open from different directions. The spines upon the surfaces of the caudal plates are composed of the same translucent structure as those projecting from the tubercles on the surface of the general integument, and show in section the same striated appearance. Toward the deep aspects of these spines, the tubes in the neighbourhood tend to converge by free extremities; and isolated portions of the same structure as that of which the tubes are composed, are seen like large cells, or strings of cells, of various size, in the substance of a number of the spines. In water, or in spirit, the tubes stand out with a rounded opaque appearance from the clear matrix. They become clearer on the addition of liquor potassæ; but when a dry section is placed in turpentine or Canada balsam, they are rendered quite transparent; so much so, that it is advisable, before adding turpentine, to steep the specimen in a potash solution of carmine, which dies the tubes, and leaves the matrix uncoloured, save only at the part bounding the deep aspect, where, there being less mineral deposition, and consequently a softer texture, the staining is nearly uniform.

The clearing up of the tubes, on addition of turpentine, brings into view in their interior, a great number of long, and generally somewhat pointed crystals, lying for the most part transversely in them, or nearly so. They are usually broader in the middle than at their extremities, are not always perfectly straight, and are always distinct from one another. Probably they are composed of carbonate of lime. There are also some dark opaque masses, of irregular size and shape, scattered in both matrix ~~and~~ tubes.

That the tubes are to a certain extent hollow, is shown by the great abundance of small bells of air which remain in them on addition of turpentine. While, on the other hand, that they are not altogether hollow is certain, not merely from the small size of the air bells, which remain distinct even when crowded thickly together, are with difficulty expelled, and do not move about; but also, because transverse sections exhibit only some irregular perforations, while the cut ends of the tubes stain uniformly with carmine. The large dilatations, above alluded to, however, are hollow in the centre.

When sections of the plates are calcined, the contents of the tubes are burned entirely away, and only the matrix remains, having suffered just sufficient change to render it less transparent, and capable of readily imbibing the carmine die.

The tubes have a somewhat irregularly nodulated outline, as if composed of large cells placed end to end. Their contents have an obscurely granular appearance, which becomes more distinct towards the deep aspects of the plates, where one can even distinguish in them bodies like small cells. In sections steeped in nitric acid, which removes the mineral matter with effervescence, the granular appearance of the contents of the tubes comes out much more strongly, while the matrix and superficial spines appear structureless.

In turpentine the matrix exhibits, at many places, a number of irregularly matted fine black lines, somewhat resembling those which may be seen in calcifications of fibrous tumours. They are found most abundantly and closely felted beneath the bases of the superficial spines.

When the structure of the dermal plates, now described, is compared with that of the general integument it becomes apparent, I think, that the former structure is derived from the latter, by altered arrangement of its parts, deposition of mineral matter, and increased vascularity. To say that the tubes in the plates are developed from series of communicating cells, is only to hazard a conjecture; but their granular contents, no doubt, correspond to the abundant interstitial substance in the meshes of the integument; while the fibrous element composing these meshes is fully represented in the matrix of the dermal plates. A minute injection of a recent specimen is greatly to be desired to show the arrangement of that great vascularity which is indicated by the large canals for vessels. We might then be able to form a comparison of the relations of the dermal plates to the integument of the sun-fish on the one hand, with those of bone to cartilage on the other.

Anatomy of the Trunk.

The *skeleton* of the sun-fish can only be properly examined in the recent state, on account of the important part played in its formation by large masses of cartilage (Pt. V. fig. 1.) The osseous part consists of a peculiar fibrous modification of bone, for the most part soft and spongy. It is composed of a network of fibrous laminæ, hardened by deposition of mineral matter, and imbedded in cartilage remarkable for the small size of its corpuscles. It has been described by Leydig.*

The osseous vertebræ are 16 in number, 8 abdominal and 8 caudal. I say the osseous vertebræ, because beyond the sixteenth there is, at least in some specimens, a cartilaginous element, of somewhat ambiguous morphological value. The basioccipital bone projects so far behind the other bones of the skull, that it is liable on a cursory glance to be mistaken for the first vertebra, a mistake into which Wellenbergh has fallen.† The neural arch of the first vertebra projects forward and overlaps the basioccipital bone, while those of the third and fourth vertebræ slope almost directly backwards; that of the second is therefore prolonged into two processes, one passing horizontally forwards over the first, and the other horizontally backwards, over the third. The first dorsal interspinous bone lies in front of the fifth vertebra. The neural arches of the succeeding vertebræ, as far as the fourteenth, become more and more vertical, and have intercalated between them, so as to fill up the intervening spaces, the expanded extremities of huge interspinous bones. The neural arch of the fifteenth vertebra is prolonged into a cylindrical process, which inclines forward, and abuts against the corresponding process of the vertebra in front. The sixteenth vertebra is a simple bone which gives off no processes whatever.

The hæmal arches of the caudal vertebræ are all prolonged into

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* Leydig, Lehrbuch d. Histologie, § 151.

† Wellenbergh, Observationes Anatomicae de Orthragorisco mola. Lugd. Bat. 1840.

long cylindrical processes, striking nearly vertically downwards. The first is in contact, at its extremity, with the second.

There are no traces of any transverse processes, nor are there any ribs. Along the middle lateral line a strong fibrous septum runs, attached, on the one hand, to the vertebral column, on the other, to the subcutaneous aponeurosis.

The dorsal interspinous bones are fourteen in number, and, except the first, are flattened out, and in mutual contact at their vertebral extremities, cylindrical and free in the distal half of their extent. Their distal extremities are inserted into a large bolster-like mass of cartilage, deeply grooved on its sides for the tendons of the fin muscles. The first of the series is closely articulated to the second, is pointed at both extremities, and projects a process forwards which gives attachment to the tendon of a muscle coming from the occiput.

The interspinous bones of the anal fin, eleven in number, are most of them shaped similarly to those of the dorsal fin, but are much longer, and not prolonged so much between the vertebral processes. Their distal extremities, which are inserted into a large mass of cartilage, similar to those of the dorsal fin, are twice as far removed as they from the vertebral column. The first of the series is a huge shafted bone, connected at its proximal end with the hæmal spines of the first and second caudal vertebræ, and at its distal end bifurcated; evidently, therefore, to be looked on as equivalent to two interspinous bones run together. The tenth and eleventh are very small, and abut against the ninth.

There are seventeen rays in the dorsal fin, sixteen in the anal. The two fins are as like one another as possible. One description will suffice for both. Each ray is composed of a pair of slender bones, placed one on each side of a block of cartilage. The most anterior of these blocks is short and very thick, the succeeding four or five get rapidly longer and are not so stout, and the remaining ones dwindle quickly both in length and thickness. They are closely compacted together in one firm mass. The fin rays that enter into the formation of the anterior edge of the fin, end in stout points, so as to make that edge unyielding; but the bony elements of the remaining rays are prolonged beyond the cartilaginous foundations, and split up into fibres which bend backwards and spread in a thin fold of integument which forms the yielding posterior edge of the fin.

The structure of the tail is more remarkable still. It has eleven fin rays, and as many corresponding interspinous bones, viz., five superior and six inferior. The proximal extremities of the interspinous bones approach one another, and abut on the posterior edges of the ascending and descending processes of the fifteenth vertebra: their distal extremities diverge, and, at the two ends of the series, are in continuation with those of the dorsal and anal fins; while, in the middle of the series, they are in a line with the tip of the sixteenth vertebra, which itself looks like an interspinous bone. Each interspinous bone is connected distally with a little mass of cartilage marked by a groove for a tendon; and these masses are joined together by a thin cartilaginous thread: the uppermost and lowermost are also joined, in the same way, to the great cartilages supporting the dorsal and anal fins; and the chain is completed by a similar little mass corresponding to the tip of the last vertebra, joined to the masses above and below it, and differing from the others only in not being grooved for any tendon. Each caudal ray consists of a broad conical cartilage in contact with the cartilage terminating the corresponding interspinous bone, on each side of which springs a slender osseous slip, which comes in contact with its neighbour of the opposite side, and pursues its way through the dense integument, to terminate opposite one of those hard plates whose structure has been already described. As the dorsal, caudal, and anal fins are continuous, this mode of termination of the rays of the latter affords the only definite line of distinction between them and those of the former. Either from neglecting this circumstance, or from a variation of the number in different specimens, Wellenbergh has allotted thirteen rays to the tail.

Lying in the same range as the cartilaginous bases of the fin rays, and differing from them only in being broader at the point, and having no osseous ray, there is, in the specimen from which I describe, a cartilage corresponding to the end of the vertebral column (Pt. V. fig. 1, *b*.); and notwithstanding that it has no osseous ray, there is a small hard plate opposite it in the margin of the tail. This cartilage and the smaller one which supports it are not placed quite opposite the extremity of the sixteenth vertebra, but are displaced slightly upwards, resembling, in this respect, the upwardly inclined last vertebra of other osseous fishes. The claims of these two cartilages to be grouped with the chain of vertebræ, appear to me to be indisputable. In that case the smaller cartilage must be looked on as an intervertebral disc.

However we may theorize on the matter, the facts are these: that if we pass the eye backwards along the vertebral column, we find the two cartilages in question continuous with the series of bodies of vertebræ; while if we pass the eye from the dorsal, round by the caudal, to the anal fin, we find that the sixteenth vertebra lies in the series of interspinous bones, that the succeeding cartilage forms part of the continuous cartilage on which the interspinous bones abut, and that the terminal cartilage lies in the series of cartilaginous bases of fin rays. The importance of these peculiar arrangements, as tending to throw light upon the structure of the fan-shaped bone which terminates the spinal column of most fishes, is noted by Professor Goodsir, in his paper already referred to. But perhaps the most curious and important point, as exhibiting how great is the amount of variation possible among individuals of one species, is the inconstancy of the cartilages terminating the spinal column. They were present in the specimen described by Mr. Goodsir, who mentions them as seventeenth and eighteenth vertebræ; and, in that instance, they appear to have been both in a direct line with the vertebral column. On the other hand, in another specimen, of the tail of which Mr. Goodsir has preserved a cast, the eleven caudal fin rays are placed exactly opposite the corresponding interspinous bones, but in their series there is no cartilage corresponding to the end of the vertebral column. In an additional specimen, from which a dried skeleton has been, this winter, prepared for Mr. Goodsir, by his former pupil, Mr. Ramsay Traquair, who has taken particular care with reference to this point, the caudal rays are of the same number as the interspinous bones, but are not placed opposite to their extremities: that which corresponds to the interspinous bone immediately below the sixteenth vertebra is placed opposite the extremity of the vertebral column, and its two osseous slips separate, one to join the ray above, the other to join the ray below; while the extremities of these rays converge to a common dermal plate, which obviously consists of at least two fused together. Lastly, Wellenbergh's sketch, taken from a dried skeleton, exhibits two fin rays placed closely together opposite the end of the vertebral column, their extremities converging to two dermal plates closely united.

Muscles of the Trunk.—(Pt. VI. fig. 2). The peculiarity of the development of the muscles of the trunk, consists in the almost total disappearance of all except those of the fins, which are of enormous size. This was first pointed out by Professor Goodsir. Meckel, indeed, describes the muscles of the sun-fish,* but his description is not at all accurate.

The muscular masses which move the dorsal and anal fins extend upwards and downwards from the middle lateral line. They are both very much stronger at the fore part than behind. That belonging to the dorsal fin is prolonged forwards along the whole length of the trunk to the back of the skull; while that belonging to the anal fin presents an abrupt anterior margin at the back of the abdominal cavity. As the middle lateral line is only half as far removed from the dorsal as from the anal fin, and as the two fins are of equal size, the greater vertical space available for muscles of the latter is compensated for by the greater antero-posterior space occupied by those of the former. Behind and in contact with those two sets of muscles, is a fan-shaped arrangement of distinct muscles, ending in tendons, one going to each caudal ray. Here, also, we find that, on account of the position of the middle lateral line, the muscles to the superior caudal rays, take origin differently from those of the inferior rays: for, while the latter arise only from the corresponding interspinous bones, and that part of the penultimate

* Meckel, Comparative Anatomy. French Edition. Vol. v, p. 184.

osseous vertebra, against which each abuts, as well as from the superficial aponeurosis; the former arise, in addition, for some distance along the fibrous septum of the middle lateral line, and overlap the posterior muscles of the dorsal fin.

The muscles of the dorsal and anal fins demand a more detailed description. The individual muscles of which they are composed are not entirely distinct; they run into one another to a certain extent; but they are arranged on a definite plan; and this plan is the same in both. The typical arrangement is this: each muscle consists of two triangular laminæ, a superficial and a deep, connected anteriorly by a tendon directed obliquely backwards, and incloses between its layers the succeeding muscle, while it is itself similarly surrounded by the muscle in front. Its posterior fibres are longest and most vertical, and form the base of the triangle; the most anterior fibres are short and oblique, forming the apex. (Pt. VI. fig. 3), The superficial lamina arises principally from the fibrous septum of the lateral line; but, at its posterior part, where it extends beyond the muscle in front, it arises also from the superficial aponeurosis. The deep lamina arises from the interspinous bones and intervening processes of vertebræ.

The tendons after quitting the muscles become more vertical, and lie in very loose watery areolar tissue till they reach the cartilaginous pillows at the extremities of the interspinous ranges. They are then received into deep perpendicular grooves which are completed into tubes by the tough integumentary tissue. Mr. Turner, in his notes, describes an arrangement by which the tendons are lubricated in these tubes: viz. a very loose and watery areolar tissue confined *in situ* by a thin but dense layer of membrane which lines the tube, extends beyond it, and is reflected thence to the surface of the tendon, like the theca of a tendon in the human subject, for example. Of course the most anterior muscles, especially of the dorsal fin, deviate a good deal from what is here given as the characteristic arrangement, but generally there is the same pennate disposition of fibres, and the same sheathing of one muscle within another.

To the joints and movements of the dorsal and anal fins Mr. Goodsir particularly directs my attention. He points out that, while in fishes generally there is a distinct joint for each interspinous bone and fin ray, and each of the latter moves independently; in the sun-fish the cartilaginous bases of the dorsal and anal fin rays respectively are compacted together to form a single body, transversely convex, which moves in one mass in a corresponding concavity of the cartilaginous pillow, the surfaces being lubricated by watery connective tissue, such as has already been referred to.

Instead of being compound organs whose motions are the result of the harmonious movements of the constituent simple organs, the dorsal and anal fins of the sun-fish are each a single organ, moving on a single joint. As regards the method of their movements:—the sun-fish being destitute of a great lateral muscle by which to wield its vertebral column as an instrument of progression, is, apart from the undulatory movements of its short tail, which probably acts principally as a rudder, entirely dependent on its dorsal and anal fins. But a mere lateral movement of these, caused by the contraction of a whole muscular mass first on one side and then on the other, would not produce progression; and indeed (as it appears to me) the integument is too unpliable to admit of such contraction. The movement is doubtless a feathering one, a combination of flexion and rotation; and, that which determines the movements so as to produce progression is the greater strength of the muscular masses anteriorly. It may be conceived thus: let the most posterior muscles of the dorsal fin on one side be contracted, and at the same time the anterior muscles of the opposite side: the former will fix the hinder angle of the fin to their own side of the joint; while the latter, being much stronger, will not only drag the anterior angle of the fin to the other side, but will also flex it, so that the fin will strike the water backwards. Let us now suppose that the muscular contraction passes forwards in a wave on one side, and at the same time backwards on the other, and so round and round: the fin will administer a series of strokes backwards, alternately on one side and the other. If the anal fin be moved in the same manner so as always to be vertical to the dorsal, the action will be a very regular one. When we understand that the fins are thus moved by a continuous wave of contraction travelling along their muscles, we are also enabled to see the advantage of the individual muscles being expanded and sheathed each one within that in front: for, by this arrangement, the fibres contracted at any one moment are scattered over as great a space as possible; the muscular mass will therefore undergo but little change in form as the wave passes along it, and will so accommodate itself to the unyielding limits of the space in which it is contained.

There is an additional small muscle in connexion with the dorsal fin, so small that its action must be very slight. (Pt. V. fig. 1, *e*.) It is so closely in contact, in the middle line, with its fellow of the opposite side as to be in appearance one with it, and stretches from the tip of the supraoccipital to the first dorsal interspinous bone. Mr. Turner pointed it out to me: he had described it in his notes. It consists of a small muscular belly, prolonged back into a long tendon, like the plantaris in man, and exists with the same attachments in other fishes, only in them it is muscular throughout.

There are only two small vestiges of the abdominal muscles, so small that they have been hitherto undetected. One of them, (Pt. VI. fig. 2, *e*) arises on the lower half of the shoulder-girdle from the "ulna:" its fibres were, in the specimen now described, less than two inches long; and the majority terminated abruptly on the membrane over the abdominal cavity; only a very few of the superior ones being continued into meagre tendons which passed up to the "clavicle." The other abdominal muscle (Pt. VI. fig. 2, *d*), arises tendinously from the tip of the "clavicle:" its muscular fibres are very sparse, about three or four inches long, and are directed downwards and backwards, and prolonged into scattered tendinous fibres which are lost on the subcutaneous aponeurosis at the lower and back part of the abdominal cavity.

Besides these two insignificant muscles which cover only a trifling part of its extent, there is nothing but a membrane between the abdominal cavity and the integument.

Superficial lymphatic and veins.—A very large lymphatic vessel was observed in the subcutaneous aponeurosis, in the middle lateral line. It extended nearly as far back as the posterior margin of the dorsal fin, and there received a branch from above, and another from behind, and continued its course directly downwards till within a little distance of the anal fin, then passed forwards, always becoming broader, flatter, and weaker in the walls, till, at the posterior margin of the abdominal cavity, it was lost sight of, and probably poured its contents into some of the lymphatic lacunæ surrounding the viscera, to be afterwards described.

The blood from the neighbourhood of the dorsal and anal fins was returned principally by two superficial veins from each, which continued superficial until near the middle lateral line. Each of these veins received its branches from precisely the same district as its neighbour, so that there was much crossing of branches, and even the main trunks of the ascending pair crossed one another in contact, but always without anastomosis, as far as was observed.

Nervous system.—The brain and spinal cord of the sun-fish have been described and figured by Arsaky (*De Piscium cerebro et medulla spinalis. Halle*, 1813, p. 5), whose work I have not as yet seen; but his description is referred to, and a sketch given from his drawing, in Carus' Comparative Anatomy. I have had an opportunity of verifying Arsaky's description as regards the extreme shortness of the spinal cord. The spinal canal is occupied only by a cauda equina, which is made up of nerves which can be traced up all the way to within the cranial cavity, behind which there is no spinal cord.

On the other hand, as if to supply, to some extent, the ganglionic functions of the spinal cord, there is a peculiar arrangement outside the spinal canal, throughout the whole length of the abdominal cavity. As each nerve emerges from the canal, it makes for the abdominal aspect of the fibrous septum of the middle lateral line, and presents a larger or smaller gangliform enlargement, and communicates with the nerves in front and behind it by a branch to each, larger than its branches of distribution. Thus a cord runs from the vagus to the first spinal nerve, from the first to the second, and so on. In like manner also the trigeminal, branchial, and vagus nerves appear to be united.

Anatomy of the Head and Shoulders.

(Pt. VI. fig. 1.) The bones of the skull exhibit nothing very remarkable in their number and relations, but present some peculiarities of proportion. The supraoccipital bone lies a long way in front of the back part of the basioccipital, and, on the other hand, the mouth is projected forwards by the combined intermaxillaries being placed entirely in front of the nasal (Owen's), not overlapping it, but moving rather after the fashion of a parrot's beak.

As regards the base of the skull: the basisphenoid is powerfully developed, presenting considerable vertical thickness; and the vomer is very small, and lies underneath the fore part of the nasal. The bones of the roof of the skull are particularly thick and spongy. The supraoccipital and paroccipitals are small, and each developed into a pointed process directed backwards. The nasal is broad and square, and is inseparably attached to the anterior extremity of the primordial cranium. The great frontals lie quite free on the surface of the latter; and, as they present no serrated sutures, drop easily separate from each other and the rest of the skull, when laid bare. They form the greater part of the roof of the skull, and, projecting as they do, as far back as the exoccipitals, they drive the postfrontals and mastoids still further back. The latter extend back a long way.

As regards the lateral wall: the exoccipitals, look almost directly backwards and are perforated for the vagus; and in front of them is the disputed bone called alisphenoid by Professor Owen, petrous by Professors Goodsir and Huxley, and which, in this instance, is perforated for the branchial nerve.*

In front of this is a large foramen which transmits the trigeminal and optic nerves; and which is bounded above by the orbitosphenoid of Owen—the alisphenoid of Goodsir and Huxley, and in front by the mesially situated bone of the interorbital septum, which, however, only invades the posterior half of the septum, the rest remaining cartilaginous.

The prefrontals are very far separated, being, on each side, in an angle between the great frontal and nasal, and perforated, as usual,

* For my own part, I am quite satisfied that the petrous bone of the cod is represented in the carp by that part of the exoccipital which gives passage to the branchial nerve, while in the sun-fish the same element, giving passage to the same nerve, forms one bone along with the alisphenoid, and is the posterior part of the bone described in the text. This variation in the development of an osseous element is quite parallel to what we know with regard to the intermaxillary bone in the human subject, which is normally developed from the maxillary, but, in cases of cleft palate, is found in front of the vomer. As to the determination of the alisphenoid and orbitosphenoid, I follow Professor Owen's view, being particularly convinced of its accuracy by the arrangement in the skull of *Malapterurus*, where the orbitosphenoid is rendered unquestionable by being completely perforated by the optic nerve.—*See* Edinburgh New Philosophical Journal, October, 1858.

by the olfactory nerves, which almost immediately afterwards pierce the skin to supply the extremely minute nostrils, situated about an inch in front of the eyes.

The osseous texture of the bones behind the trigeminal nerve extends inwards to the cranial cavity. Both on the external and internal aspect they have regular edges which come almost in contact, but in the thickness of the wall there is a greater quantity of persistent cartilage than bone.

On inspecting the interior of the cranium, I find, strange to say, that there are no otoliths at all, and that each ear has only two semicircular canals, which are, however, of great length.* The small vestibulary sacs of opposite sides are united by a slender tube. Thus it appears that, of the three principal organs of special sense in the sun-fish, two are very imperfectly developed, while the remaining one—the eye—is very large, its globe being, in the specimen described, more than an inch and a half in diameter.

Concerning the face bones little need be said. On account of the small size and projecting position of the jaws, the palatals and pterygoids are very short, while the tympanic series (of Owen) and the preoperculum are very elongated. The palatals send backwards long processes on the sides of the basisphenoid, which support them against the pressure of the maxillaries. The epitympanic articulates not only with the mastoid and postfrontal, but also with the alisphenoid.

The bones of the opercular range are three in number. Wellenbergh could find only two, and contradicts Meckel who describes three; but Meckel is right. The operculum is very small; its breadth does not exceed that of the joint on which it moves. The interoperculum is slightly dilated above to lay hold of the operculum, and is prolonged down as a linear process, which is continued into a ligament which, concealed by the preoperculum, is directed toward the angle of the lower jaw. The suboperculum is a mere linear ossification contained in this ligament.

The shoulder-girdle is very large in proportion to the head. There is no suprascapular bone. The elongated scapula articulates immediately with the mastoid. To the lower half of the coracoid is attached the "ulna;" and against the upper border of this abuts a row of small bones which support the pectoral fin. These bones are four in number; they lie in a row, are similarly related to the fin, and are very like each other in general appearance, especially the most anterior two of them. Yet, the first of them is related to the coracoid and "ulna" exactly as is the "radius" in the cod, and, like

* Professor Goodsir has pointed out to me that the ear in *Petromyzon* has likewise only two semicircular canals. In *Bdellostoma* and *Myxine* the membranous vestibule is reduced to a ring. In none of these genera are any otoliths found. *See* Müller "Ueber den eigenth. Bau des Gehörorganes bei den Cyclostomen.' *Berlin*, 1838.

it, allows passage to a large nerve for the depressors of the fin, by the space between it and the "ulna." (I merely make this observation without endeavouring to draw any morphological conclusion.) The "clavicle" is very remarkable. It articulates with the coracoid and scapula, and passes downwards and backwards in continuation of the direction of the latter to a point a little beyond the carpal range. There it terminates in a joint, and sends back a barb-like process which lies outside the two last carpal bones, so as completely to fix that range in the plane from before backwards.

The pectoral fin has twelve rays, which are based on cartilages, on the same principle as the other fins. It is worked by four muscles, two of which, arising one from the external, the other from the internal surface of the "ulna," respectively depress and elevate it; while the other two, arising, one from the lower part of the coracoid, to be inserted along with the tendons of the depressor, the other from the upper part of the coracoid, to be inserted with the tendons of the extensor, more especially serve to rotate it.

Anatomy of the Viscera.

The Abdominal cavity.—There is a general peritoneal cavity. The intestines are coiled closely together, and the coiled mass is surrounded by one tight investment of peritoneum with an appearance of muscular fibres in its substance. The general arrangement of the peritoneum is very simple. A mesenteric fold arises along the whole length of the superior and posterior margins of the abdominal cavity, beginning in front where the œsophagus enters the abdomen, and suspending it and the stomach by their dorsal margin from the superior wall, and the coil of intestines from the posterior. The right and left layer of peritoneum, after investing the stomach, meet beneath it, and pass down to the liver and invest it, and again beneath the liver a fold of peritoneum surrounds the vessels which pass between it and the intestines. The intestinal coil is in addition connected with the right edge of the liver by a special short stout ligament of peritoneum. (Pt. VI. fig. 2, *f.*) A distinct and free funnel of peritoneum surrounds the vessels entering the cardiac cavity from the liver.

The liver occupies about half the bulk of the abdomen. It consists principally of left lobe; but in front it passes under the stomach, and slightly to its right side, so as to form a small right lobe. From the two lobes, two hepatic veins pass directly from the liver into the auricle of the heart: they enter side by side, with about an inch between them, and the left is three or four times the diameter of the right. There is a large gall bladder with a long gall duct which opens into the cavity of the stomach itself. (Pt. V. fig. 2.) The spleen is small and compact; it lies between the liver and stomach.

The stomach and intestines have very strong muscular walls like a turtle's, in compensation for the absence of muscular abdominal walls. On cutting into the investing bag of the intestinal coils, a bloody looking fluid pours out, and the interstices between the coils are seen to be occupied by numerous loculi varying in size and in the consistence of their walls. These were traced upwards on the stomach, and found to pour their contents into an arrangement of very large sinuses on the sides of the œsophagus as it entered the abdomen,—the sinuses of Monro.

In the fluid contained in these loculi, Mr. Turner, after examining it microscopically, notes that he observed "numerous small pale corpuscles about the size of and a little smaller than the white blood corpuscles of man. Each of these corpuscles exhibited finely granular contents. No decided nucleus was visible. The outlines of the corpuscles were irregular."

The stomach extends the greater part of the length of the abdominal cavity. It is merely a slightly dilated part of the alimentary canal. (Pt. V. fig. 2.) At its pyloric extremity there is a slight curvature and a momentary constriction, followed by a thick part of the intestine which soon enters the common sac. The intestine makes about six coils forward and back again, these coils being of various length and rolled on one another. The first coils are on the left side. The upper part of the intestine is most dilated; in the middle of its course it becomes small; and again it is dilated above the rectum. Throughout its whole extent its membrane is finely reticulated; but this appearance is in some parts concealed by the length of the villi. The villi are longest in the part immediately following the stomach, in the middle of the course of the intestine, and in the rectum. The commencement of what I call the rectum is marked, about seven inches from the anus, by a circular fold or valve of the mucous membrane, one and a half lines deep. There are longitudinal rugæ above this; below it the rugæ are transverse. The arteries of the stomach and intestine are derived from a trunk which comes off from the aorta before entering the abdominal cavity. The veins fall into the liver.

The urinary bladder and the single ovary receive their blood by an artery given off from the aorta immediately before leaving the abdomen and which accompanies the ureter. They return it by a vein which runs along the whole length of the abdomen in the fold of peritoneum above the stomach. The ureter enters the bladder near the upper end, on the anterior aspect, by an elongated slit. (Pt. V. fig. 2, *c*.) It arises by two branches, one from each kidney. The kidneys lie in contact behind, but are quite distinct; they are most bulky behind; in front they are each prolonged forwards above a fibrous septum which attaches the scapula and the branchial pouch to the vertebræ. The great vein returning the blood from the tail divides, immediately on reaching the abdomen, into two branches, which enter the kidneys, and ramify within them. It was not satisfactorily ascertained whether or not there was any direct communication between the veins entering the kidneys and those leaving them. The latter pass in front of the fibrous septum above mentioned, and run down, one on each side of the commencement of the œsophagus, being joined, doubtless, by the veins from the head, and fall into the heart side by side.

The heart is very perfectly supplied with valves. Wellenbergh has described those of the bulbus arteriosus, viz., four in number, two of them large, and two small ones intercalated between them; and also the four semilunar valves which prevent regurgitation into the auricle. The latter he describes as equal: in my specimen there are two of them large, and the intervening ones not half the size. Besides these there are other three semilunar valves guarding the openings of the veins into the auricle, and joined edge to edge with one another, viz., one for each hepatic vein, and a very large and muscular one over the entrance of the two systemic veins.

Branchial cavity.—The gills on each side are enclosed in a large pouch, opening on the outside by an opercular aperture only two inches long; and internally by five apertures about the same length, of which the first is in front of the first branchial arch, and the last between the fourth branchial arch and the pharyngeal bone. The pouch extends down to the middle line, and upwards almost to the vertebral column, and is surrounded almost completely by strong muscles.

From the preceding sketch of the anatomy of the sun-fish, it will be observed that the leading characteristic of its structure is concentration. Thus the head and shoulders are greatly developed, while the trunk is cut short: of lateral fins it has only one pair, the pectorals: of the mesial fins it only depends upon two for progression, and each of these is compacted into a single organ. Thus also as regards its nervous system, the origins of its spinal nerves are accumulated behind the brain; and as regards its organs of sense, the olfactory organ and the ear are very imperfect, while the eye is extremely large.

ILLUSTRATIONS.

Plate V.—Fig. 1. View of the skeleton of the short sun-fish taken from a cast. *a*, is placed under the first vertebra, the bone in front of which is the basioccipital: *b*, the cartilage corresponding to the extremity of the vertebral column; while above and below it are arranged the caudal fin rays, each consisting of a cartilage, osseous slip and dermal plate: *c*, cartilaginous pillow on which the dorsal fin moves: *d*, that on which the anal fin moves: *e*, attrahent muscles of the dorsal fin: *f*, muscles of the opposite side of the dorsal fin: *g*, muscles of the opposite side of the anal fin.

Fig. 2. View of the intestines lying in their natural coils, but divested of the covering of peritoneum which encloses them. *a*, the stomach: *b*, the gall-bladder: *c*, the urinary bladder, partially opened to exhibit the longitudinal slit by which *d*, the ureter, opens into it: *e*, the ovary.

Fig. 3. Longitudinal section of a portion of one of the dermal plates which terminate the caudal fin rays. The inferior margin of the figure represents the aspect which is imbedded in the integument, showing the elevations on its surface; while, toward the left side, is a portion of the free margin, with the section carried through a spine; and at the upper part of the same margin is shown the felted

arrangement of fibres, mentioned in the text. The manner in which the crystals lie in the tubes is exhibited.

PLATE VI.—Fig. 1. Skeleton of the head and shoulder. *a*, supraoccipital bone; *b*, paroccipital; *c*, frontal; *d*, nasal; *e*, prefrontal; *f*, bone of the interorbital septum; *g*, orbitosphenoid; *i*, alisphenoid; *k*, postfrontal; *l*, mastoid; *m*, scapula; *n*, coracoid; *o*, ulna; *p*, the bone described in the text as belonging to the row of carpal bones, yet corresponding to the radius in its relations to the coracoid and ulna; *q*, the bone called clavicle; *r*, intermaxillary; *s*, maxillary; *t*, palatal; *v*, dental, articular, and angular portions of the lower jaw; *w*, entopterygoid; *x*, hypotympanic; *y*, mesotympanic; *z*, epitympanic; 1, operculum; 2, preoperculum, beyond whose posterior and anterior margins are seen projecting the interoperculum and suboperculum.

Fig. 2. View of the muscles *a*, muscles of dorsal fin; *b*, muscles of anal fin; *c*, *c*, are placed opposite the most superior and most inferior muscles of the caudal fin; *d*, small abdominal muscle, arising from the tip of the clavicle, and resting on the peritoneum; *e*, the other small abdominal muscle, arising from the ulna, and likewise resting on the peritoneum. The peritoneum is torn open inferiorly, so as to exhibit the inferior margin of the liver, and the intestines surrounded by their common investment, together with, *f*, the peritoneal ligament connecting the liver and intestines; *g*, the vent.

Fig. 3. A few of the individual muscles of the left side of the anal fin, showing how each muscle is sheathed by that in front, and how the tendons pass into the grooves, and are there invested with sheaths.

XVIII.—On the Structure and Composition of the Integument of the Orthragoriscus mola. By William Turner, M.B. (Lond.), F.R.S.E., Senior Demonstrator of Anatomy, University of Edinburgh.

SEVERAL noteworthy peculiarities, both structural and chemical, are presented by the integument of the short sun-fish. These I had an opportunity of examining, not only in the specimen dissected by Dr. Cleland, but in one dissected a few years ago by Professor Goodsir and myself. The skin of the latter varied in its thickness in different parts of the body of the animal, from not more than a quarter of an inch to four or five inches. In one examined many years ago by Mr. Goodsir, which was a remarkably large fish, it reached in places as much as six inches.* The great thickness of the skin was produced by an opaque, white, tough and resisting structure, which extended from the tubercle-covered surface of the integument to the loose areolar tissue lying between it and the muscles. When blocks of this white structure were cut off, and set on one side for a short time, a considerable quantity of a pale straw-coloured, serous-looking fluid drained off from them, so as greatly to diminish their

* In the Edinburgh Philosophical Journal, vol. 30, p. 188, Mr. Goodsir gives an account of the microscopic characters of the skin of this specimen, which he dissected in 1840, but as he only employed a doublet in the examination, the description is necessarily an imperfect one.

size. This fluid heated, either alone, or with nitric acid, gave a flocculent albuminous precipitate. It contained no oil, and exhibited when allowed to cool, after being heated, no tendency to gelatinization. When portions of the white structure were heated in their own fluid, in a water bath, and then allowed to cool, gelatinization took place, which was due, not to any peculiarity of the fluid, but to the chemical composition of the opaque white substance, in the interspaces of which the fluid was infiltrated. Other portions of the skin placed under an exhausted receiver, along with sulphuric acid, shrivelled up to flake-like shavings of glue. The white mass was thus shown to belong to the gelatine-yielding structures, and to have no similarity in composition to the blubber-yielding integument of the cetacea.

From the chemical examination it was probable that this structure was to be regarded as cutis, a supposition which was confirmed by a microscopic examination. When small portions of the cutis were examined in the fresh state, under a magnifying power of 200 diameters, they were found to be composed of a closely arranged network of fine fibres, the exact characters of which could not be clearly studied until they were separated by dissection with needles. (Pl. VI. fig. 4.) It was then seen that the fibres presented certain special peculiarities, which distinguished them from the fibres of ordinary connective tissue. Instead of being collected in fibrillated bundles, each fibre possessed a distinct form and outline, (some being almost twice as broad as others), and extended for some distance, pursuing either a slightly wavy, or a curling tortuous course. From the very curly nature of many of these fibres I thought that they represented the elastic element of the cutis, but, on the addition of acetic acid, they disappeared in the same manner as the undulating fibres. This observation was repeated on fibres taken from various parts of the cutis, so that it may fairly be stated that the elastic element was either altogether absent from the skin of this fish, or was at a minimum. Throughout the entire thickness of the cutis, the fibres presented a well-marked reticulated arrangement, which distinguished them from that which is generally described to exist in the skin of fishes, where the fibres are mostly disposed in bundles parallel to the free surface, being crossed only at comparatively wide intervals by bundles possessing a vertical direction. In the meshes of this reticulation the abundant fluid of the skin was lodged. Numbers of small, ovoid, elongated, sometimes roundish cells, some of which possessed a single, others two or more nuclei, were also contained in these meshes. (Fig. 4.) These cells were visible, not only in the fresh skin, but after the addition of acetic acid, and even in those slices of the skin which had been digested in the water bath. From the close relation which these cells had to the fibres amongst which they were imbedded, I thought it likely, that, by a careful examination, it might be possible to see processes springing from them in such a manner as to produce that stellated, or radiated, aspect, which has recently been described by many observers, in connection with the corpuscles of the connective tissue generally. For this purpose I subjected, to repeated observation, portions, not only of the fresh skin, but also sections which had been hardened in spirit, or chromic acid, without being able to convince myself that such stellate connective-tissue corpuscles existed in this cutis.* Passing through the cutis from its deep to the tubercle-covered surface many nerve fibres were seen. In slices of the skin, which had been previously steeped in chromic acid, and then slightly acted on by caustic potash, the nerve fibres appeared, as they approached the deep surface of the tubercles, to present indications of a net-work-like arrangement beneath the tubercles, but not entering in them.

When the free surface of the integument was examined it was seen to consist of a multitude of tubercular plates, large enough to be distinguished by the naked eye, but requiring for their due examination the use of a compound microscope. These tubercles were polygonal in shape, irregularly serrated at their margins, by which serratures they were connected together. (Fig. 5.) A short firm spine projected from the centre of each tubercular plate. In some cases the spine was acuminated at its free extremity, but more generally it was an irregular ridge-like projection, widening out at the base and strengthened laterally by buttresses. These spines gave to the surface of the skin a shagreen-like aspect. A granular pigment was scattered over the surface of many of the plates. In some cases it was collected into stellate, at others into rounded masses, and at others it existed as free scattered granules. It gave to the tubercles a brownish colour, or metallic lustre. It was never found on the apices of the spines, although it frequently extended for some distance up their sides. The tubercles which did not possess any pigment, had a dull white appearance.

Vertical sections through the tubercles and their spines, enabled one to obtain a clearer conception, not only of their structure, but of their relation to the subjacent cutis. (Fig. 6.) The tubercles rested by their deep aspect on the fibrous cutis, with which they were very closely united. The outline of this portion of the cutis was unbroken and continuous, not at all times straight but slightly undulating, and occasionally presenting short digitiform elevations, which might, although did not necessarily, correspond to the position of the spines of the tubercles. The tubercles themselves consisted of two parts, which possessed distinctive microscopic characters, a superficial cuticular and a deeper hard portion, both of which differed structurally and chemically from the subjacent fibrous cutis.

* It is important, therefore, in discussing the presence of corpuscles in connective tissue, to keep in mind, that they may exist in very large numbers in this texture, as in the skin now under consideration, without possessing a radiated and anastomosing arrangement.

The cuticle covered the superficial surface of the tubercles and extended for some distance up the sides of the spines, although I never saw it passing over their free ends. It was continued from the outer surface of one tubercle to that of the adjacent ones, over the serrated apposed margins. In it, and in it only, the pigment of the skin was contained.

The deeper hard part of the tubercle, which owed its great density to the deposition of a calcareous, or other inorganic, material in its substance, formed the chief portion of the tubercle, and the spine projecting from it. It presented very slight traces of structure, a few faint lines, running for the most part horizontally, constituting the only markings on it. The spine had a closely similar aspect, and in many cases appeared to possess a cavity in its interior. In the spine faint lines might be seen, extending in a direction parallel to its long axis. When the tubercles were acted on by hot caustic potash, they were entirely broken up and resolved into a number of particles, some of which were elongated, others irregularly shaped, respecting the nature of which it would be difficult to give a positive opinion. When a portion of the skin was digested in warm caustic potash the tubercles separated from the cutis, whilst the cuticle still remained connected to their outer surfaces. The inference might be drawn from this, that the hard part of the tubercles, like the cuticle, was an epidermal, rather than a dermal structure. Such an inference might possibly, however, be erroneous, as the separation along this line might perhaps be due to the alkali acting more readily on the fibrous cutis than on the different parts of the tubercle. An absolute opinion as to the homology of the tubercles could only be given by tracing the manner of their development.

By digestion in hydrochloric acid the inorganic material was dissolved out of the hard part of the tubercle.

ILLUSTRATIONS.

Plate VI.—Fig 4.—Fibres and cells of cutis. × 200 diam. This figure simply gives the anatomical elements of the cutis, as seen in a portion which has been dissected with needles. The cellular element bears a larger proportion to the fibrous element than has here been represented.

Fig. 5. Surface view of integument, showing serrations at margins of tubercular plates, central spines, and various forms of pigment arrangement. × 45 diam.

Fig. 6.—Section through tubercular plate with its spine, and subjacent cutis. × 120 diam.

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XIX.—PERIODICALS.

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Miscellanea.

Note on the Habits of the Viper.

In reference to the "Note" on this subject in our last number (p. 118) we have received several interesting communications from Dr. J. Davy, to whom specimens of the young vipers reported to have taken refuge in the maternal mouth, were forwarded for examination.

Dr. Davy remarks that, if, as Mr. Norman appears to be sure, the eleven young Vipers were all found in the same situation (in the interior of the mother) he has little doubt that that place was the uterus and not the stomach. His reasons for coming to this conclusion will be found in the following observations, consisting for the most part of extracts from his letters.

"Neither of the three specimens," he says, "examined by me bore any marks of having breathed, or of being in a state sufficiently advanced, as I imagine, for independent existence. The poison fangs were not fully developed, though whether at the time of birth these organs are fully formed or not, I do not know. Probably, considering how small and feeble the young snakes would then be, those organs would then be little more than rudimentary, and if so that may account for Vipers, which are so prolific, not being more common, defenceless as they would thus be, and exposed to the attacks of so many enemies."

"The lungs again were perfectly collapsed. If respiration had taken place, I should not have expected this; and I do not think that there would be a complete absorption of the air by the spirit. The stomach was quite empty, as also the intestine, with the exception of the lower portion, which contained some yelk from the included vitellus."

"The circumstance that in some of the specimens a portion of vitelline sac was still external to the body, is, I think, adverse to the conclusion that any of them had left the uterine cavity. For were the young ones born with the vitellus thus exposed to the rough friction unavoidable in locomotion, on land, such a delicate structure could hardly but suffer injury."

With reference to the circumstance that the young vipers appeared to be moulting, Dr. Davy remarks:—

"That this was very distinctly the case in two specimens, the fine cuticle readily separating and exposing a surface of a brighter hue." But this moulting he apprehends is not incompatible with their having been taken from the abdominal (or uterine) cavity.

"May it not be supposed," he observes, "that the young of the snake before birth are subject to several moults, necessary as they increase in size after the integument has been fully formed." In some fœtal vipers dissected by him less advanced than those in question such was the condition of the skin; the colouring and markings were distinct and precisely similar to those of their parent. In these instances also the poison fangs though formed could not be detected until the specimens were dried, when, the soft enveloping tissue shrinking, their points came into view.

On the supposition that Mr. Norman's gamekeeper was not deceived in what he saw, but that he really witnessed the swallowing of two or three of its brood by the parent Viper, may it not probably be assumed that she actually devoured them? A *primâ facie* objection to this supposition, lies in the fact above pointed out by Dr. Davy, that the specimens of young examined by him were in an immature condition and had not breathed, and consequently that they had not been born at all. To this it may be answered, that it is by no means certain that the Viper produces the whole of its brood at once. The young may be issued one or two at a time as they reach maturity, the rest remaining in the uterine cavity. Those which were swallowed might have been more perfect than the individuals examined by Dr. Davy.

That excellent observer, considers it not at all improbable that the parent snake may occasionally devour its own young when pressed by hunger, and if so, that the seeing it in the act may have led to the popular notion. In order to show the occasionally stupid and blind voracity manifested by Reptilian animals, Dr. Davy relates an instance, in Ceylon, of one snake in confinement with another swallowing his companion though about the same size as itself. And an incident in the same island was related to him by the person who witnessed it of a Python owing its death to an attempt to swallow a Deer, the horns sticking in its throat. Other instances of the same kind might be cited, and amongst these, as noticed by Dr. Davy, one which occurred in the Zoological Gardens a few years since of a Python swallowing its blanket. He also relates an anecdote, for the accuracy of which he can vouch, of a large Frog, in Ceylon, which, reversing the usual order of things, attempted to avenge the wrongs of its race by trying to swallow a Duck. Both were found dead, the head of the Duck in the gullet of the too ambitious Frog.

In further support of the opinion that the Viper may on occasion commit infanticide, Dr. Davy notices an interesting account of the Slow Worm (*A. fragilis*) given by D. Rankin, Esq. in the 5th volume of the Edinburgh New Philosophical Journal. In speaking of the food of this Reptile, Mr. Rankin remarks; "I have good grounds for believing that its own young are not rejected," and gives an instance of his having witnessed the deed. "Of a brood," he says, "during the first day one was no doubt devoured by its parent, for I found half the tail unconsumed, which the little creature had, in all probability, wriggled off in an instinctive struggle. The parent and young ones were confined in a box." Now, if the Slow-Worm, Dr. Davy pertinently asks, "occasionally devours its young, why should not the Viper?"

On Collecting and Preserving Specimens of Fishes and Reptiles.

Through the zealous efforts of the present able head of the Zoological department at the British Museum, the series of specimens of cold-blooded Vertebrata preserved in spirits has of late years received very considerable accessions. From one of the most indifferent in Europe, our national collection is, as regards this class of zoological preparations, now become one of the finest, if not the very best, in the world, embracing as it does about 7000 specimens of Reptiles and 20,000 of Fishes. A well known and accomplished German naturalist, Dr. A. Günther, has been engaged for these last three years in arranging and cataloguing this vast mass of materials. Dr. Günther has already prepared and published catalogues of the *Batrachia salientia* and the Colubrine Snakes, and is now engaged in working out the extensive series of Fishes, of which he has already issued three thick volumes, relating to the Acanthopterygians. But although so much has already been done towards the investigation of these extensive departments of the Animal Kingdom, still more, we may safely say, remains to be done. The Reptilian Faunas of many parts of the globe are as yet comparatively but little known, and in the class of Fishes still larger discoveries remain to be made. So little trouble is involved in the preparation of this class of Zoological Specimens, that it is easy for any person resident abroad, however little leisure he may have, to give important assistance to science in this matter. For the following directions how to set about this in the most simple way, we have to thank the kindness of one of our correspondents who is greatly interested in the subject. We may remark that as regards fishes, though at the present moment the fresh-water species of the inner waters and mountain-streams of extra-European countries are the most important desiderata; yet, those from the low lands and marine fishes are also very valuable.

Directions for Collecting and Preserving Fishes and Reptiles.

1. Collect fishes of every size. The eel-like fishes ought not to exceed thirty-six inches in length; the broad kinds not eighteen. Six specimens of each species will be quite sufficient.

2. Tie to each specimen a label of parchment or of tin foil, on which the name of the exact locality where the specimen is procured, is written, or a number referring to a list of localities.

3. Cut a small slit in the belly of the specimens, so as to admit the spirit, but do not remove the intestines.

4. Put the specimens into a large jar or tub containing spirit to extract the water, mucus, etc. This spirit may be used for any number of specimens as long as it is strong enough to preserve them from *early* putrefaction. Leave the specimens in this spirit for from 8 to 10 days.

5. Transfer the specimens into other spirit, stronger than the former, and leave them there for another fortnight.

6. Pack, finally, the specimens in spirit which is strong enough to be inflammable with a lighted match. In spirit, like this, the specimens may be shipped, and will keep for 6 or 8 months. Rum of the strength indicated, answers very well for this purpose.

7. The best way of sending specimens is in a square tin box fitted into a wooden case. Wrap each specimen in a piece of linen to prevent the rubbing off of the scales and other injuries. Pack the specimens as close as herrings, and do not leave any free space at the top or on the sides of the box. Fill the box with spirit, taking care to drive out the air which may remain between the specimens, and close it hermetically by soldering down the cover. The best way of closing the box is to make a small round hole in the cover of the box. First fix down the cover of the box, then pour spirit through the small hole, until the box is quite full. This hole may then be easily closed by another small square lid of tin.

8. Turn the box upside down and see whether it keeps in the spirit perfectly.

9. Reptiles of every description may be preserved in the same way. However, as they naturally contain less fluid, it will be sufficient, to change the spirits once.

10. It frequently happens in very hot climates, that the specimens begin to decompose even in very strong spirits; in such cases, it will be better to add arsenic or corrosive sublimate to the spirit. This ought to be mentioned to the party who receives or opens the box.

11. It may be advisable to prevent sailors, servants, etc. from tasting the spirits. This may be done by adding some nauseous substance to the mixture.

P. L. S.

THE

NATURAL HISTORY REVIEW:

A

QUARTERLY JOURNAL OF BIOLOGICAL SCIENCE.

Reviews.

XXV.—On the Two Forms, or Dimorphic Conditions, in the Species of *Primula*, and on their remarkable Sexual Relations. By Charles Darwin. Linnean Society's Journal, VI. (Botany), pp. 77-96.

We do not wish to attach an undue importance to the observations which have been here recorded by Mr. Darwin upon the remarkable sexual relations which he has proved to exist between individuals of that very commonest and most familiar of our spring favourites, the Primrose; yet we may say, with all sincerity, that Botanical Science has, of late years, been enriched with few of equal value. And this impresses us as especially the case if we regard the impulse and direction which these observations must necessarily give to future investigation. The simple fact that, in one set of primroses or cowslips, the stigma reaches to the mouth of the corolla-tube, the anthers being externally invisible, while in the other set the anthers surround and close its mouth while the stigma is far down the tube, is not, of course, advanced by Mr. Darwin as novel. As he says, gardeners speak of the two forms as the "pin-eyed" (with stigma at the mouth of tube) and "thumb-eyed" (with anthers at mouth of tube). Children too, he tells us, select the former for their necklaces; the upper part of the corolla-tube being wider, and not closed by sessile anthers, they more easily slip them over each other. It is the satisfactory explanation which, with characteristic sagacity, this distinguished zoologist offers of the (botanical) fact that primarily concerns us, and it is this that we so greatly admire.

We feel that we are yet far from being in a position to enter upon a discussion of the general question of sexuality in plants: it is a very large subject, and the basis upon which we can rest an argument is much too slender for useful application. We shall be content, therefore, to devote the short space at our disposal to a review of the facts and conclusions established by Mr. Darwin, directing attention to other instances of dimorphism in other and very different species of flowering plants.

We may, after a certain fashion, rudely group the kinds of dimorphism exhibited in the flower under two heads. First, a dimorphism, apparently favourable to variation, marked primarily by a partial or complete separation of the sexes, which may be accompanied or not by alteration in the form or arrangement of the parts of the perianth surrounding them; and, second, a dimorphism, conservative, and unfavourable to variation, marked primarily by an alteration in the form or arrangement (frequently a reduction) of the outer whorls of the flower, which more or less completely enclose and seal up the sexual organs, which are never wholly separated.*

Such grouping we may well designate as rude, but there do certainly appear to be two classes or kinds of dimorphism, which even in the present state of our knowledge—feeling as it were our uncertain way—it may be well to distinguish, and we do not see how better to define them than as above.

It is to the first group that we may refer the primroses, and with them a very numerous company indeed of trees, and shrubs, and herbs. There are comparatively few natural orders of flowering plants out of the 200 or 300 which are generally recognized, in which we do not find more or less of a diclinous condition—a condition which necessarily involves "dimorphism" in respect of the sexual organs. There are numerous Orders invariably, or almost invariably, characterized by unisexual flowers. There are others again in which a tendency to this condition is more or less conspicuously manifest in many of their members. A large proportion of the trees of temperate Europe bear only flowers thus dimorphic. In the oak, beech, chestnut, and pine, for example, this dimorphism is extreme. In the stamen-bearing flowers, we find no rudiment of a pistil—in the pistil-bearing, no rudiment of stamens. But between plants which we may regard as wholly homomorphic, and consequently with flowers completely hermaphrodite, and the extremes just cited, we have an infinity of intermediate conditions.

Parting from the hypothetical truly homomorphic hermaphrodite, we find in the case of Mr. Darwin's *Primulas* one of the first grades of incipient dimorphism of which cognizance can be taken.

Hence one peculiar interest of his observations, to which we recur. Besides the differences already mentioned in the relative length of the style and height of the anthers in the corolla-tube of these plants, Mr. Darwin points out that in the long-styled form the stigma is globular and rough with minute papillæ, and the pollen-grains about

* This second group we have not framed to include a dimorphic condition of the male flower, or of the female flower, of a unisexual plant. We are not aware, however, that such exist. If there be none, the circumstance is worth noticing.

7/7000ths of an inch in diameter, while in the short-styled form the stigma is depressed and nearly smooth, the pollen-grains ranging from 10/-to-11/-7000ths of an inch in diameter. Our own observations entirely confirm the minute accuracy of these statements, though of the relative sizes of the pollen-grains we have only judged by comparison of them by the eye, on the same slip of glass under the microscope.

To these differences between the two forms, we may add another, noticed while dissecting the flowers. The ovules of the long-styled *Primula*, which Mr. Darwin states to produce a smaller number of seeds, are considerably larger (and probably less numerous) even before the flower expands, than in the short-styled form, which he finds to produce the larger number of seeds. These two forms—the long-styled and short-styled—occur in nature in about equal proportions. It is not yet satisfactorily shown that the same plant can produce both forms, though this is a point to which we think further attention might be directed, especially in those species which have occasionally a second or autumn flowering.

Now the carefully conducted experiments of Mr. Darwin, which are described in detail in his paper, show a remarkable difference in the influence exercised by the pollen upon the stigma of its own flower and upon the stigma of a flower of the other form. Fertilisation of a flower by pollen of its own form he terms 'homomorphic,' by the pollen of the other form 'heteromorphic.' And it is the heteromorphic unions which he shows to be pre-eminently fertile. If, therefore, the abundant production of good seed be advantageous to the species, so must be heteromorphic fertilisation, a process dependent however upon circumstances, which we may call accidental, though they are nevertheless certain and ever-acting. The agency of insects is absolutely necessary for the crossing of the different forms, and there can be no question but that the part they play in this economy is of the very highest importance. Having explained the provision which nature has made to favour the crossing of distinct individuals, Mr. Darwin suggests the possibility that the species of *Primula* may possibly be tending to a dioicous condition. In their present condition they are, as he observes, 'subdioicous hermaphrodites.' We are not in possession of corresponding facts relative to any other species in either of the groups which are distinguishable of dimorphic flowers; so that, unable to institute a single comparison, we are reduced to the necessity of speculating upon very meagre materials. We have referred the case of the *Primulas* to one category with unisexual or diclinous flowers, whether of monoicous or dioicous plants does not immediately affect the question. We have done so simply because between the comparatively trivial amount of diclinism in *Primula* and the more extreme instances which are at hand on every side in overwhelming number, we are utterly unable to draw the line.

Before we proceed to give a few instances from our second category we would just recall a difficulty which constantly presents itself when we contemplate this subject from—so far as we can apprehend it—Mr. Darwin's point of view. If these plants be tending to a diclinous condition, if such a condition advantage the species, how and why did they ever become hermaphrodite? We cannot help conjecturing that there may be in plants two counter-agencies at work, the one acting as a constant check upon the other; the one conservative, favouring the persistence of unaltered forms, indicated in the general barrenness of hybrids and the difficulty of crossing many nearly allied species as well as in other and special arrangements which we shall afterwards advert to, the other favouring, it may be ever so slightly, a tendency to vary, indicated by the various grades of diclinism, as also by special obstacles contrived absolutely to prevent self-fertilisation in hermaphrodite flowers.* While we may, with perhaps the greater shew of reason suggest that certain species are tending to a separation of the sexes, we must not forget that arguments may be advanced to shew that it is not impossible but that they may be striving towards more perfect hermaphroditism, especially if we bring to mind the evidence (to which indeed we are scarcely hardy enough to attach a particle of weight) furnished by the 'Geological Record.' This evidence does certainly appear in favour of a greater predominance of unisexual forms at an early period than obtains at the present day. A consideration of instances referred to our second kind of dimorphism may perhaps enable us to appreciate better the phenomenon, and further illustrate the remark that there may possibly be two counter agencies at work manifesting themselves in various dimorphic conditions.

Linnaeus in the 'Praelectiones Botanicae'† remarks of *Viola mirabilis* that the early flowers provided with a corolla are often barren, while others appearing subsequently and destitute of a corolla are fertile. This observation was extended by Gingins who published a Memoir on the Violaceae in 1823. He shewed that violets presented the singular peculiarity of producing imperfect flowers, more or less destitute of petals, but with perfect fruits, which fruits he adds are "quelquefois même plus parfaits que ceux qui succédent aux fleurs complètes." M. Monnier of Nancy, yet further extended our knowledge of this dimorphic condition in the violets.‡ He says of *Viola hirta* that none of the early spring flowers yield fruit, "they all abort and wither up;" after the first flowering the leaves assume a fuller development, they become more hairy and bear in their axils flowers destitute of corolla and with the five stamens almost always free and shorter than the ovary. The peduncles bearing these flowers curve downward and bury the ovaries under the surface of the soil where the seeds are ripened. M. Monnier found the sweet-scented

* Conf. Hooker Introd. Essay to Tasmanian Flora, x.
† Ed. 1792, p. 401.
‡ Guillemin's Archives de Botanique, 1833, i. 412.

flowers of *V. odorata* to be quite infertile. In this species, as in *V. hirta* (which some botanists unite with it) it is the later flowers, without corolla and with stamens of variable length, which give the fertile capsules. Plants of the double violet he showed also bore apetalous flowers. *V. ericetorum* was found to exhibit the same phenomenon. This botanist concluded from his observations that the species of the section *Nominium** of the genus *Viola* have two flowerings, the first vernal with well-developed petaloid flowers not maturing seeds, the second aestival, with abortive corollas but always fertile. The dimorphism in *Viola* has been more recently examined by M. Michalet† and M. Müller.‡ The former says that the earlier of the 'apetalous' flowers offer transitional forms between the two states, which, however, he did not sufficiently follow. The second flowering lasts from the close of the first through part of the summer even until autumn; the May and June flowers being scarcely one-fourth the size of the earlier ones. In these he finds the calyx to be hermetically closed over the flower, leaving a large and empty space above the ovary, which he considers may favour fecondation. The sepals are afterwards burst open by the enlargement of the capsule. The petals are not entirely absent but fall considerably short of the sepals; they are membranous and hyaline, occasionally they are reduced to one or two, hence the summer flowers are not correctly described as truly apetalous. M. Michalet observes that he never found the anthers open, even in flowers the ovary of which was certainly fertilized. The style is much shorter than in the 'petaloid' flowers, the stigma truncate and funnel-shaped at top, the cavity opening into the ovary. The stigmatic surface seems smooth and not papillose. How fecondation is effected in these flowers he is unable to say.

A case parallel to the above is described by M. Michalet in the Wood-sorrel (*Oxalis Acetosella*), with the difference that the early and beautiful petaloid flowers are regularly fertilized, and produce perfect seeds. In the second or summer flowers, the sepals are closely applied and hermetically closed over the essential organs as in the violet. The petals, usually of the normal number, are much shorter than the sepals; they are rarely all wanting. There are ten stamens, of which five are smaller and appear quite barren; the five larger ones are fertile, and incline over the stigmas, with which they are described as being apparently united by delicate filaments. The part which these play, M. Michalet is unable to explain. The anthers appear to remain closed, and the pollen seems as it were deliquescent. The seeds of the smaller flowers, which are ripened under the surrounding moss and detritus, offer no apparent difference from those of the normal ones. The same observer finds

* Messrs. Hooker and Bentham in their "Genera Plantarum" attribute dimorphous flowers to all the sections excepting *Melanium*.

† Bull. Soc. Bot. France, vii. 465.

‡ Bot. Zeit. 1857, 729.

hypogean flowers of *Linaria spuria* which ripen seed, but these flowers offer no notable difference from the rest.

We have ourselves examined the dimorphic flowers both of *Viola* and *Oxalis*, but have nothing to add to M. Michalet's detailed account. Another case of similar character, however, in a far removed natural order, has recently been closely under our notice; and as it is one which we believe is not widely known, although it has been carefully investigated by M. Brongniart, and is described by M. Ad. de Jussieu in his "Monographie des Malpighiacées," and by Torrey in his 'Flora of New York' (i. 428), we may be permitted to give some account of it here. Our observations have been made solely upon dried specimens, so that we can only speak to structural facts. The most important problems which these phenomena suggest, it is needless to say, can only be solved by study and carefully watching of the living plant, and this we have not yet had the opportunity of doing. Linnæus long ago* wrote of *Campanula perfoliata*—"flores laterales raro corollo instructos producit, sed tantum calycem semen continentem; flores vero terminales perfecti sunt." This species we have not examined, though, from M. Jussieu's account,† it would appear to have been the same that M. Brongniart observed. This excellent botanist found, in the smaller flowers, a 'tympanum' covering the base of the calyx-tube. This is the rudiment of the corolla. On removing it he found the stigma and stamens with well-formed pollen. Our attention has been devoted to two Indian species (*C. canescens*) alluded to by Messrs. Hooker and Thomson in their Præcursores ad Floram Indicam,‡ and *C. colorata*. We find the smaller and apparently apetalous flowers to be usually lateral, often borne on short racemes springing from the lower leaves of the stem, though sometimes they abound along the branches of the principal inflorescence. They are various in size, from that of a coriander seed to a pea. The ovary is inferior, as in the normal flowers, though occasionally only two-celled. The limb of the calyx is not always regularly five-lobed, but often, and especially in the smallest flowers, three-lobed or irregularly divided. The disc of the flower is covered by a *completely closed* hairy membrane, with a slight mammilliform elevation in the centre. This membrane is the rudimentary corolla, and the number of petals composing it is indicated by converging lines. On dissection, this elevation is found to cover a pentagonal or five-lobed body which at first sight resembles a stigma, but examination shows that each lobe is opposite to a corresponding lobe of the calyx-limb, and that each lobe of the pentagonal process is united to the base of the opposed calyx-lobe by a delicate cord, the filament in fact of the stamen, of which the lobe of the central body to which it is united is the anther. The stamens are extended horizontally between the upper mem-

* Prælectiones Botanicæ, 299. † *Op. cit.* 84.
‡ Journ. Linn. Soc. ii. 7.

brane and the lower, which separates them from the ovary, and the anthers, closely applied, are apparently quite connate and together adnate to the stigma. We have observed in soaked specimens what we have every reason to believe are true pollen granules, with their tubes penetrating the tissue of the stigma.

The contents of the ovary do not appear to differ in the normal and abnormal flowers. In *Campanula colorata* we have seen flowers intermediate in character between those above described, and normal ones, in which the corolla, instead of being imperforate, opened by teeth in the centre, though falling short of the calyx-lobes in length,—the style considerably lengthened and the anthers free. In connection with the occurrence of dimorphous flowers in Campanulaceæ, it may be well to bear in mind that the method of fertilization of the normal flowers was long a puzzle to botanists. For a detailed notice of the various hypotheses suggested to explain it we must refer to M. A. de Candolle's Monographie des Campanulées (1830) and especially to M.M. Brongniart* and Tulasne's† Papers in "Annales des Sciences Naturelles." In these flowers the anthers open and discharge their pollen before the expansion of the corolla. M. Du Petit-Thouars conjectured that the stigmas were fertilized before it opened. He found that the stigmatic lobes were slightly divergent in the bud at a time when the anthers might be supposed to open and that they again close shortly before the corolla expands: after its expansion they are once more divergent. This view was considered to be supported by the case of the allied Goodenieæ and Scaevolae in which the pollen is received into a capsule or indusium terminating the style before the flower opens. When the corolla expands the indusium in these plants is closed. Again, much attention has been directed to what have been termed the 'collecting-hairs' with which the style in the Bell-flowers is so frequently clothed. A function has been attributed to them in the fertilisation of the flower, but this, as Brongniart showed was due to imperfect observation. These hairs, which brush off the remaining pollen from the anthers as the style shoots up through them, frequently become invaginated, like the finger of a glove drawn back half way up: the sheathing portion entangles a few of the grains so that they appear actually drawn into the tissue of the style: hence the mistake. M. Tulasne, whose observations are of the highest authenticity, finds that pollen received upon the stigma produces the tubes which fertilize the ovules. How the pollen reaches the stigma must be more fully settled by careful observation. It is highly probable that insects play an important part in its conveyance, as various observers have suggested. There are other plants belonging to different Natural Orders to those above noticed, which offer like dimorphism. In Caryophyllaceae, Maximowicz,‡ describes a *Stellaria* (dis-

* 2e Sér. xii. 244. † 3e Sér. xii. 71.
‡ Primitiae Fl. Amurensis, 57.

tinguished generically under the name of *Kraschenikowia*), "floribus superioribus sterilibus, infimis (radicalibus) anantheris fertilibus carnosulis." The flowers from the axils of the lower leaves become buried in the soil and are described as "floribus * * clausis * * * petalis staminibus stylisque nullis, capsulae rotundatae parietibus carnosis, seminibus fuscis * * * embryone peripherico arcuato albumineque normali! donatis." The normal flowers are petaloid with the stamens nearly equalling the sepals. He says, "verosimillime capsulae intra paniculam steriles." M. Weddell* and Asa Gray,† describe dimorphism in the genus *Impatiens*: M. Weddell in the common *I. Noli-me-tangere*. In this plant some of the fruits ripen without the previous expansion of the flowers to which they belong. All the whorls of the flower exist, but excepting the ovary, they are extremely small and rudimentary, uniting into a little hood, which the fruit, in elongating, bears up with it and wears as a cap. These abnormal flowers arise near the normal ones, but usually in lateral peduncles. Dr. Gray gives some interesting particulars respecting the structure of the normal flowers of the American species, in which certain membranaceous appendages of the filaments are connivent and more or less coherent over the summit of the pistil, entirely preventing the access of pollen in the greater proportion of even fully developed flowers, which, consequently, fall away unfertilized. In some, however, the growing ovary pushes the stigma through the cap, thus securing its fertilization.

M. Jussieu records dimorphous flowers in the section *Meiostemones* of the Natural order Malpighiaceae. In Acanthaceae (*Ruellia*) it was long ago observed by Dillenius. And we might adduce other instances, but these must suffice, for we possess no instance of this kind of dimorphism, referred to our second category, which has been fully and satisfactorily described, much less explained; indeed the examples which we have given are amongst the most marked and the best observed.

The main feature and that to which we would wish to direct attention in, at least some, of these cases, is the occurrence of a second kind of flower in which it would seem that nature has especially contrived to exclude the possibility of fertilization by other than own-flower stamens. It is true that the anthers in the closed flowers of *Viola* and *Oxalis* are stated never to have been found open, but in the *Campanula* observed by us the pollen evidently had access to the stigma; and indeed, M. Michalet points out, as we have said, the existence of fine threads connecting the anthers with the stigmas in the "hermetically closed" flowers of *Oxalis*. These fine threads, there can be no doubt, are the pollen-tubes. It is impossible that we should here enter upon the *rôle* of these remarkable flowers in the economy of the species to which they belong. We do not possess, as we have already said, a sufficient basis of

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* Jussieu. Malpighiacées. 85. † Gen. United States, ii. 131.

facts to work upon. It must suffice to suggest conjecturally that a conservative agency, if we may so term it, is at work in the vegetable kingdom, over and above the inherent check of a like tendency possessed in a high degree by the great majority of species, which absolutely prevents miscellaneous or wide hybridization or crossing. We do not forget that the question of hybridization of distinct species may be entered upon, to a certain extent, apart from that of the crossing of different individuals of the same species, and that a most important distinction may be drawn between them, but facts fail to show how far the check which prevents a crossing of species operates in preventing too wide a crossing of individuals of any one species, if indeed it operate in the latter case at all. We have alluded to what have seemed to be special contrivances in certain flowers to *prevent* self-fertilization. Several familiar cases might be quoted but we have already exceeded a reasonable limit, and until some more careful observers, with a measure of that earnest diligence in an unprejudiced search after truth, which so pre-eminently characterizes Mr. Darwin, shall have described to us the true character and end of some of these anomalous structures it would be useless to offer any blind speculations with regard to them. Finally, let us beg those who have opportunity,—and but a short time each day, if perseveringly devoted to the purpose, will suffice for important results,—let us beg that they will select for careful watching and study either one of the common cases of dimorphism mentioned above, or some of the plants which we have adverted to as offering obstacles to self-fertilization. Either class promises well to be resultful. Let us just observe that it is by no means essential that the observer should be a "botanist." Mr. Darwin is not a botanist, nor did he ever pretend to be such, yet his observations prove of the very highest value to botanical science.

[In the above paper we have not referred to the phenomenon of dimorphism exhibited by various Orchidaceae. We hope to return to the subject, in connection with Mr. Darwin's new work on the 'Fertilisation of Orchidaceae' in a future number.]

Original Articles.

XXVI.—On the Evidence of the Antiquity of Man, afforded by the Physical Structure of the Somme Valley. By John Lubbock, Esq., F.R.S.

While we have been straining our eyes to the East, and eagerly watching excavations in Egypt and Assyria, suddenly a new light has arisen in the midst of us; and the oldest relics of man yet discovered, have occurred, not among the ruins of Nineveh or Heliopolis, not in the sandy plains of the Nile or the Euphrates, but in the pleasant valleys of England and France, along the banks of the Seine and the Somme, the Thames and the Waveney.

So unexpected were these discoveries, so irreconcileable with even the greatest antiquity then assigned to the human race, that they were long regarded with neglect and suspicion. M. Boucher de Perthes to whom we are primarily indebted for this great step in the history of mankind, published his first work on the subject, "De l'industrie primitive, ou les arts et leur origine," in the year 1846. In this he announced that he had found human implements in beds unmistakeably belonging to the age of the drift. In his "Antiquités Celtiques et Antédiluviennes" (1847), he also gave numerous illustrations of these stone weapons, but unfortunately the figures were so small and rude, as scarcely to do justice to the originals. For seven years M. Boucher de Perthes made few converts; he was looked upon as an enthusiast, almost as a madman. At length, in 1853, Dr. Rigollot, till then sceptical, examined for himself the drift at the now celebrated St. Acheul, found several weapons, and believed. Still the new creed met with but little favour; prophets are proverbially without honour in their own country, and M. Boucher de Perthes was no exception to the rule. At last, however, the tide turned in his favour. Dr. Falconer, passing through Abbeville, visited his collection, and made known the result of his visit to Mr. Joseph Prestwich, who, accompanied by Mr. John Evans, immediately proceeded to Abbeville and examined carefully not only the flint weapons, but also the beds in which they were found. For such an investigation our two countrymen were especially qualified: Mr. Prestwich from his long examination and great knowledge of the more recent strata; and Mr. Evans as having devoted much study to the stone implements belonging to what we must now consider as the second, or at least the more recent, stone-period. On their return to England Mr. Prestwich communicated the results of his visit to the Royal Society,* (On the Occurrence of Flint Implements associated

* Phil. Transact. 1860.

with the remains of extinct species, in beds of a late Geological Period, May 19, 1859), while Mr. Evans described the implements themselves in the Transactions of the Society of Antiquaries (1860).

Shortly afterwards Mr. Prestwich returned to Amiens and Abbeville, accompanied by Messrs. Godwin Austen, J. W. Flower, and R. W. Mylne. In the same year Sir Charles Lyell, whose opinion on the subject was naturally expected with great interest, visited the now celebrated localities. In 1860, I made my first visit with Mr. Busk and Captain Galton, under the guidance of Mr. Prestwich, while Sir Roderick Murchison, Professors Henslow, Ramsay, Rogers, Messrs. H. Christy, Rupert Jones, James Wyatt, and other geologists, followed on the same errand. M. L'Abbé Cochet, therefore, in his "Rapport adressé a Monsieur le Sénateur Préfet de la Seine-Inférieure," (1860) does no more than justice to our countrymen, when after a well-merited tribute of praise to M. Boucher de Perthes, and Dr. Rigollot, he adds, "Mais ce sont les Géologues Anglais, en tête "desquels il faut placer d'abord M.M. Prestwich et Evans, puis M. "M. Flower, Mylne, et Godwin Austen, et enfin Sir C. Lyell . . . . "qui . . . . ont fini par élever à la dignité de fait scientifique la "découverte de M. Boucher de Perthes."

Soon after his return, Mr. Prestwich addressed a communication to the Academy of Sciences through M. Elie de Beaumont, in which he urged the importance of these discoveries, and expressed a hope that they would stimulate "les géologues de tous les pays à une "étude encore plus approfondie des terrains quaternaires." The subject being thus brought prominently before the geologists of Paris, M. Gaudry, well known for his interesting researches in Greece, was sent to examine the weapons themselves, and the localities in which they were found.

M. Gaudry was so fortunate as to find several flint weapons *in situ*, and his report, which entirely confirmed the statements made by M. Boucher de Perthes, led others to visit the valley of the Somme, among whom I may mention M.M. de Quatrefages, Lartet, Collomb, Hebert, de Verneuil, and G. Pouchet.

In the "Antiquités Celtiques," M. Boucher de Perthes suggested some gravel pits near Grenelle at Paris, as being, from their position and appearance, likely places to contain flint implements. M. Gosse of Geneva has actually found flint implements in these pits, being, I believe, the first discovery of this nature in the valley of the Seine.* In that of the Oise a small hatchet has been found by M. Peigné Delacourt at Précy, near Creil.

Dr. Noulet has also found flint weapons with remains of extinct animals at Clermont, near Toulouse.

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* M. L'Abbé Cochet states (l. c. p. 8) that similar weapons have been found at Sotteville, near Rouen, and are deposited in the Musée d'Antiquités. There seems, however, to be some mistake about these specimens, at least M. Pouchet, who received us at Rouen with the greatest courtesy, was quite unaware of any such discovery.

Nor have these discoveries been confined to France. There has long been in the British Museum a rude stone weapon, described as follows:—"No. 246. A British weapon, *found with elephant's tooth*, "opposite to black Mary's, near Grayes inn lane. Conyers. It is a "large black flint, shaped into the figure of a spear's point." Mr. Evans tells us, moreover, (l. c. p. 22) "that a rude engraving of it "illustrates a letter on the Antiquities of London, by Mr. Bagford, "dated 1715, printed in Hearne's edition of Leland's Collectanea, "Vol. I. 6. p. lxiii. From his account it seems to have been found with "a *skeleton* of an elephant in the presence of Mr. Conyers." This most interesting weapon agrees exactly with those found in the valley of the Somme.

In the museum belonging to the Society of Antiquaries, Mr. Evans found, on his return from Abbeville, some specimens exactly like those in the collection of M. Boucher de Perthes. On examination it proved that they had been presented by Mr. Frere, who found them with bones of extinct animals in a gravel pit at Hoxne in Suffolk, and had well described and figured them in the Archæologia for the year 1800.

Again, twenty-five years ago, Mr. Whitburn of Godalming, (See Prestwich, Geol. Jour. August 1861), examining the gravel pits between Guildford and Godalming, remarked a peculiar flint, which he carried away and has since preserved in his collection. It belongs to the "drift" type, but is very rude. Thus this peculiar type of flint implement has been actually found in association with the bones of the mammoth on various occasions during nearly a hundred and fifty years! While, however, these instances remarkably corroborate the statements made by M. Boucher de Perthes, they in no way detract from the credit due to that gentleman.

In addition to the above mentioned, similar hatchets have been found in Suffolk, Kent, Bedfordshire, and Hertfordshire. In the first of these counties Mr. Warren of Ixworth obtained one from a workman in a gravel pit near Icklingham, and he subsequently found another himself. This specimen closely resembles the one figured in this Review (Vol. I. Pl. VII. fig. 10), which was given to me by M. Marcotte of Abbeville, who obtained it from Moulin Quignon.

The next discovery was made by Mr. Leech, on the shore between Herne Bay and Reculvers, whence altogether eleven specimens have been obtained, six found by Mr. Leech, and five subsequently by Messrs. Evans and Prestwich and Wyatt.* In the gravel near Bedford, again associated with remains of the mammoth, rhinoceros, hippopotamus (?), ox, horse, and deer, Mr. Wyatt has found implements

* "Another implement of the round pointed form has been discovered in Kent (Nov. 1861), on the surface of the ground at the top of the hill on the east side of the Darent, about a mile E.S.E. of Horton Kirby, by Mr. Whitaker, F.G.S., of the Geological Survey."—(Evans' Archæologia, 1861, p 18.)

resembling both of the two principal types found at Abbeville and Amiens.

Finally, Mr. Evans himself, near Abbots Langley in Hertfordshire, has picked up on the surface of a field a weathered hatchet with the top broken off, but otherwise identical in form with the spear-head-shaped specimens from Amiens and Herne Bay.

But why, it may be asked, should the history of this question be so recounted? Why should it be treated differently from any other scientific discovery? The answer is not difficult. That the statement by Mr. Frere has been forgotten for half a century; that the weapon found by Mr. Conyers should have lain unnoticed for more than double that time; that the discoveries by M. Boucher de Perthes have been ignored for fifteen years; that the numerous cases in which caves have contained the remains of men together with those of extinct animals, have been explained away; are facts which show how deeply rooted was the conviction that man belonged altogether to a more recent order of things, and, whatever other accusation may be brought against them, geologists can at least not be said to have hastily accepted the theory of the coexistence of the human race with the now extinct Pachydermata of Northern Europe.

Though, however, the distinguished geologists to whom I have referred, have all, with one exception, expressed themselves more or less strongly as to the great antiquity of these curious weapons, still, I do not wish that they should be received as judges; I only claim the right to summon them as witnesses.

The questions to be decided may be stated as follows:—

1st. Are the so-called flint implements of human workmanship, or the results of physical agencies?

2ndly. Are the flint implements of the same age as the bones of the extinct animals with which they occur?

3rdly. Are we entitled to impute a high antiquity to the beds in which these remains occur?

4thly. What are the conditions under which they were deposited?

To the first three of these questions an affirmative answer would be given, almost unanimously, by those geologists who have given any special attention to the subject. Fortunately, however, there is one exception to this rule; Blackwood's Magazine for October, 1860, contains an article in which the last two questions are maintained to be still unanswered, and in which therefore a verdict of "Not Proven" is demanded. Not indeed that there is any difference of opinion as to the weapons themselves. "For more than twenty years," says Prof. Ramsay, "I have daily handled stones, whether fashioned by nature "or art, and the flint hatchets of Amiens and Abbeville seem to me as "clearly works of art as any Sheffield whittle."* It will be better however to quote from the candid sceptic in Blackwood. "They bear," he admits (p. 438), "unmistakeably the indications of having

* Athenæum, July 16, 1859.

been shaped by the skill of man." But best of all, an hour or two spent in a pit, examining the forms of ordinary flint gravel would, we are sure, convince any man that these stones, rude though they be, are undeniably fashioned by the hand of man.

Still, it might be supposed that they were forgeries, made by the workmen to entrap unwary geologists. They have however been found by Messrs. Boucher de Perthes, Henslow, Christy, Flower, Gaudry, Pouchet, Wyatt, and others. One seen, though not found *in situ*, is thus described by Mr. Prestwich. "It was "lying flat in the gravel at a depth of 17 feet from the original "surface, and $6\frac{1}{2}$ from the chalk. One side slightly projected. The "gravel around was undisturbed, and presented its usual perpendi- "cular face. I carefully examined the specimen, and saw no reason "to doubt that it was in its natural position, for the gravel is "generally so loose, that a blow with a pick disturbs and brings "it down for some way around; and the matrix is too little ad- "hesive to admit of its being built up again as before with the same "materials. . . . . I found also afterwards, on taking out the "flint, that it was the thinnest side which projected, the other side "being less finished and much thicker."* Neither in my first visit, nor this spring, when with Mr. Prestwich and Mr. Evans, I made another careful examination of these localities, was I so fortunate as find any implement *in situ*. But evidence of this nature, though interesting, is unnecessary; *the flints speak for themselves.* Originally of a dull black, they have been more or less discolored and their surfaces are generally stained yellow or white, according to the nature of the beds in which they have been lying. As this discoloration follows the contours of the present surfaces, it is evident that the alteration of color has been subsequent to the manufacture, as I have attempted to show in the first Volume of this Review. (Pl. VII. fig. 11.) Even when, as is the case in some strata, the color is unaltered, the weapons have a glossy surface, and a lustre very unlike newly broken flints. In many cases also they have an incrustation of carbonate of lime and small dendritic markings. Moreover, it must be remembered, that when M. Boucher de Perthes' work was published, the weapons therein described were totally unlike anything then known Since that time, however, not only have similar implements been found in various parts of England and France, but as already mentioned it has since come to light that similar weapons were in two cases actually described and figured in England many years ago, and that in both these instances they were found in association with the bones of extinct animals.

On this point, therefore, no evidence could be more conclusive.

It has, however, been suggested that though the worked flints are really found by the workmen in the mammaliferous gravel, they may perhaps be comparatively recent, and have gradually inserted

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* Phil. Trans. 1860, p. 292.

themselves from above by the force of gravity. Here however, again, I cannot do better than quote from the writer in Blackwood, "that "a few minutes' inspection of the beds containing and overlying the "flint implements of the Somme will assure any observer that they "are entirely destitute of the imagined crevices, and are moreover "altogether too compact and immoveable to admit of any such insi- "nuation or percolation of surface objects."

Taking all these circumstances into consideration, it cannot be doubted that the flint implements really belong to the same age as the sands and gravels in which they occur.

Perhaps the most striking peculiarity of these weapons is, that they are never polished, not a single specimen having presented a trace of grinding; while, on the other hand, the implements of the later stone period, those which occur in burial-places, river beds, &c., are always carefully polished.

As regards their form, they are grouped by Mr. Evans under three heads:

"1. Flint flakes, apparently intended for arrowheads, or knives."

"2. Pointed weapons, analogous to lance or spear heads."

"3. Oval or almond-shaped implements, presenting a cutting edge all round."

The flakes offer no special peculiarities, The mode of their manufacture has already been described and illustrated (Nat. Hist. Rev. Oct. 1861),* and similar articles have been used by savages in all ages and countries, where flint or obsidian was obtainable.

The implements of the other two forms, which, however, pass almost imperceptibly into one another, are on the contrary quite unlike any of those belonging to the last or polished stone-period. The nearest approach to them is made by the small and rude implements found in the Danish Kjökkenmöddings,† but these again have a peculiar form, and would be at once distinguished by any experienced observer. During my last visit to Abbeville, I was much interested by finding, in the museum of M. Boucher de Perthes, a few small hatchets, which, both in shape and size, very closely resembled those which are found in the Danish Kjökkenmöddings, but all of these belonged to the later or post-elephantine period. It is, I think, probable that similar axes will be found in other countries, but that they have generally escaped notice hitherto on account of their rudeness.

Up to the present time no bones of men have been found in the strata containing the flint implements. This, though it has appeared to some so inexplicable as to throw a doubt on the whole question, is, on consideration, less extraordinary than it might at first sight appear to be. If, for instance, we turn to other remains of human settlements, we shall find a repetition of the same phenomenon. Thus

* See also Sir E. Belcher, British Ass. T. 1860, p. 154, and Mr. Tylor's "Anahuac," p. 331.

† Nat. Hist. Review, Vol. 1, Pl. VII. figs. 8 and 9.

in the Danish refuse-heaps, where worked flints are a thousand times more plentiful than in the St. Acheul gravel, human bones are of the greatest rarity. In this case, as in the Drift age, mankind lived by hunting and fishing, and could not therefore be very numerous. In the era however of the Swiss lake habitations, the case was different. M. Troyon estimates the population of the "Pfahlbauten" during the Stone age as about 32,000; in the Bronze era, 42,000. On these calculations, indeed, even their ingenious author would not probably place much reliance: still, the number of the Lake villages already known is very considerable; in four of the Swiss lakes only, more than 70 have been discovered, and some of them were of great extent: Wangen, for instance, being, according to M. Lohle, supported on more than 40,000 piles. Yet, if we exclude a few bones of children, only five skeletons have been obtained from all these settlements taken together. The number of flint implements obtained hitherto from the drift of the Somme valley, is not estimated at more than 3000; the settlement at Concise alone (Lake of Neufchatel) has supplied about 24,000, and yet has not produced a single human skeleton. (Rapport a la Commission des Musées, October 1861, p. 16). Probably this absence of bones is almost entirely attributable to the habit of burying; the instinct of man has long been in most cases to bury his dead out of his sight; still, so far as the drift of St. Acheul is concerned, the difficulty will altogether disappear if we remember that *no trace has ever yet been found of any animal as small as a man.* The larger and more solid bones of the elephant and rhinoceros, the hippopotamus, ox and stag* remain, but every vestige of the smaller bones has perished. Till we find the remains of the dog, boar, roedeer, badger, and other animals which existed during the drift period, we cannot much wonder at the entire absence of human skeletons.

In all the other places where flint implements have occurred they have been very rare (except perhaps at Hoxne), and though the ascertained mammalian fauna is not everywhere quite so restricted as at St. Acheul, still very few small animals have as yet occurred.

It is useless to speculate as to the use made of these venerable weapons. Almost as well might we ask to what would they not be applied. Infinite as are our instruments, who would attempt even at present to say what was the use of a knife. But the primitive

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* The bones of the stag owe their preservation perhaps to another cause. Prof. Rütimeyer tells us that among the bones from the Pfahlbauten none are in better condition than those of the stag; this is the consequence, he says, "ihrem dichten Gefüge, ihrer Härte und Sprödigkeit, so wie der grossen Fettlosigkeit," peculiarities which recommended them so strongly to the men of the stone age, that they used them in preference to all others, nay almost exclusively, in the manufacture of those instruments which could be made of bone—(Fauna der Pfahlbauten, p. 12). How common the bones of the stag are in quaternary strata, geologists know, and we have here perhaps an explanation of the fact. The antler of this animal is also preferred at the present day by the Esquimaux in the manufacture of their stone weapons. (Sir E. Belcher, l. c. p. 154.)

savage had no such choice of tools; we see before us perhaps the whole contents of his workshop; and with these weapons, rude as they seem to us, he may have cut down trees, scooped them out into canoes, grubbed up roots, killed animals and enemies, cut up his food, made holes in winter through the ice, prepared firewood, built huts, and in some cases at least they may have served as slingstones. When, however, we shall have considered the physical evidence as to the then condition of the country, and the contemporary animals, we shall better be able to form a conception of the habits of these our long lost progenitors.

For I have as yet but partly answered the second of the two questions with which we started. Even admitting that the flint hatchets are coeval with the gravel in which they occur, it remains to be shown that the bones of the extinct animals belong also to the same period. With reference indeed to two of those ordinarily quoted as belonging to this group, there may still be some little doubt. It seems very questionable whether any remains really belonging to the cave-bear have ever occurred in these beds, as will presently be mentioned, and though a few tusks of the hippopotamus have been found, yet (as this genus never occurs in the corresponding beds of Germany) it is possible that they may have been washed out of some older stratum.

But as regards the elephant and the rhinoceros the case is different. There is not the slightest reason to doubt that they really belong to this period and, in the case of the rhinoceros, we have the evidence of M. Baillon that the bones of the hind leg of a rhinoceros were found, at Menchecourt, in their relative situations, while the rest of the skeleton was discovered at a little distance. In this case, therefore, the body must have been entombed before the decay of the ligaments. Sir Cornewall Lewis, however, in his interesting and able, even if unsatisfactory work, on the Astronomy of the Ancients, argues that even if we must give an affirmative answer to the two first questions, and admit the coexistence of man in Western Europe with the mammoth and tichorine rhinoceros; still we may do this by bringing these animals down to a later period, as well as by carrying man back to an earlier one.

Fairly admitting this, let us now, therefore, turn to the physical evidence in the case, and see how far this will enable us to give any, and if so what, answer, to the third of the above questions.

In this part of the subject I shall be principally indebted for my facts to Mr. Prestwich, who has long studied the quaternary beds, and has done more than any other man to render them intelligible. In most of his conclusions I entirely concur, but I may perhaps be permitted to mention that though the following statements are given on his authority, I have verified almost the whole of them for myself, having had the advantage of visiting, with him and Mr. Evans, many localities not only in the valley of the Somme, but also along the banks of the Seine and its tributaries.

Fig. 4, gives a section across the valley of the Somme at Abbeville, taken from Mr. Prestwich's first paper.* We should get almost the same arrangement and position of the different beds, not only at St. Acheul, but elsewhere along the valley of the Somme, wherever the upper beds have not been removed by subsequent action of the river. Even at St. Valery, at the present mouth of the river, we found a bed of gravel at a considerable height above the level of the sea. This would seem to show that at the period of these high level gravels, the channel was narrower than it is at present, as indeed we know to have been the case even in historical times. So early as 1605 our countryman Verstegan† pointed out that the waves and tides were eating away our coasts. Sir C. Lyell gives much information on this subject, and it appears that even as lately as the reign of Queen Elizabeth, the town of Brighton was situated on the site now occupied by the Chain Pier.

Mr. Prestwich has shown‡ that a section, similar to that of the Somme, is presented by the Lark, Waveney, Ouse, &c. while it is well shown also along the banks of the Seine. Probably, indeed, it holds good of most of our rivers, that along the sides of their valleys are patches of old gravels left by the stream at various heights, before they had excavated the channels to their present depth. Mr. Prestwich considers that the beds of sand and gravel can generally be divided into two more or less distinct series, one continuous along the bottom of the valleys and rising little above the water level; the other occurring in detached masses at an elevation of 50 to 200 feet above the valley. Rather, perhaps, these are the two extremes of a series, once continuous, but now almost always presenting some interruption. A more magnified view of the strata at St. Acheul, near Amiens, is shown in Fig. 2. The upper layer of vegetable soil having been removed,

1. A bed of brick earth from four to five feet in thickness, and containing a few angular flints.
2. Below this is a thin layer of angular gravel, one to two feet in thickness.
3. Still lower is a bed of sandy marl, five to six feet thick, with land and fresh water shells, which though very delicate, are in most cases perfect.
4. At the bottom of all, and immediately overlying the chalk, is the bed of subangular gravel in which the flint implements are found.

In the early Christian period this spot was used as a cemetery: the graves generally descend into the marly sand, and their limits are very distinctly marked, Fig. 2; an important fact, as showing that the rest of the strata have lain undisturbed for 1500 years. The coffins used were sometimes made of hard chalk, sometimes of wood, in which latter case the nails and clamps only remain, every

* Phil. Trans. 1860. † See Principles of Geology, p. 315.
‡ Proc. Roy. Soc. 1862.

particle of wood having perished, without leaving even a stain behind. Passing down the hill towards the river, all these strata are seen to die out, and we find ourselves on the bare chalk; but again at a lower level occurs another bed of gravel, resembling the first, and capped also by the bed of brick earth which is generally known as loëss.

These strata, therefore, are witnesses; but of what? Are they older than the valley, or the valley than they? are they the result of causes still in operation, or the offspring of cataclysms now, happily, at an end. According to the accomplished writer in Blackwood their testimony is but unsatisfactory. Examined they tell one tale; cross-examined they contradict themselves, until the jury falls back hopelessly on a verdict of "not proven."

If, indeed, we can show that the present river, somewhat swollen perhaps, owing to the greater extension of forests in ancient times, and by an alteration of climate, has excavated the present valley, and produced the strata above enumerated; then "the suggestion of an "antiquity for the human family so remote as is here implied, in the "length of ages required by the gentle rivers and small streams of "eastern France to erode its whole plain to the depths at which "they now flow, acquires, it must be confessed, a fascinating gran-"deur, when, by similitude of feature and geology, we extend the "hypothesis to the whole north-west frontiers of the continent, "and assume, that from the estuary of the Seine to the eastern "shores of the Baltic, every internal feature of valley, dale and "ravine—in short, the entire intaglio of the surface—has been "moulded by running waters, since the advent of the human race."

But, on the other hand, it has been maintained that the pliant facts may be read as "expressions of violent and sudden mutations, only compatible with altogether briefer periods." The argument of the Paroxysmist, I still quote from Blackwood, would probably be something like the following:—

"Assuming the pre-existing *relief*, or excavation rather, of the "surface to have approximated to that now prevailing, he will ac-"count for the gravel by supposing a sudden rocking movement of "the lands and the bottom of the sea of the nature of an earthquake, "or a succession of them, to have launched a portion of the tempo-"rarily uplifted waters upon the surface of the land."

Having thus heard the arguments of Counsel, let us now call the witnesses to speak for themselves.

Taking the section at St. Acheul and commencing at the bottom, we have first of all the subangular gravel throughout which, though especially at the lower part, the flint implements occur.

A similar bed may be found here and there all along the valley of the Somme; at St. Acheul it is about 90 ft. above the present river level; at Moulin Quignon, near Abbeville, the same; while at Picquigny and at Cæsar's Camp near Liercourt, we found it at a height of 150 feet. Though only occurring in places, this gravel is so similar in composition and contents, that we seem justified in assuming it to have been at one time continuous; and we may almost take the section, Fig. 4, as representing generally a section taken anywhere across the valley, only bearing in mind that through the action of subsequent causes, the gravel and the beds covering it have been in most cases removed. Nor is this a phenomenon peculiar to the Somme. During our last excursion we visited many gravel pits holding a similar relation to the Seine, while Mr. Prestwich in his recent communication to the Royal Society,* extends the same statement to many other rivers in England and France, the greatest height of the gravel above the present river level, varying however in different cases. At St. Acheul and in several other places this bed of gravel, which for the future we will call the *high level gravel*, is separated from the *low level gravel* by a bare tract of the underlying rock. We do, however, sometimes find beds at intermediate levels, and must therefore consider the upper level, and lower level gravels as the extremes of a continuous series, rather than as strata separated by an intermediate and different condition of the valley.

The mammalia found in this upper level gravel are but few; the Mammoth, the *Rhinoceros tichorhinus*, with species of *Bos*, *Cervus*, and *Equus* are almost the only ones which have yet occurred at St. Acheul, but beds of the same age in other parts of France have, in addition, supplied us with remains of the Bear, of a species of Tiger, of the *Hyæna spelæa*, *Cervus tarandus priscus*, of a species of Dog, of the Musk Ox, and the *Hippopotamus*. The Mollusca however are more numerous; they have been identified by Mr. J. G. Jeffreys, who finds in the upper level gravel 43 species, all of them land or freshwater forms, and all belonging to existing species. It is hardly necessary to add that these shells are not found in the coarse gravel, but only here and there, where quieter conditions, indicated by a seam of finer materials, have preserved them from destruction. Here, therefore, we have a conclusive answer to the suggestion that the gravel may have been heaped up to its present height by a sudden irruption of the sea. In that case we should find some marine remains; but as we do not, as all the fossils belong to animals which live on the land, or inhabit fresh waters, it is at once evident that this stratum not being subaerial, must be a freshwater deposit.

But the gravel itself tells us even more than this: the river Somme flows through a country in which there are no rocks older than the chalk, and the gravel in its valley consists entirely of chalk flints and tertiary debris.† The Seine, on the other hand, receives tributaries which drain other formations. In the valley of the Yonne we find fragments of the crystalline rocks brought from the Morvan.‡ The valley of the Oise is in this respect particularly instructive: "de Ma-

* Proceedings. 1862. † Buteux, l. c., p. 98.
‡ D'Archiac, Progrés de la Géologie, p. 163.

quenoise à Hirson* la vallée en présente que des fragments plus ou moins roulés des roches de transition que traverse le cours de la rivière. En descendant à Etréaupont, on y trouve des calcaires jurassiques et des silex de la craie, formations qui ont succédé aux roches anciennes. A Guise, le dépôt erratique . . . . est composé de quartzites et de schistes de transition de quelques grès plus recent, de silex de la craie, et surtout de quartz laiteux, dont le volume varie depuis celui de la tête jusqu'à celui de grain de sable . . . . Au delà les fragments de roches anciennes diminuent graduellement en volume et en nombre." At Paris we found the granitic debris brought down by the Yonne to form a notable proportion of the gravel; and at Précy, near Creil on the Oise, the fragments of the ancient rocks were abundant; but lower down the Seine at Mantes, they had both diminished very much in quantity, and at Rouen and Pont de l'Arche we saw none, though a longer search would doubtless have shown us fragments of them. This case of the Oise is however interesting, not only on account of the valuable evidence contained in the above quotation, but because, though it flows, as a glance at the map will show, immediately across and at right angles to the Somme, yet none of the ancient rocks which form the valley of the Oise, have supplied any debris to the valley of the Somme: and this though the two rivers are at one point within six miles of one another, and separated by a ridge of only 80 feet in height.

The same division occurs between the Seine and the Loire: "bien " que la ligne de partage des eaux de la Loire et de la Seine, " entre St. Amand (Nièvre) et Artenay, au nord d'Orléans, soit a " peine sensible, aucun débris de roches venant du centre de la France, " par la vallée de la Loire n'est passé dans le bassin de la Seine."†

In the Vivarais near Auvergne, " Les dépôts diluviens, sont com- " posés des mêmes roches que celles que les rivières actuelles entraî- " nent dans les vallées, et sont les débris des seules montagnes de la " Lozin, du Tanargue et du Mézene, qui entourent le bassin du " Vivarais.‡

Again,

" Le diluvium des vallées de l'Aisne et de l'Aire ne renferme que " les débris plus ou moins roulés des terrains que ces rivières coupent " dans leur cours."§

Other instances of the same law may be quoted; Mr. Prestwich has found it to hold good in England, but as it is an important link in the chain of evidence on which his views depend, it seemed better to take the facts from other observers. The conclusion deduced by M. D'Archiac from the consideration of these observations, and specially from those concerning the valley of the Seine, was " que les " courants diluviens ne venaient point d'une direction unique mais

* D'Archiac, l. c. p. 155.

† D'Archiac, l c. p. 164.

‡ D'Archiac, l. c. p. 160.

§ Malbos. Bull. Geol. Vol. III. p. 631.

"qu'ils convergaient des bords du bassin vers son centre, suivant les "depressions préexistantes, et *que leur élévation ou leur force de* "*transport ne suffisait pas pour faire passer les debris qu'ils charriaient* "*d'une de ces vallées dans l'autre.*"*

Considering, however, all these facts, remembering that the constituents of the upper level gravels are, in all cases, derived from beds now *in situ* along the valley, that they have not only followed the lines of these valleys, but have done so in the direction of the present waterflow, and without in any case passing across from one river system to another, we may surely, I think, follow Mr. Prestwich in his conclusion that these gravels have been brought down, and deposited by the present rivers.

The sandstone blocks which occur in the gravel appear indeed at first sight to be irreconcileable with any such hypothesis. In some pits they occur frequently, and are of considerable size; the largest I have myself seen is represented in the section, Fig. 1, taken close to the railway station at Joinville. It was 8 ft. 6 inches in length, with a width of 2 ft. 8 in., and a thickness of 3 ft. 4 in. Even when we remember that at the time of its deposition the valley was not excavated to its present depth, we must still feel that a body of water with power to move such masses as these must have been very different from any floods now occurring in those valleys, and might fairly perhaps deserve the name of a cataclysm. But whence could we obtain so great a quantity of water? We have already seen that the gravel of the Oise, though so close, is entirely different from that of the Somme, while that of the Seine again is quite different from that of any of the neighbouring rivers. These rivers therefore cannot have drained a larger area than at present; the river systems must have been the same as now. Nor would the supposition after all account for the phenomena. We should but fall from Scylla into Charybdis. Around the blocks we see no evidence of violent action; in the section at Joinville, the grey subangular gravel passed under the large block abovementioned, with scarcely any alteration. But a flood which could bring down so great a mass would certainly have swept away the comparatively light and moveable gravel below. We cannot therefore account for the phenomena by aqueous action, because a flood which would deposit the sandstone blocks would remove the underlying gravel, and a flood which would deposit the gravel would not move the blocks. The Deus ex machinâ has not only been called in most unnecessarily, but when examined turns out to be but an idol after all.

Driven, then, to seek some other explanation of the difficulty, Mr. Prestwich falls back on that of floating ice. Here we have an agency which would satisfactorily explain all the difficulties of the case. The "packing" and propelling action of ice would also account for some irregularities in the arrangement of the beds which

* L. c., p. 163.

are very difficult otherwise to understand. We are, indeed, irresistibly reminded of the figure given by Sir Charles Lyell* from a view taken by Lieut. Bowen, of the boulders drifted by ice on the shores of the St. Lawrence. I wish that I could transfer this view to our pages; but Sir C. Lyell's work must be in the hands of almost every geologist, and it will, perhaps, therefore, be unnecessary for me to quote the accompanying description, accurately as it portrays what must, I think, have been taking place in the valley of the Somme thousands of years ago, just as it does in the St. Lawrence at the present time. Nor does the physical evidence only, point to a more arctic climate during the period now under consideration; the fauna also tells the same tale. The mollusca, indeed, do not afford much evidence, but though mainly the same as those now living in the country, they have rather northern tendencies, 35 out of the 43 species being at present found in Finland.† With the mammalia the case is different. The Reindeer, the Musk Ox, the Norwegian Lemming, and the still more Arctic *Myodes torquatus*, all of which occur in the drift, are decidedly indications of a cold climate. The circumstances attending the discovery of the Tichorhine rhinoceros in Siberia, the fact of the Mammoth of the Lena being enveloped in ice so soon after death that the flesh had not had time to decay, as well as the manner in which these extinct Pachydermata were provided against cold, all tend to show that the *Elephas primigenius* and the *Rhinoceros tichorhinus*, unlike their congeners of to-day, were inhabitants rather of Arctic than Tropical climates. That there are in this argument two weak points, I must frankly admit. In the first place, it may be objected that the *Hippopotamus major*, of which bones occur in the drift, could scarcely have existed in a cold country. Mr. Prestwich, indeed, suggests that this species may, perhaps, like its gigantic relatives, have been fitted to flourish in an arctic climate. But there is some difference of opinion as to its occurrence; it has not yet been found in the "diluvium" of Germany, (Sir C. Lyell, Supplement to Manual, 1857, p. 8), and though remains of it have undoubtedly occurred in the drift gravel of the Somme, there is some reason to believe that they are not in quite the same condition as the bones of the Elephant and Rhinoceros; it is possible, therefore, that they may belong, as Dr. Falconer suggests, to an anterior period. Secondly, it might also be argued, that the animals above-mentioned, though at present confined to the colder regions, may once have lived in temperate countries. Until lately we should have regarded the Tiger as an essentially tropical animal; yet it is now known to be common in the neighbourhood of Lake Aral, in the forty-fifth degree of north latitude; and "the last Tiger killed, in "1828, on the Lena, in lat. 52¼°, was in a climate colder than that "of St. Petersburg and Stockholm."‡

* Principles, 1853, p. 220. † Proc. Roy. Soc. 1862, p. 44.
‡ Lyell, Principles, p. 77.

While, however, admitting these two possible objections, it is still, I think, felt by most Palæontologists, that though the presence of one Arctic species would scarcely perhaps justify any very decided inference as to climate, still that the co-existence of such a group as this; the musk ox, the reindeer, the lemming, the *Myodes torquatus*, the Siberian mammoth, and its faithful companion the woolly haired rhinoceros, decidedly indicates, even though it may not prove, the existence of a climate unlike that now prevailing in Western Europe. But when, in addition, we get the physical evidence brought forward by Mr. Prestwich, the disturbed condition of the beds, and the presence of the large blocks, the inference is much strengthened. The amount of difference still remains to be ascertained. Taking the present range of the Musk ox and Reindeer as his guides, Mr. Prestwich assumes a difference in the mean winter temperature of 19° to 29°. While, however, admitting the probability of a somewhat greater winter cold, we are not, I think, yet in a position to estimate the amount of change.

It must always be borne in mind that the temperature of Western Europe is at present exceptionally mild; if we go either to the east or west, to Canada or Siberia, we find countries under the same latitude as London and Paris suffering under a far more severe climate.

The river St. Lawrence, to which I have pointed as throwing so much light on the transport of the blocks now in question, is actually in a lower latitude than the Seine or the Somme. Moreover, geologists are agreed that at the period of the boulder clay, a period immediately preceding that now under consideration, the cold in Western Europe must have been far more intense than it is at present. The subject is treated at length in an excellent paper by Mr. Hopkins* (then President of the Geological Society), and it is admitted (p. 61) that many of our rivers have probably followed their present directions "ever since the glacial period." Mr. Prestwich's hypothesis involves therefore in reality no *change of climate*. He only supposes that, in this early period of our rivers, the temperature of Western Europe agreed with that which had preceded, rather than with that which now prevails; or rather, perhaps, that, in this intermediate period, the temperature had neither the extreme severity of the glacial era, nor the exceptional mildness of modern times.

But though diminishing the improbability of the suggestion, these considerations throw no light on the alteration of the conditions which must have taken place to produce an alteration of climate so great as that inferred by Mr. Prestwich.

The principal causes which have been suggested are the following:—

1stly. A possible variation in the intensity of solar radiation.

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* Geol. Journal, 1852, p. 56.

To this Mr. Hopkins sees no *a priori* objection; but he does not feel disposed to attach much weight to it, because it is "a "mere hypothesis framed to account for a single and limited "class of facts, and unsupported by the testimony of any other "class of allied, but independent phenomena."

2ndly. Admitting the proper motion of the sun, it has been suggested that we may have recently passed from a colder into a warmer region of space.

I must refer to Mr. Hopkins' paper for his objections to this suggestion, which certainly appear to "render the theory "utterly inapplicable to the explanation of the changes of "temperature at the more recent geological epochs." (l. c. p. 62.)

3rdly. The effect of an altered position of land and water.

This cause, which has been advocated by Sir C. Lyell with so much ability, would no doubt have the effect attributed to it, but it seems scarcely applicable to the present difficulty, because the geography of Western Europe must have been nearly the same during the period under consideration, as it is at present. The existence of a continent north of Scandinavia and Scotland, might indeed go far towards accounting for the phenomena; but to this suggestion we must make the same answer as to the first.

4thly. An alteration in the earth's axis.

The possibility of such a change has indeed been denied by many astronomers. My father, on the contrary, in a letter to Sir C. Lyell,* has maintained that it would necessarily follow from upheavals and depressions of the earth's surface, if only they were of sufficient magnitude. This suggestion, however, like the preceding, involves immense geographical changes, and would therefore necessarily have required an enormous lapse of time.

5thly. Mr. Hopkins, in the paper to which I have already alluded, inclines to find another solution of the difficulty in the supposition that the Gulf Stream did not at this period warm the shores of Europe "A depression of 2000 feet would," he says, "convert the Mississippi into a great arm of the sea, of which "the present Gulf of Mexico would form the southern ex-"tremity, and which would communicate at its northern "extremity with the waters occupying the . . . . . . great "valley now occupied by the chain of lakes." In this case the Gulf Stream would no longer be deflected by the American coast, but would pass directly up this channel into the Arctic Sea; and as every great ocean current must have its counter current, it is probable that there would be a flow of

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* Geol. Jour., Vol. V. p. 4.

> cold water from the north, between the coasts of Norway and Greenland. The absence of the gulf stream would probably lower the January temperature of Western Europe 10 degrees, while the presence of a cold current from the North would make a farther difference of about three or four degrees;* an alteration of the climate which would apparently be sufficient to account for all the phenomena. This theory, Mr. Hopkins considers as no mere hypothesis, but as necessarily following from the submergence of North America, which has been inferred from evidence of a different nature.

In this case, of course, the periods of great cold in Europe and in America must have been successive and not synchronous; and it must also be observed, that in this suggested deflection of the Gulf Stream Mr. Hopkins was contemplating a period anterior to that of the present rivers. For if we are to adopt this solution of the difficulty, what an immense time would be required. If, when the gravels and loëss of the Somme and the Seine were being deposited, the Gulf Stream was passing up what is now the Valley of the Mississippi, then it follows that the formation of the loëss in that valley and its delta, an accumulation which Sir C. Lyell has shown to require a period of about 100,000 years, would be subsequent to the excavation of the Somme Valley, and to the presence of man in Western Europe.

Thus, therefore, though the alteration of climate apparently indicated by the zoological contents and the physical condition of the beds, might by increasing the power of the floods, add to the erosive action of the river, and thus diminish on the one hand the time required for the excavation of the valley, still the very alteration itself appears, on the other hand, to require an even greater lapse of time.

But even if the presence of the sandstone blocks, and the occasional contortions of the strata, far from being objections to Mr. Prestwich's views, seem rather to speak strongly in their favour, still the height which the gravels sometimes attain above the present water-level, is at first sight a great difficulty, and we cannot wonder therefore that these beds have generally been attributed to violent cataclysms, owing to the emergence of the land, to astronomical causes, and even to the elevation of the Andes.

M. Boucher de Perthes has always been of this opinion. "Ce "coquillage, cet éléphant, cette hache, ou la main qui la fabriqua, "furent donc témoins du cataclysme qui donna à notre pays sa con- "figuration présente."†

M. C. D'Orbigny, observing that the fossils found in these quaternary beds are all either of land or freshwater animals, correctly dismisses the theory of any marine action, and expresses himself as

* Hopkins, l. c., p. 85.

† Mem. Soc. d'Em. l'Abbeville, 1861, p. 475.

follows :—" En effet l'opinion de la plupart des géologues est que les " cataclysmes diluviens ont eu pour causes prédominantes de fortes " oscillations de l'écorce terrestre, des soulèvements de montagnes " au milieu de l'ocean, d'où seraient résultées de grandes érosions. " Par conséquent les puissants courants d'eau marine, auxquels on " attribue ces érosions diluviennes, auraient dû laisser sur les conti- " nents des traces authentiques de leur passage, tels que de nombreux " débris de coquilles, de poissons et autres animaux marins analogues " à ceux qui vivent actuellement dans la mer. Or, ainsi que M. " Cordier l'a fait remarquer depuis longtemps à son cours de géologie, " rien de semblable n'a été constaté. Sur tous les points du globe " où l'on a étudié les dépôts diluviens, on a reconnu que, sauf quelques " rares exceptions très contestables, il n'existe dans ces depôts aucun " fossile marin: ou bien ce sont des fossiles arrachés aux terrains " préexistants, dont la dénudation a fourni les matériaux qui com- " posent le diluvium. En sorte que les dépôts diluviens semblent " avoir eu pour cause des phénomènes météorologiques, et paraissent " être le résultat d'immenses inondations *d'eau douce*, et non d'eau " marine, qui, se précipitant des points élevés vers la mer, auraient " dénudé une grande partie de la surface du sol, balayé la généralité " des êtres organisés et pour ainsi dire nivelé, coordonné les bassins " hydrographiques actuels."* (See also D'Archiac, l. c. passim). It is unnecessary for me to point out how entirely these views differ from the one here advocated, and which we owe mainly to the persevering researches of Mr. Prestwich. Such cataclysms as those supposed by Mr. D'Orbigny, and many other French Geologists, even if admitted, would not account for the results before us. We have seen that the transport of materials has not followed any single direction, but has in all cases followed the lines of the present valleys, and the direction of the present waterflow; that the rocks of one valley are never transported into another; that the condition of the loëss is irreconcileable with a great rush of water; that the mammals and molluscs are the same throughout the period; while, finally, the perfect preservation of many of the most delicate shells is clear proof that they have not been subjected to any violent action.

We must, moreover, bear in mind that the gravels and sands are themselves both the proof and the results of an immense denudation. In a chalk country, such as that through which the Somme flows, each cubic foot of flint, gravel or sand, represents the removal of at the very least twenty cubic feet of chalk, all of which, as we have already seen, must have been removed from the present area of drainage. In considering, therefore, the formation of these upper and older gravels, we must not picture to ourselves the original valley as it now is, but must, in imagination, restore all that immense mass of chalk which has been destroyed in the formation of the lower level gravels and sands. Mr. Prestwich has endeavoured to illustrate this by a dia-

* C. D'Orbigny, Bul. Geo. 2nd ser. V. xvii. p. 66.

gram,* and I must once more repeat that this is no mere hypothesis, since the mass of sand and gravel cannot have been produced without an immense removal of the chalk.

Far, therefore, from requiring an immense flood of water, two hundred feet in depth, the accumulation of the gravel may have been effected by an annual volume of water, differing little from that of the present river.

A given quantity of water will, however, produce very different effects, according to the manner in which it passes. "We learn "from observation, that a velocity of three inches per second at the "bottom will just begin to work upon fine clay fit for pottery, and "however firm and compact it may be, it will tear it up. Yet no beds "are more stable than clay when the velocities do not exceed this: for "the water even takes away the impalpable particles of the superficial "clay, leaving the particles of sand sticking by their lower half in the "rest of the clay, which they now protect, making a very permanent "bottom, if the stream does not bring down gravel or coarse sand, "which will rub off this very thin crust, and allow another layer to "be worn off. A velocity of six inches will lift fine sand, eight "inches will lift sand as coarse as linseed, twelve inches will sweep "along fine gravel, twenty-four inches will roll along rounded peb- "bles an inch diameter, and it requires three feet per second at the "bottom to sweep along shivery angular stones of the size of an egg."†

If, therefore, we are justified in assuming a colder climate than that now existing, we should much increase the erosive action of the river, not only because the rains would fall on a frozen surface, but because the rainfall of the winter months would accumulate on the high grounds in the form of ice and snow, and would every spring produce floods much greater than any which now occur.

We now come to the light-coloured sandy marl (Fig. 2). It is described by Mr. Prestwich as follows, "White siliceous sand "and light-coloured marl, mixed with fine chalk grit, a few large sub- "angular flints, and an occasional sandstone block, irregular patches "of flint gravel, bedding waved and contorted, here and there layers "with diagonal seams, a few ochreous bands, portions concreted. "Sand and freshwater shells common, some mammalian remains."

In the pits at Amiens this bed is generally distinct from the underlying gravels, owing perhaps to the upper portion of the gravel having been removed; but in several places (Précy, Ivry, Bicêtre, &c.) we saw this section complete, the gravel coarser below becoming finer and finer, and at length passing above into siliceous sand. These sections evidently indicate a loss of power in the water at these particular spots, rapid enough at first to bring down large pebbles, its force became less and less until at length it was only able to deposit fine sand. This, therefore, appears to indicate a change in the course

* Proceed. Roy. Soc. 1862, p. 41.

† Cyc. Brit. Article "Rivers," p. 274.

of the river, and gradual excavation of the valley, which, by supplying the floods with a lower bed, left the waters at this height with a gradually diminishing force and velocity.

The upper part of the section at St. Acheul consists of brick earth, passing below into angular gravel, while between this and the underlying sandy marl is sometimes a small layer of darker brick earth. These beds, however, vary much even in adjoining sections. Taken as a whole they are regarded by Mr. Prestwich as the representatives of that remarkable loamy deposit which is found overlying the gravels in all these valleys of Northern France, and which, as the celebrated "loëss" of the Rhine, attains a thickness of 300 feet. The greatest development of it which I have seen was in a pit in the Rue de la Chevalerie, near Ivry, where it was twenty-two feet thick, some of which however may have been reconstructed loëss brought down by rain from the higher ground in the immediate neighbourhood.

Assuming that this loëss is composed of fine particles deposited from standing or slowly moving waters, we might be disposed to wonder at not finding in it any traces of vegetable remains. We know, however, from the arrangement of the nails and hasps that in some of the St. Acheul tombs wooden coffins were used, while the size of the nails shows that the planks must have been tolerably thick; yet in these cases every trace of wood has been removed, and not even a stain is left to indicate its presence.

Such is a general account of those gravel pits which lie at a height of from 80 to 150 feet above the present water level of the valleys, and which along the Somme are found in some places even at a height of 200 feet.

Let us now visit some of the pits at the lower levels. At about thirty feet lower, as for instance at Menchecourt, near Abbeville, and at St. Roch, near Amiens, where the gravels slope from a height of about sixty feet down to the valley, we find almost a repetition of the same succession; coarse subangular gravel below, finer materials above. So similar, indeed, are these beds to those already described, both in constitution and in the animal remains they contain, that it will be unnecessary for me to give any farther description of them.

Finally, the lowest portion of the valley is at present occupied by a bed of gravel, covered by silt and peat, which latter is in some places more than twenty feet thick, and is extensively worked for fuel. These strata have afforded to the antiquaries of the neighbourhood, and especially to M. Boucher de Perthes, a rich harvest of interesting relics belonging to various periods. The depth at which these objects are found has been carefully noted by M. Boucher de Perthes.

" Prenant," he says, " pour terme moyen du sol de la vallée, une " hauteur de 2 mètres audessus du niveau de la Somme, c'est à 30 à " 40 centimètres de la surface qu'on rencontre le plus abondamment "les traces du moyen-âge. Cinquante centimètres plus bas, on "commence à trouver des débris romains, puis gallo-romains. On "continue à suivre ces derniers pendant un mètre, c'est a dire "jusqu'au niveau de la Somme. Après eux, viennent les vestiges "gaulois purs qui descendent sans interruption jusqu'à près de "2 mètres audessous de ce niveau, preuve de la longue habitation "de ces peuples dans la vallée. C'est à un mètre plus bas, ou a 4 "mètres environ audessous de ce même niveau, qu'on arrive au "centre du sol que nous avons nommé Celtique, celui qui foulèrent "les Gaulois primitives ou les peuples qui les précédèrent;" and which belonged therefore to the ordinary stone period. It is, however, hardly necessary to add that these thicknesses are only given by M. Boucher de Perthes "comme terme approximatif."

The "Antiquités Celtiques" was published several years before the Swiss Archæologists had made us acquainted with the nature of the Pfahlbauten; but, from some indications given by M. Boucher de Perthes, it would appear that there must have been, at one time, lake-habitations in the neighbourhood of Abbeville. He found considerable platforms of wood, with large quantities of bones, stone implements, and handles closely resembling those which come from the Swiss lakes.

These weapons cannot for an instant be confounded with the ruder ones from the drift gravel. They are ground to a smooth surface and a cutting edge, while the more ancient ones are merely chipped, not one of the many hundreds already found having shown the slightest trace of grinding. Yet though the former belong to the stone age, to a time so remote that the use of metal was apparently still unknown in Western Europe, they are separated from the earlier weapons of the upper level drift by the whole period necessary for the excavation of the Somme Valley, to a depth of more than 100 feet.

If, therefore, we get no definite date for the arrival of man in these countries, we can at least form a vivid idea of his antiquity. He must have seen the Somme running at a height of, in round numbers, a hundred and fifty feet above its present level. From finding the hatchets in the gravel up to a level of a hundred feet, it is probable that he dates back in Northern France almost, if not quite, as long as the rivers themselves. The face of the country must have been indeed unlike what it is now. Along the banks of the rivers ranged a savage race of hunters and fishermen, and in the forests wandered the mammoth, the two-horned, woolly, rhinoceros, a species of tiger, the musk ox, the reindeer, and the urus.

Yet the geography of France cannot have been very different from what it is at present. The present rivers ran in their present directions, and the sea even then lay between the Somme and the Adur, though the channel was not so wide as it is at present.

Gradually the river deepened its valley; ineffective, or even perhaps constructive, in autumn and winter, the melting of the snows turned it every spring into a roaring torrent. These floods were probably more destructive to animals even than man himself; while, however rude they may have been, our predecessors can hardly be supposed to have been incapable of foreseeing and consequently escaping the danger. While the water, at an elevation of 150 feet above its present level, as for instance at Liercourt, had sufficient force to deposit coarse gravel; at a still higher level it would part with finer particles, and would thus form the loëss which, at the same time, would here and there receive angular flints and shells brought down from the hills in a more or less transverse direction by the rivulets after heavy rains.

As the valley became deeper and deeper the gravel would be deposited at lower and lower levels, the loëss always following it;* thus we must not consider the loëss as a distinct bed, but as one which was being formed during the same time, though never at the same place as the beds of gravel. Fig. 3, I have given an imaginary diagram, the better to illustrate my meaning; the loëss is indicated by letters with a dash and is dotted, while the gravels are represented as rudely stratified. In this case I suppose the river to have run originally on the level (*a*), and to have deposited the gravel (*a*) and the loëss (*a′*); after a certain amount of erosion which would reduce the level to (*b*), the gravel would be spread out at *b*, and loëss at (*b′*). Similarly the loëss (*c′*) would be contemporaneous with the gravel (*c*).

Thus while in each section the lower beds would of course be the oldest, still the upper-level gravels as a whole would be the most ancient, and the beds lying on the lower parts of the valley the most modern.

For convenience I have represented the sides of the valley as forming a series of terraces; and though this is not actually the case, there are several places in which such terraces do occur.†

It is, however, well known that rivers continually tend to shift their courses; nor is the Somme any exception to the rule; the valley itself indeed may be comparatively straight, but within it the river winds considerably, and when in one of its curves, the current crosses "its general line of descent, it eats out a curve in the opposite bank, "or in the side of the hills bounding the valley, from which curve it "is turned back again at an equal angle, so that it recrosses the line "of descent, and gradually hollows out another curve lower down in "the opposite bank, till the whole sides of the valley, or river-bed,

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* See Mr. Prestwich's paper read before the Royal Society, June 19th, 1862.

† While attributing the excavation of these valleys to the action of the existing rivers, Mr. Prestwich doubts whether they could have produced such an effect without an elevation of the land. Marine shells occur at Abbeville about 25 feet above the sea-level; this bed Mr. Prestwich correlates with some of the raised beaches round our coasts, and with the lower level valley gravels. The higher level valley gravels correspond in his opinion with the raised beaches which occur at a higher level.

"present a succession of salient and retiring angles." (Lyell, Principles, p. 206.) During these wanderings from one side of the valley to the other, the river continually undermines, and removes the gravels which at an earlier period it had deposited. Thus the upper-level gravels are now only to be found here and there, as it were in patches, while in many parts they have altogether disappeared, as, for instance, on the right side of the valley between Amiens and Pont Rémy, where hardly a trace of the high level gravels is to be seen.

At length the excavation of the valley was completed; the climate must have approached what it is now, and whether from this change, or whether perhaps yielding to the irresistible power of man, the great Pachydermata had become extinct. Under new conditions, the river, unable to carry out to sea the finer particles brought down from the higher levels, deposited them in the valley, and thus raised somewhat its general level, checking the velocity of the stream, and producing extensive marshes, in which a thick deposit of peat was gradually formed. We have, unfortunately, no reliable estimate as to the rate of formation of this substance, but on any supposition the production of a mass more than 20 feet in thickness must have acquired a very considerable period. Yet it is in these beds that we find the remains of the stone period. From the tombs at St. Acheul, from the Roman remains found in the peat near the surface of the ground, at about the present level of the river, we know that fifteen hundred years have produced scarcely any change in the configuration of the valley. In the peat, and at a depth of about 15 feet in the alluvium at Abbeville, are the remains of the stone period,* which we know from the researches in Denmark and Switzerland to be of an age so great that it can only be expressed in thousands of years. Yet all these are subsequent to the excavation of the valley; what antiquity then are we to ascribe to the men who lived when the Somme was but beginning its great task? No one can properly appreciate the time required who has not stood on the heights of Liercourt, Picquigny, or on one of the other points overlooking the valley: nor, I am sure, could any geologist return from such a visit without an overpowering sense of the change which has taken place, and the enormous time which must have elapsed since the first appearance of man in Western Europe.

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* We shall probably ere long be able to divide this era into several divisions. Already we have two well marked epochs, the elephantine and the post-elephantine. But Prof. Worsaae proposes, and not without reason, to subdivide this latter into the period of the "Kjökkenmöddings" on the one hand, and that of the "Pfahlbauten" on the other. The contents of the Danish tumuli belonging to the Stone period, agree rather with those from the lake habitations of Switzerland, than with those which occur in the Refuse-heaps of Denmark, and though we could not expect to find many well-worked implements in the kjökkenmöddings, we ought otherwise surely to have obtained ere now at least some broken pieces of the beautiful flint weapons which were so common in Denmark during the later part of the stone period.

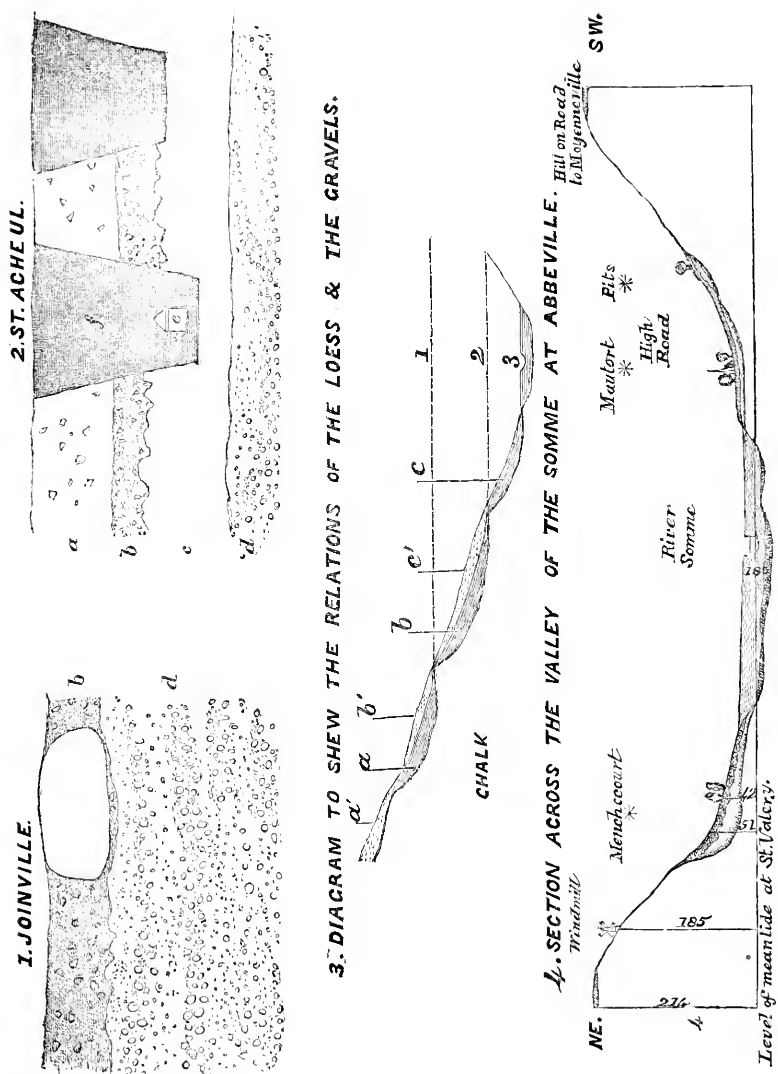
We cannot but ask what manner of men they were who lived in these distant times: did they resemble the present inhabitants of Arctic Europe, who were regarded by a quaint old writer of the last century as being even lower than Apes,* or did the celebrated Neanderthal skull (Nat. Hist. Review, Vol. I. p. 155) belong to this race of men? We may hope that the discovery of a skeleton will ere long enable us to answer this question; may the veteran antiquary of Abbeville himself be the fortunate finder of the first human bones in the drift!

But were these the first settlers in Europe? M. Lartet answers in the negative, and ingeniously attempts to construct a Palæontological Chronology. (Ann. Sci. Nat. iv.; Ser. V. xv. 6217.) The great cave-bear (*Ursus spelæus*) has been frequently found associated with man in caves, but its remains have, according to M. Lartet, not yet been found in the river drifts. The species is indeed quoted by Messrs. Buteux and Ravin, on whose authority it is also given by Messrs. Prestwich and Evans; but M. Lartet, after careful examination, not having been able to find the specimen originally attributed to this species, concludes that the *Ursus spelæus* perished at an earlier period, and that the *Hyæna spelæa* and the *Felis spelæa* belong only to the earliest beds of the drift. The caves, therefore, in which these animals have been found associated with the remains of men, indicate, he thinks, a still greater antiquity for the human race.

Negative evidence in Palæontology must indeed always be regarded with suspicion, but I may at least be permitted to repeat the opinion that it is not in a northern country and in a cold climate that we shall find the first traces of man. No nation would choose such an abode; civilised man, indeed, may prefer a temperate region, favourable to the exercise both of mind and body; but the savage will go where he can most readily satisfy savage wants; he will not therefore betake himself to temperate, still less to Arctic regions, until driven there by increasing density of population.

But are we justified in concluding that even the cave men were the earliest human settlers in Western Europe? Surely not. The whole history of Palæontology is a standing protest against such an assumption. We have not indeed as yet the materials to decide the question, but if we were to express any opinion on the subject, it would seem more philosophical to imagine that the genus *Homo* dates back to a period as ancient as the other widely-spread genera of Mammalia; and that wherever the bones of Deer, Elephants, Horses, Oxen and Dogs are to be found, there we may fairly expect ere long to discover also the remains of Man.

* "Such is the description of this little animal, called a Laplander; and it may "be said, that, after the Monkey, he approaches nearest to Man."—*Regnard's Journey to Lapland*, p. 164.


1. JOINVILLE.
b
d
2. ST. ACHEUL.
a
b
c
d
f
e
3. DIAGRAM TO SHEW THE RELATIONS OF THE LOESS & THE GRAVELS.
a'
a
b'
b
c'
c
1
2
3
CHALK
4. SECTION ACROSS THE VALLEY OF THE SOMME AT ABBEVILLE.
NE.
SW.
Windmill
Hill on Road to Moyenneville
Menchecourt
Mautort
High Road
Pits
River Somme
185
274
4
42
51
18
Level of mean tide at St. Valery.

DESCRIPTION OF THE FIGURES.

PLATE VII.—A flint instrument found near Abbeville; slightly reduced. Our artist has been so careful to present a faithful image of this interesting specimen, that he has even copied exactly my memorandum as to the place and date of its discovery.

WOOD ENGRAVINGS.—

Fig. 1. Section taken in a pit close to the Joinville Station.
b. Red angular gravel, containing a very large sandstone block.
d. Grey subangular gravel.

Fig. 2. Section at St. Acheul near Amiens.
a. Brick earth, with a few angular flints.
b. Red angular gravel.
c. Marly sand, with land and freshwater shells.
d. Grey subangular gravel, in which the flint implements are found.
e. Coffin.
f. Tomb.

Fig. 3. Diagram to illustrate deposit of loëss and gravel.
a′ Loëss corresponding to a contemporaneous with gravel *a*
b′ Loëss ,, ,, ,, *b*
c′ Loëss ,, ,, ,, *c*
1. Level of valley at period *a*
2. ,, ,, *b*
3. ,, present.

Fig. 4. Section across the valley of the Somme at Abbeville, after Prestwich; the length is however reduced to one-third.

XXVII.—ON THE MAMMALS, BIRDS, ETC., OF THE MACKENZIE RIVER DISTRICT. By Bernard H. Ross, Esq.

Fort Simpson, McKenzie's River District.
10th November, 1861.

MY DEAR SIR JOHN,—I am happy to acquaint you that I have procured from the Youcon, through the kindness of Mr. Lockhart, who is in charge of that establishment, two teeth and three tusks of the *Elephas primigenius*, or what Prof. Leidy calls, in his "Ancient Fauna of Nebraska," *Elephas americanus*. Two of the tusks are moderately-sized portions; but they show clearly the great curve that distinguishes the fossil from the existing species of elephants. The third tusk is of much larger dimensions, not much decayed, and nearly straight. It possibly may belong to some other animal. How curious it is that a tradition exists up the Peace River of some immense animal.

If you do not require the specimens, after examination, might I suggest the British Museum as a proper place to deposit them in?

Should you have any particular destination in view, do with them as you think fit.

I enclose to your address an amended list of the mammals, birds, and eggs collected in this district up to the present date. This, however, excludes more than 300 specimens from various posts, which I have not yet had time to arrange; and among which some additional species will doubtless be found. At present, the list contains about 50 species of mammals and 190 of birds. A considerable portion of the names has been corrected by Professor Baird, and the remainder I am responsible for; and I do not think there are many errors, as I am now becoming tolerably *au fait* at identifications. If you think the list would be of interest, as showing the progress of Zoölogical investigation in the Arctic regions, might I ask you to forward it, after perusal, to some scientific journal. You will find, on reading, that the *Colymbus Adamsii* is of frequent occurrence on Great Slave Lake; and I have received about a dozen specimens from the Big-Island. Two specimens of the *Somateria V. nigra* have also been procured on the same sheet of water, which is the richest field for rare birds of any place in the district. My own Fort Simpson collection you will recognise by a (‖) placed after the species obtained here; and from the number thus marked you can form an idea of my labours. The number of specimens collected by myself is about 1000. I procured one nest of the *Nyctale Richardsonii* containing three eggs, but I expect four will prove to be the complete number. The bird had built in a woodpecker's deserted hole. Two nests of the *Surnia ulula* were procured for me, one at Lapierre's House and one at Salt River. They were built some height up pine trees, and contained each *four* eggs. One set is for the British Museum, for which Institution I am forming a general collection. I am surprised that a specimen of the *Sialia arctica* has not come in yet.

You will see that the advance in Oölogy is considerable. Could a full series of the eggs of all birds be obtained, I think that they would lead to the most easy and natural classification for the Aves. The conformation and position of the *nests* is so much influenced by the natural features of the locality in which they nest, that, though of secondary value, they could not be much depended upon. From overlooking this fact, the great ornithologist, Audubon, has in some instances doubted the correctness of other writers' identification of eggs, because the construction of the nests did not absolutely agree with those which fell under his own observation.

A post has been established this year among the Eskimos. It is built on the Anderson or Inconnue River, a stream rising at some distance eastward of Fort Good Hope and falling into Liverpool Bay. I am not very sanguine of the success of the speculation, in a commercial point of view.

I hope to obtain leave of absence next year. I have now been fifteen years in this district, and think I deserve a holiday. The

District is now greatly improved. I have nice carpeted rooms, and a library of above 700 volumes, besides the use of a public one of about the same size.

With best wishes, I remain, my dear Sir John,

Respectfully and truly yours,

BERNARD H. ROSS.

Sir John Richardson, C.B. &c. &c.

A LIST OF MAMMALS, BIRDS, AND EGGS OBSERVED IN THE McKENZIE'S RIVER DISTRICT, WITH NOTICES. By Bernard R. Ross, Corresponding Member N. H. Society, Montreal.

MAMMALS.

I.—Order Rapacia.

(Insectivora.)

Family Soricidæ.

No. of Species.

1. *Sorex Fosteri (?)* || (Richardson).
2. *Sorex palustris (?)* || (Bachm). } This genus is abundant throughout the District, as far North as the Arctic coast. I cannot speak confidently as to either the names or the number of the species.

(Carnivora.)

Family Felidæ.

Genus Lynx.

3. *Lynx canadensis* || (Rafin.). Canada Lynx. Loup Cervier, of the Canadians; Cat, of the Hudson's Bay residents; Picheu, of the Cree Indians and Red River Half-Breeds; Ché-say, of the Chipewyan Indians. This animal is numerous some years, but is migratory, following the hares (Lep. Amer.), its principal food. It ranges to the Arctic coast in summer. In the winter, it does not leave the shelter of the woods.

Family Canidæ.

(Lupinæ.)

Genus Canis.

4. *Canis griseo-albus* (Rich.). Strong-wood Wolf. Loup-gris, of the Canadians; Ma-heé-can, of the Cree Indians; Nun-dei-yah, of the Chipewyans; Yess, of the Copper Indians; and Mah-núckh of the Anderson River Eskimos. Of this species I consider that there are two varieties,—one of which is of a dark colour and large size, inhabiting the wooded portions of the District as far North as the

No. of Species.

Youcon River. The other is usually of a dirty white tint, with, in general, a dark stripe down the back, and frequents the barren grounds northwards to the Arctic coast. It is of smaller size than the first-mentioned variety, and lives in much larger bands; indeed, it may possibly be a distinct species.

(Vulpinæ.)

Genus Vulpes.

5. *Vulpes fulvus* var. *fulvus*‖ *Vulpes decussatus*‖ *Vulpes argentatus*‖ } Red, Silver, and Cross Foxes. Ma-káy-sis, of the Cree Indians; Naw-kée-thay, of the Chipewyan Indians; Pee-sóot-eh, of the Anderson River Eskimos. This species, in all its varieties, is found all over this District to the Arctic coast. They are most numerous around the shores of the lakes, and in swampy tracts on the banks of the larger rivers. In the mountain ranges they are rare. The proportions of the various colours killed in the McKenzie District are as follow:—Red, $\frac{6}{15}$; Cross, $\frac{7}{15}$; Silver, $\frac{2}{15}$.

6. *Vulpes lagopus* var. *lagopus* *Vulpes fuliginosus* } White and Blue Foxes. Both these varieties inhabit the barren grounds and shores of the Arctic Sea. The latter is exceedingly rare, much more so than the Silver Fox is in the Fulvus species. White Foxes have been killed on the south shore of Great Slave Lake, and *one* Blue one on the north shore.

Family Mustelidæ.

Martinæ.

Genus Mustela.

7. *Mustela americana*‖ (Turton). American Sable Marten. Thă, of the Chipewyan Indians; Naw′-they, or Naw′-fey, of the Slave Indians. Common wherever there are woods; but migratory. The farther North that the skin is obtained, the darker the tint of the pelage. On the Youcon River they strongly resemble the Siberian Sable.

8. *Mustela Pennantii* (Erxleben). Fisher. Pecan, of the Canadians; Thā-cho, or Big Marten, of the Chipewyan Indians: rare. Range, up to 62° North.

Genus Putorius.

9. *Putorius pusillus* (Aud. and Back.). Least Weasel. New York to Big Island, Great Slave Lake.

10. *Putorius Cicognani* (Bonap.). Small Brown Weasel. Boston to 62° North: common.

No. of Species.

11. *Putorius Richardsonii?* (Bonap.). Little Ermine. Boston to Lapierre's House: rather rare.
12. *Putorius noveboracensis?* || (De Kay). Ermine. Northern New York to 62° North: rare.
13. *Putorius longicauda?* || (Richards). Long-tailed Weasel. Upper Missouri to 62° North: rare. I am far from certain of the identities of the three last species. All the Ermines which are killed in this District have the white of the winter coat slightly tinged with sulphur yellow.
14. *Putorius vison* || (Richards.). Brown Mink. Teth-gew-say, of the Chipewyan Indians; Trai-ek-puck, of the Eastern Eskimos. Range, from Florida to the Arctic coast: common.
15. *Putorius nigrescens* || (Aud. and Back.). Little Black Mink. Northern New York to 62° North. This supposed species is nothing more than the young of the P. Vison.

Genus Gulo.

16. *Gulo luscus* || (Sabine). Wolverine. Carcajou. Nó-gah, of the Chipewyan Indians; Khá-vig, of the Eastern Eskimos. Northern New York to Arctic coast: common.

Lutrinæ.

Genus Lutra.

17. *Lutra canadensis* || (Sabine). Otter. Naw-peé-ah, of the Chipewyan Indians. Florida to Arctic coast: not uncommon.

(Melinæ.)

Genus Mephitis.

18. *Mephitis mephitica* (Shaw). Common Skunk. Texas to Fort Resolution, Great Slave Lake. I have never seen a living specimen of this animal in McKenzie's River; but I found the bones and a part of the skin of one a short distance from the shores of Great Slave Lake.

Family Ursidæ.

Genus Ursus.

19. *Ursus horibilis* (Ord.). Grizzly Bear. Sas-tel-kie, of the Chipewyan Indians. Plains of Upper Missouri to Youcon River: not rare in the mountain ranges.
20. *Ursus americanus* || var. *americanus* *Ursus cinnamoneus* } (Aud. and Back.). Black and Brown Bears. Sas, of the Chipewyan Indians. Common throughout to the Arctic Circle, and beyond: the brown variety is very rare.
21. *Ursus arctos?* Barren-ground Bear. Inhabits the barren-grounds and Arctic coasts. Distinguished from the *U. horibilis* by its smaller size and reddish coloration.

No. of Species.

22. ***Ursus maritimus*** (Linn.). Polar Bear. Nait'-suck of the Eastern Eskimos. Common along the Arctic coasts.

II.—Order Rodentia.

Family Sciuridæ.

(Sciurinæ.)

Genus Sciurus.

23. ***Sciurus hudsonius*** || (Pallas). Chickaree. Throughout to within the Arctic circle.

Genus Pteromys.

24. *Pteromys alpinus* (Richs.). Rocky Mountains Flying Squirrel. Found on the mountain ranges of the Liard River: rather rare.

Genus Tamias.

25. *Tamias quadrivittatus* || (Richs.). Missouri Striped Squirrel. From lat. 33° 30′ to 67° North: very abundant on the Liard River.

Genus Arctomys.

26. *Arctomys monax* || (Gmelin). Ground Hog. South Carolina to 62° North: rare.

27. *Arctomys pruinosus* (Gmelin). North to Arctic circle: abundant on the mountain ranges.

28 *Arctomys Kennicottii* (Ross). This I consider to be a new species; but I may be wrong. It is of small size, and inhabits the Northernmost ranges of the Rocky Mountains.

(Castorinæ.)

Genus Castor.

29. *Castor canadensis* || (Kuhl). Beaver. Isă, of the Chipewyan Indians. Throughout North America to within the Arctic circle: very abundant.

Family Muridæ.

(Murinæ.)

Genus Jaculus.

30. *Jaculus hudsonius* || (Wagler). Jumping Mouse. Pennsylvania to Youcon River. Common at Portage-la-loche: rare, in McKenzie's River.

Genus Hesperomys.

31. *Hesperomys myoides* || (Gapper). Hamster Mouse. New York to Arctic Sea. Very abundant, east of the Rocky Mountains: not found westward, on the Youcon River. This species is very annoying in dwellings, as it carries off quantities of sugar, rice, &c., in its cheek-pouches, to store for its winter consumption.

No. of Species.

Genus Arvicola.

32. *Arvicola riparia* ‖ (Ord.). Middle States to the Arctic Sea: common.
33. *Arvicola Richardsonii* ‖ (De Kay). 62° North: rare.
34. *Arvicola xanthognathus* (Leach). Red-cheeked Arvicole. North to the Arctic Sea: common.

Genus Fiber.

35. *Fiber zibethicus* ‖ (Cuvier). Musk Rat. Dzin, of the Chipewyan Indians. North America to Arctic Sea: abundant.

Family Hystricidæ.

Genus Erithezon.

36. *Erithizon dorsatus* ‖ (Cuvier). White-haired Porcupine. From Pennsylvania to within the Arctic Circle: common.
37. *Erithizon epixanthus* (Brandt). Yellow-haired Porcupine. From Upper Missouri to Liard's River.

Family Leporidæ.

Genus Lepus.

38. *Lepus americanus* ‖ (Errl). White Rabbit. Khă, of the Chipewyan Indians. From Virginia to within the Arctic Circle: migratory.
39. *Lepus glacialis* (Leach). Arctic Hare. Newfoundland, North, to Arctic Sea: not common.

Genus Lagomys.

40. *Lagomys princeps* (Richs.). Little Chief Hare: common among mountain ranges of the Liard's River.

III.—Order Ruminantia.

Family Cervidæ.

(Cervinæ.)

Genus Alce.

41. *Alces americanus* ‖ (Jardine). Moose. Tin-der′-yah, of the Chipewyan Indians. New York to within the Arctic Circle: abundant.

Genus Rangifer.

42. *Rangifer caribou* ‖ (Aud. and Bach.). Strong-wood Caribou. From Maine to the Youcon River: abundant.
43. *Rangifer groënlandicus.* Barren-ground Caribou. Barren grounds and Arctic coasts in spring, summer, and autumn; fringes of the woods, in winter. Chipewyan name for both species, Et-thin′.

Family Cavicornia.

Antilopinæ.

Genus Aplocerus.

44. *Aplocerus montanus* ‖ (Richs.). Mountain Goat. From Northern Cascade Mountains to the Arctic Sea: not uncommon.

No. of Species.

(Ovinæ.)

Genus Ovis.

45. *Ovis montana* (Cuvier). From the Upper Missouri to within the Arctic Circle.

(Bovinæ.)

Genus Ovibos.

46. *Ovibos moschatus* (Blainville). Musk-Ox, Eh-gir-ray-yaz-ze (Little Buffalo) of the Chipewyan Indians, barren grounds and Arctic coast: not rare.

Genus Bos.

47. *Bos americanus* (Gmelin). Bison. North to Little Buffalo River, Great Slave Lake.

IV.—Order Cheiroptera.

48. *Vespertilio subulatus* (Say). North to Salt River: very rare.

BIRDS.

Those marked thus * are winterers; thus †, the eggs have been procured.

I.—Order Raptores.

Family Falconidæ.

Genus Falco.

1. *Falco anatum* (Bonap.). Duck Hawk. North to Slave Lake: rare.

†2. *Falco columbarius*|| (Linn.). Pigeon Hawk. North to Lapierre's House: common.

†3. *Falco sparverius*|| (Linn.). Sparrow Hawk. North to Lapierre's House: rather rare.

Genus Astur.

4. *Astur atricapillus* (Bonap.). North to Fort Good Hope: rare.

Genus Archibuteo.

5. *Archibuteo Sancti-Johannis* (Gray). Black Hawk. North to Salt River: rare.

6. *Archibuteo lagopus*|| (Gmelin). Rough-legged Hawk. North to Lapierre's House: common.

7. *Archibuteo ferrugineus?* || (Gray). Squirrel Hawk. North to Fort Simpson (uncertain): rare.

Genus Buteo.

†8. *Buteo Swainsonii* (Bonap.) Swainson's Buzzard. North to Slave Lake: rare.

Genus Accipiter.

†9. *Accipiter fuscus*|| (Gmelin). Sharp-skinned Hawk. North to Fort Simpson: rare.

No. of Species.

Genus Circus.

10. *Circus hudsonicus* (Lacep). Marsh Harrier. North to Slave Lake: rather common.

Genus Aquila.

11. *Aquila canadensis*|| (Linn.). Golden Eagle. North to Arctic coast: rare.

Genus Haliaetus.

†12. *Haliaëtus leucocephalus*|| (Linn.). Bald Eagle. North to Arctic coast: common.

Genus Pandion.

†13. *Pandion carolinensis* (Gmelin). Osprey. North to Arctic coast: common.

Family Strigidæ.

Genus Bubo.

*14. *Bubo virginianus*|| (Swain.). Horned Owl. North to Arctic Circle and beyond.

Genus Otus.

*15. *Otus Wilsonianus*|| (Lesson). Long-eared Owl. North to Fort Simpson: rare.

Genus Brachyotus.

*16. *Brachyotus Cassinii*|| (Brewer). Short-eared Owl. North to Fort Simpson: common.

Genus Nyctale.

*†17. *Nyctale Richardsonii*|| (Bonap.). Sparrow Owl. North to Fort Simpson: rather rare.

Genus Nyclea.

*18. *Nyctea nivea* (Daudin). White Owl. North to Fort Norman: rare.

Genus Surnia.

*†19. *Surnia ulula*|| (Linn.). Hawk-Owl. North to Arctic coast: common.

II.—Order Scansores.

Family Picidæ.

Genus Picus.

*20. *Picus villosus*|| (Linn.). Hairy Woodpecker. North to Fort Simpson: common.

*21 *Picus pubescens* (Linn.). Downy Woodpecker. North to Fort Liards: not rare.

Genus Picoides.

*22. *Picoides arcticus*|| (Swain.). Black-backed Woodpecker. North to Simpson: rare.

*23. *Picoides hirsutus*|| (Vieillôt). Banded Woodpecker. North to Good Hope.

No. of Species.

*24. *Picoides dorsalis* || (Baird). Striped Woodpecker. North to Simpson. But one specimen of what I am disposed to consider to be this very rare bird has been secured. It resembles the P. hirsutus, except that the white is marked on the back in longitudinal instead of lateral lines.

Genus Sphyrapicus.

†25. *Sphyrapicus varius* || (Baird). Yellow-bellied Woodpecker. North to Fort Simpson: common.

Genus Colaptes.

†26. *Colaptes auratus* || (Swain.). Golden Woodpecker. North to Peel's River: common.

Genus Hylatomus.

27. *Hylatomus pileatus* (Baird?) Black Woodcock. North to Fort Liards: rare.

III.—Order Insessores.

Family Caprimulgidæ.

Genus Chordeiles.

†28. *Chordeiles popetue* || (Viell.). Night Hawk. North to Lapierre's House: rather rare.

Family Alcedinidæ.

Genus Ceryle.

†29. *Ceryle alcyon* || (Boie). Kingfisher. North to Peel's River: common.

Family Clopteridæ.

(Tyranninæ.)

Genus Tyrannus.

30. *Tyrannus carolinensis* || (Baird). King Bird. North to Simpson: rare.

Genus Sayornus.

31. *Sayornus Sayus* || (Baird). Says' Flycatcher. North to Simpson: rare.

†32. *Sayornus fuscus* || (Baird). Pewee. North to Simpson: rare.

Genus Contopus.

33. *Contopus borealis* || (Baird). Olive-sided Flycatcher. North to Simpson: rare.

Genus Empidonax.

†34. *Empidonax pusillus* || (Swain.) North to Fort Simpson: rare.

†35. *Empidonax Trailii.* Traill's Flycatcher. North to Fort Resolution: rare.

†36. *Empidonax minimus* || (Baird). Least Flycatcher. North to Fort Simpson: common.

No. of Species.

Family Turdidæ.

(Oscines.)

Genus Turdus.

†37. *Turdus Pallasii*||? (Cabanis). Hermit Thrush. North to Simpson: identity uncertain.

†38. *Turdus Swainsonii*|| (Cabanis). Olive-backed Thrush. North to Lapierre's House: abundant.

†39. *Turdus Aliciæ* (Bain). North to Youcon River; only found west of Rocky Mountains.

†40. *Turdus migratorius*|| (Linn.). Robin. North to Lapierre's House: abundant.

(Regulinæ.)

Genus Regulus.

41. *Regulus calendula* (Licht.). Ruby-crowned Wren. Fort Resolution: rare.

Family Syvicolidæ.

(Motacillinæ.)

Genus Anthus.

42. *Anthus ludovicianus*|| (Licht.) Tit-Lark. North to Fort Simpson: not common.

(Sylvicolinæ.)

Genus Mniotilta.

43. *Mniotilta varia?* || (Vieill.). Black and white Creeper. North to Simpson: very rare.

Genus Oporornis.

44. *Oporornis agilis?* || Connecticut Warbler. Fort Simpson: identity doubtful.

Genus Helmintophaga.

†45. *Helmintophaga peregrina*|| (Cabanis). Tennessee Warbler. North to Fort Simpson.

†46. *Helmintophaga celata* (Baird). Orange-crowned Warbler. North to Resolution: rare.

47. *Helmintophaga ruficapilla* (Wilson). Nashville Warbler. North to Resolution; rare.

Genus Seiurus.

†48. *Seiurus noreboracensis*|| (Gmelin). Water Thrush. North to Lapierre's House: common.

Genus Dendroica.

†49. *Dendroica coronata* || (Linn.). Myrtle Bird. North to Lapierre's House: rare.

†50. *Dendroica striata* (Forster). Black-poll Warbler. North to Lapierre's House: common.

No. of Species.

†51. *Dendroica aestiva* || (Gmelin). Yellow Warbler. North to Lapierre's House: abundant.

†52. *Dendroica maculosa* || (Gmelin). Black and yellow Warbler. North to Fort Simpson: rather rare.

†53. *Dendroica palmarum* || (Gmelin). Yellow red-poll Warbler. North to Resolution: rare.

Genus Myiodioctes.

54. *Myiodioctes pusillus* (Wilson). Green black-cap Fly-catcher. North to Lapierre's House: very rare.

Genus Setophaga.

†55. *Setophaga ruticilla* (Linn.). Red-start. North to Fort Good Hope: common.

Family Hirundinidæ.

Genus Hirundo.

56. *Hirundo horreorum* (Barton). Barn Swallow. North to Fort Resolution: rare.

†57. *Hirundo lunifrons* || (Say.). Cliff Swallow. North to Rat River: common.

58. *Hirundo bicolor* || (Vieill.) White-bellied Swallow. North to Good Hope: rare.

Genus Cotyle.

†59. *Cotyle riparia* || (Linn.). Bank Swallow. North to the Arctic sea: abundant.

Family Bombycillidæ.

Genus Ampelis.

†60. *Ampelis garrulus* || (Linn.). Wax-wing. North to Youcon River: not rare. An egg of this bird has been obtained on the Youcon by Mr. R. Kennicott. I have been informed by Mr. J. Hope, schoolmaster of the Church Missionary Society, resident at Fort Franklin, on Great Bear Lake, that these birds nest in numbers in that vicinity; but build so high up the trees as to render it difficult to obtain the eggs. A specimen was shot at Fort Liards in February, which causes me to mark the species as a winter resident.

Family Laniidæ.

Genus Collyris.

61. *Collyris borealis* || (Bon.). Northern Shrike. North to Good Hope: not rare.

62. *Collyris ludovicianus ?* || (Linn.). Logger-head Shrike. Fort Simpson: rare; doubtful.

(Vieroninæ.)

Genus Vireo.

63. *Vireo olivaceus* || (Vieill.). Red-eyed Fly-catcher. North to Fort Simpson: rare.

No. of Species.

64. *Vireo gilvus*|| (Bon.). Warbling Fly-catcher. North to Fort Simpson: rare.

Family Paridæ.

Genus Parus.

*65 *Parus septentrionalis*|| (Harris). Chickadee. North to Fort Simpson: not rare.

*66. *Parus atricapillus*|| (Linn.). Black-cap Tit. North to Fort Simpson: rare.

*67. *Parus hudsonicus* || (Forster). Hudson's Bay Tit. North to Fort Simpson: not rare.

Family Fringillidæ.

(Coccothraustinæ.)

Genus Pinicola.

*68. *Pinicola canadensis* || (Brisson). Pine Grosbeak. North to Fort Good Hope: not rare.

Genus Curvirostra.

*69. *Curvirostra leucoptera* || (Gmelin). North to Fort Good Hope.

Genus Aegiothus.

*†70. *Aegiothus linaria*|| (Linn.). Lesser Red-poll. North to Fort Good Hope: abundant.

*†71. *Aegiothus canescens*|| (Gould). Mealy Red-poll. North to Lapierre's: common.

Genus Plectrophanes.

(Plectrophanes.)

72. *Plectrophanes nivalis* || (Meyer). Snow Bunting. North to Good Hope: abundant.

(Centrophanes.)

73. *Plectrophanes lapponicus*|| (Selby). Long-spur. North to Fort Simpson.

74. *Plectrophanes pictus*|| (Swain.). Painted Bunting. North to Fort Simpson.

(Spizellinæ.)

Genus Passerculus.

†75. *Passerculus savanna* || (Bon.). Swamp Sparrow. North to Fort Simpson: abundant around Slave Lake.

76. *Passerculus sandwichensis*|| (Baird). North to Fort Simpson rare.

77. *Passerculus anthinus ?* (Baird). Great Bear Lake: uncertain.

Genus Zonotrichia.

†78. *Zonotrichia leucophrys* (Forster). North to Resolution: rare.

†79. *Zonotrichia Gambelii*|| (Nuttal). North to Lapierre's House: abundant.

No. of Species.

†80. *Zonotrichia ambicollis* (Gmelin). North to Fort Simpson: rather rare.

Genus Junco.

81. *Junco oregoneus* (Towns.). Oregon Snow Bird. North to Fort Simpson: rare.

†82. *Junco hyemalis* (Sclater). Snow-bird. North to Good Hope.

Genus Spizella.

†83. *Spizella monticola* (Baird). Tree Sparrow. North to Lapierre's House: abundant.

†84. *Spizella socialis* (*a*) (Wilson.) Social Sparrow. North to Fort Simpson: abundant.

†85. *Spizella socialis* (*b*) (Wilson). Striped-crown variety. North to Fort Simpson: common.

†86. *Spizella pallida* (Bonap.). North to Fort Resolution: rare.

Genus Melospiza.

†87. *Melospiza Lincolnii* (Baird). Lincoln's Finch. North to Fort Simpson: not rare.

88. *Melospiza palustris* (Baird). Swamp Finch. North to Fort Resolution: rare.

(Passerellinæ.)

Genus Passerella.

†89. *Passerella iliaca* (Swain.). Fox Sparrow. North to Lapierre's House: common.

Family Icteridæ.

Genus Melothrus.

90. *Melothrus pecoris* (Swain.). Cow-bird. North to Fort Simpson: very rare.

Genus Agelaius.

†91. *Agelaius phœniceus* (Vieill) Swamp Blackbird. North to Fort Norman.

92. *Agelaius gubernator* (Bon.). Red-shouldered Blackbird. North to Fort Simpson: common.

93. *Agelaius tricolor* (Nutt). Red and white-shouldered Blackbird. North to Fort Simpson: rare.

Genus Xanthocephalus.

94. *Xanthocephalus icterocephalus* (Baird). Yellow-headed Blackbird. Though no specimen of this bird has been procured I observed it *once* at Fort Simpson.

(Icterinæ.)

Genus Scolecophagus.

95. *Scolecophagus ferrugineus* (Swain). Rusty Blackbird. North to Good Hope: common.

No. of Species.

96. *Scolecophaqus cyanocephalus*|| (Cab.). Brewer's Blackbird North to Fort Simpson: not rare.

(Quiscalinæ.)

Genus Quiscalus.

97. *Quiscalus versicolor*|| (Vieill). Crow Blackbird. North to Fort Simpson: rare.

(*Family Corvidæ.*)

Genus Corvus.

*98. *Corvus carnivorus*|| (Bartram). Raven. North to Arctic coast: abundant.

99. *Corvus americanus* (Aud.). Common Crow, to 61° north latitude: abundant.

(Garrulinæ.)

Genus Pica.

*100. *Pica hudsonica* (Bon.). Magpie. On west of the mountains north to Lewis and Pelly Rivers.

Genus Perisoreus.

*101. *Perisoreus canadensis*|| (Bon.). Canada Jay. North to Lapierre's House: abundant.

IV.—Order Rasores.

(Columbae.)

Family Columbidae.

(Columbinae.)

Genus Ectopistes.

102. *Ectopistes migratoria*|| (Swain). Wild Pigeon. North to Fort Norman: not common,

(Gallinae.)

Family Tetraonidae.

Genus Tetrao.

*103. *Tetrao Richardsonii* (Doug.). Black Partridge. North to Fort Halkett: only in the mountains.

*†104. *Tetrao canadensis*|| (Linn.). Spruce Partridge. North to the Arctic coast: abundant.

Genus Pediœcetes.

*†105. *Pediœcetes phasianellus* (Baird). Sharp-tailed Grouse. North to Fort Good Hope.

Genus Bonasa.

*†106. *Bonasa umbellus*|| (*a*) (Steph.). Ruffled Grouse. North to Fort Simpson: common.

*†106. *Bonasa umbellus*|| (*b*) (Baird). Var. Umbelloides. Grey Mountain Grouse. North to Lapierre's House: common.

No. of Species.

Genus Lagopus.

*107. *Lagopus albus*|| (Aud.). White Ptarmigan. North to Arctic coast: common.

*108. *Lagopus rupestris* (Leach). Ptarmigan. North to Arctic coast: rather rare.

*109. *Lagopus leucurus*|| (Swain). White-tailed Ptarmigan. North to Lapierre's House in the mountains.

V.—Order Grallatores.

(Herodiones.)

Family Gruidae.

Genus Grus.

110. *Grus americanus*|| (Ord). White Crane. North to Fort Simpson: rare.

†111. *Grus canadensis*|| (Temm.). Brown Crane. North to Arctic coast: common.

112. *Grus fraterculus* (Cassin). North to Youcon River: only west of Rocky Mountains.

Genus Botaurus.

113. *Botaurus lentiginosus* (Steph.). Bittern. North to Arctic coast: rare northward.

(Grallae.)

Family Charadriidæ.

Genus Charadrius.

114. *Charadrius virginicus*|| (Borck.). Golden Plover. North to Arctic Coast: abundant.

Genus Ægialitis.

115. *Ægialitis semipalmatus*|| (Cab.). Semipalmated Plover. North to Fort Simpson: common.

Genus Squaterola.

116. *Squaterola helvetica* (Cuv.). Black-bellied Plover. North to Fort Simpson: rare.

Family Hæmatopodidæ.

Genus Strepsilas.

117. *Strepsilas interpres* (Illig.). Turnstone. North to Big Island: rare.

Family Recurvirostridæ.

Genus Recurvirostra.

118. *Recurvirostra americana* (Gmelin). American Avoset. North to Fort Rae: rare.

Family Phalaropodidæ.

Genus Phalaropus.

†119. *Phalaropus hyperboreus* (Temm.). North to Fort Rae: rare.

No. of Species.

Family Scolopacidæ.

Genus Gallinago.

120 *Gallinago Wilsonii* || (Bon.). English Snipe. North to Fort Simpson: rare.

Genus Macrorhamphus.

†121. *Macrorhamphus griseus* || (Leach). Red-breasted Snipe. North to Fort Norman: rare.

122. *Macrorhamphus scolopaceus* || (Laur.). North to Lapierre's House: rare.

Genus Tringa.

123. *Tringa maculata* || (Vieill). Jack Snipe. North to Fort Simpson: common.

124. *Tringa Wilsonii* || (Nutt.). Least Sandpiper. Fort Simpson: rather rare.

†125. *Tringa Buonapartii* || (Sch.). North to Fort Simpson: rare.

Genus Calidris.

126. *Calidris arenaria* (Illig.). Sanderling. North to Big Island: rare.

Genus Ereunetes.

127. *Ereunetes petrificatus* || (Illig.). Semipalmated Sandpiper. Fort Simpson: rare.

Genus Micropalama.

†128. *Micropalama himantopus* || (Baird). North to Fort Simpson: very rare.

(Totaninæ.)

Genus Gambetta.

129. *Gambetta melanoleuca* || (Bon.). Tell-Tale. North to Fort Simpson: rare.

†130. *Gambetta flavipes* || (Bon.). Yellow Legs. North to Lapierre's House: very abundant.

Genus Rhyacophilus.

131. *Rhyacophilus solitarius* || (Bon.). Solitary Sandpiper. North to Fort Simpson: common. It is rather a misnomer to call this bird solitary, as I have generally observed them in large flocks.

Genus Tringoides.

†132. *Tringoides macularius* || (Gray). Spotted Sandpiper. North to Fort Simpson: abundant. I have never observed this species to keep in flocks.

Genus Tryngites.

133. *Tryngites rufescens* || (Cab.). Buff-breasted Sandpiper. North to Fort Simpson: rare.

Genus Limosa.

134. *Limosa hudsonica* (Swain.). North to Big Island: rare.

No. of Species.

Genus Numenius.

135. *Numenius borealis* (Lath.) Eskimo Curlew. North to Fort Good Hope: rare.

Family Rallidæ.

(Rallinæ.)

Genus Porzana.

136. *Porzana carolinæ* (Vieill). Common Rail. North to Big-Island: rare.

Genus Fulica.

137. *Fulica americana*|| (Gmelin). Coot. North to Fort Simpson: rather rare.

VI.—Order Natatores.

(Anseres.)

Family Anatidae.

(Cygninæ.)

Genus Cygnus.

(Olor.)

138. *Cygnus americanus*|| (Sharp.). American Swan. North to Arctic coast: not common.

†139. *Cygnus buccinator*|| (Richd.). Trumpeter Swan. North to Arctic coast: common.

(Anserinæ.)

Genus Anser.

(Chen.)

140. *Anser hyperboreus*|| (Pallas). Snow Goose. North to Arctic coast: abundant.

141. *Anser albatus* (Cass.). North to Fort Resolution. Although no specimen of this Goose is among our collection I am certain that I have shot it on Slave Lake.

142. *Anser Rossii* (Baird). Ross's Wavey. North to Fort Resolution. There can be little doubt of the existence of these three species of Snow Geese (exclusive of the Blue Wavey of Hudson's Bay), as the Slave Lake Indians have a different name for each kind. The first which arrives is the middle-sized species which I believe to be the *A. albatus;* next comes the smallest sort, the *A. Rossii;* and lastly, the *A. hyperboreus*, which arrives when the trees are in leaf, and is called the Yellow Wavey by the Indians.

(Anser.)

143 *Anser Gambelii*|| (Hart.). White-fronted Goose. North to Arctic coast: common.

Genus Bernicla.

†144. *Bernicla canadensis*|| (Boie). Canada Goose. North to Arctic coast: common.

No. of Species.

†145. *Bernicla Hutchinsii* || (Bon.). Hutchin's Goose. North to Arctic coast: common.

146. *Bernicla Barnstenii?* || (Ross). This bird was shot at Fort Simpson. It is of very large size, with the breast of a bright fawn colour. The delta of feathers running up into the lower mandible is white, instead of black, as in *B. Canadensis*. The tail is of 16 feathers. The Indians consider it a species distinct from the Canada Goose. It seldom flies in parties of more than five or six. I cannot, however, positively state it to be a new species until the *Berniclæ* of North America are properly worked up, as they are in rather a hazy condition at present.

147. *Bernicla brenta* (Steph.). Brant. North to Youcon River. From information. This may probably be the *B. nigricans* (Cassin), as the Youcon has, in all likelihood, a Pacific Fauna.

(Anatinæ.)

Genus Anas.

†148. *Anas boschas* || (Linn.). Mallard. North to Arctic coast: abundant.

Genus Dafila.

†149. *Dafila acuta* || (Jenyns.). Pin-tail. North to Lapierre's House: common.

Genus Nettion.

†150. *Nettion carolinensis* || (Baird). Green-winged Teal. North to Peel's River: abundant.

Genus Querquerdula.

†151. *Querquerdula Discors* (Step.). Blue-winged Teal. North to Fort Resolution: rare.

Genus Spatula.

†152. *Spatula clypeata* || (Boie). Shoveller. North to Good Hope: not common.

Genus Mareca.

†153. *Mareca americana* || (Step.). American Widgeon. North to Peel's River: common.

(Fuligulinæ.)

Genus Fulix.

154. *Fulix marila* (Baird). Big Black-head. North to Fort Resolution: rather rare.

†155. *Fulix affinis* || (Baird). Little Black-head. North to Peel's River: abundant.

156. *Fulix collaris* || (Baird). Ring-necked Duck. North to Fort Simpson: rare.

Genus Aythya.

†157. *Aythya vallisneria* (Bon.). Canvass Back. North to Slave Lake: common.

No. of Species.

Genus Bucephala.

†158. *Bucephala albeola* || (Baird). Spirit Duck. North to Arctic coast: abundant.

†159. *Bucephala americana* || (Baird). Golden Eye. North to Arctic coast: not rare.

Genus Histrionicus.

160. *Histrionicus torquatus* || (Bon.). Harlequin Duck. North to Arctic coast: rare.

Genus Harelda.

161. *Harelda glacialis* || (Leach). South Southerly. North to Arctic coast: abundant.

Genus Malanetta.

†162. *Malanetta velvetina* (Baird). Velvet Duck. North to Arctic coast: not rare.

Genus Pelionetta.

163. *Pelionetta perspicillata* || (Kaup.). Surf Duck. North to Peel's River: abundant.

Genus Somateria.

164. *Somateria V. nigra* (Gray). Slave Lake Eider. A male specimen of this very rare bird was shot by me at Fort Resolution, in 1858; and a female was obtained by Mr. Alex. McKenzie, in 1861, at the same place. It is exceedingly rare, having never been seen elsewhere in the district.

(Erismaturinæ.)

Genus Erismatura.

165. *Erismatura rubida* (Bon.). Ruddy Duck. North to Slave Lake: rare.

Merginæ.

Genus Mergus.

166. *Mergus serrator* || (Linn.). Red-breasted Merganser. North Peel's River: common.

Genus Lophdytes.

167. *Lophodytes cucullatus* (Rich). Hooded Merganser. North to Slave Lake: rare.

(Giviæ.)

Family Phalacrocoracidæ.

Genus Graculus.

168. *Graculus dilophus* (Gray). Double-crested Cormorant. Slave Lake: rare.

Family Pelecanidæ.

(Crytopelicanus.)

Genus Pelecanus.

169. *Pelecanus erythrorhynchus* (Gmelin). American Pelican. North to Big Island: common.

No. of Species.

Family Laridæ.

(Lestridinæ.)

Genus Stercorarius.

170. *Stercorarius pomarinus* (Temm.). Pomarine Skua. Slave Lake: very rare.

171. *Stercorarius parasiticus* || (Temm.). Arctic Skua. North to Fort Simpson: rare.

†172. *Stercorarius parasiticus*, var. Richardsonii. Slave Lake: rare.

173. *Stercorarius catarraches* (Temm.). North of Slave Lake: very rare.

174. *Stercorarius Cepphus* || (Bru.). Buffon's Skua. North to Lapierre's House: rare.

(Laridæ.)

Genus Larus.

†175. *Larus glaucescens* || (Light.). Glaucus-winged Gull. Slave Lake: abundant.

†176. *Larus argentatus* || (Brii). Herring Gull. North to Arctic coast: abundant.

†177. *Larus californicus* (Lawr.). California Gull. Slave Lake: abundant.

Genus Chroicocephalus.

178. *Chroicocephalus philadelphia* (Laur.). North to Fort Simpson: not rare.

Genus Rissa.

179. *Rissa septentrionalis* || (Laur.). Slave Lake: very common.

(Sterninæ.)

Genus Sterna.

†180. *Sterna caspia* (Pallas). Caspian Tern. Slave Lake: rare.

†181. *Sterna Wilsonii* || (Bon). Wilson's Tern. Slave and Bear Lakes: very rare.

†182. *Sterna macroura* || (Naum). Arctic Tern. Bear Lake: abundant.

Genus Hydrochelidon.

183. *Hydrochelidon plumbea* (Wilson). Short-tailed Tern. Slave Lake: rare. Numerous other species of the sub-family Larinæ doubtless exist in this district; and will appear by degrees as the collections increase.

Family Colymbidæ.

(Colymbinæ.)

Genus Colymbus.

184. *Colymbus torquatus* || (Brii). Loon. North to Arctic coast: abundant.

185. *Colymbus Adamsi.* || North to Great Slave Lake: abundant.

†186. *Colymbus arcticus* || (Linn.), var. Pacificus. To Arctic coast: rather rare.

No. of Species.

187. *Colymbus septentrionalis* * (Linn.). Red-throated Diver. To Arctic coast: abundant.

(Podicipinæ.)

Genus Podiceps.

†188. *Podiceps Griseigna* || (Gray). Red-necked Grebe. North to Peel's River: common.

†189. *Podiceps cornutus* || (Latham). Horned Grebe. North to Lapierre's House: common.

190. *Podiceps auritus* (Latham). Eared Grebe. Slave Lake: rare.

Genus Podilymbus.

†191. *Podilymbus podiceps* (Laur.). Slave Lake: not common.

Additional.

192. *Numenius hudsonicus* (Latham). Hudsonian Curlew. Slave Lake: rare.

|| shows specimens were obtained at Fort Simpson.

Remarks.

The Northern range of the birds means the Northernmost Post at which a specimen has been obtained. I have on hand about 300 specimens yet unexamined, among which a few additional species will doubtless be found.

The following other collections have also been made:—

Fish—At Resolution, Big Island, Simpson, Bear Lake, and Liards.

Insects—At Resolution, Simpson, Youcon, Peel's River, and Good Hope.

Geological Fossils, &c. — On Clear Water, Elk, McKenzie, Anderson, and Rat Rivers.

Ethnological—In the District generally.

Meteorological Observations made, and register kept, at Forts Simpson, Youcon, Anderson, Rae, Norman, Good Hope, and Bear Lake.

XXVIII.—Note on the Distortions which present themselves in the Crania of the Ancient Britons. By Joseph Barnard Davis, M.R.C.S. Engl. F.S.A. &c.

During the lengthened and minute investigation of ancient British skulls, to which I have been impelled by the preparation of the "Crania Britannica," I have been frequently struck with a peculiar flatness in the occipital region prevailing among them. It often extends over a good part of the parietals, about the posterior portion of the sagittal suture, and over the upper part of the occipital bone.

Hence I have denominated it *parieto-occipital flatness*. The most peculiar and characteristic, normal form of these crania, which is very general, exhibits a shortness of the whole calvarium. This form must not be considered universal, yet it has prevailed among tribes far apart, if not deserving to be looked upon as different races. Such natural shortness has been found to be so common as in a material degree to mask the parieto-occipital flatness, to which allusion is now made. Another complication was early perceived in the occurrence of *posthumous distortion*, to which the skulls of the ancient Britons, like those of other people, are liable. The crania of those who were buried under tumuli have become singularly deformed by the pressure of the superincumbent earth, acting constantly upon a moist and slightly plastic body like the spheroidal skull. Others, whose remains were enclosed in cists, kistvaens, and cromlechs, were mostly defended from the mechanical influences which produced posthumous deformation. Still the effects of this kind of compression are often evident in the occipital region. Hence they serve to interfere with our appreciation of that deformity which manifests itself in the parieto-occipital flatness. It was only after witnessing many examples in which both kinds of distortion were present, and observing that they were not coincident, but quite independent of each other, that their real distinctness became fully apparent. In some ancient British crania of *young subjects*, preserved in the Bateman Museum, the original parieto-occipital flatness is observed, and at the same time another distinct and non-coincident flattening, generally on one side of the occipital region, which is clearly posthumous. To this subject I have directed attention in the Description of the Newbigging Skull in the "Crania Britannica," plate 21, p. (4); and more at length in the Description of the Green Lowe Skull, plate 41, p. (2). In the examples enumerated in these places both the two kinds of deformation manifest themselves, and, since they do not correspond, it is obvious that they have no relation to each other—one has been produced before and independently of the other.

It has long appeared to me most probable that the parieto-occipital flatness now under consideration was produced by some artificial process. In the Description of the undeformed British Skull from Caedegai Barrow in Denbighshire, "Crania Britannica," plate 23, p. 3, I distinctly attributed it to art at an early period of life. Still, the subject being curious, it may be deserving of some further attention and additional evidence, by which it will be satisfactorily proved that the ancient Britons observed certain practices which resulted in deformation of the skull. Further investigation has shown that neither these practices nor their results were confined to the ancient Britons alone, but have equally prevailed among the ancient Caledonians and Hibernians and the ancient Gauls.

I will, in a few words, describe the appearance of this peculiar parieto-occipital flatness. It varies in extent in the different crania in which it is seen; it also varies somewhat in its position, so as to present much diversity in the angle which its plane forms with that of the *vertical line* of the cranium; but it is always situated about the point of junction of the sagittal and lambdoidal sutures. This particular spot is commonly the centre of the flatness, which extends upwards upon the parietals and downwards on the occipital, in different degrees in different examples. The flatness itself is seldom perfect, for the progressive growth of the head, after the flattening influence has ceased to operate in infancy, has almost always occasioned some rounding of the surface, so as to give it a slight convexity. Nevertheless, the parieto-occipital flatness is very marked, and gives the idea of its having been produced by impression upon a plane. It is by no means always quite symmetrical, but, on the contrary, it is very often more apparent and extensive on one side than the other, as if the head had not rested upon the plane exactly at right angles to its long axis. It occurs in the skulls of females as well as of males, and is thus shown not to be any mark of distinction, such as the distorting processes to which the head was subjected in infancy among the Scythian tribes described by Hippocrates, among the ancient Aymaras, among the Chenooks and other races of North and South America. With these people there was a notion of *nobility* attached to the deformed head, which was wholly unapproachable by the inferior orders, such as slaves and women. In many cases, the diameter of the area of the flatness is fully four inches in every direction. It is impossible to estimate the comparative prevalence of this flatness with accuracy. In the plates of the "Crania Britannica," it is plainly perceptible in the skull from Green Gate Hill Barrow, Pl. 4; that from End Lowe, Pl. 13; that from Codford Barrow, Pl. 14. (Fig. 1.) where it is especially apparent; that from the Juniper Green Cist, Pl. 15; that from the Lesmurdie Cist, Pl. 16; that from the Newbigging Cist in the Orkneys, Pl. 21; that from the Kinaldie Cist, Pl. 25; that from the Wetton Hill Barrow, Pl. 34; that from Green Lowe, Pl. 41; and that from Ballard Down Barrow, Pl. 45. Thus we have reason to presume that it was a very general peculiarity of the aboriginal inhabitants of Britain and its islets. Parieto-occipital flatness is obviously present in two ancient Orcadian crania, derived from Cists in the Island of Pomona, in my collection. A skull disinterred from a Kistvaen in the Phœnix Park, Dublin, to be figured in the "Crania Britannica," proves that it prevailed among the ancient Hibernians. This is most likely that of a young man of about 30. The flatness extends over a little more of the sagittal region of the parietals than over the occipital. It is asymmetrical, the depression being greater on the right than the left side, which causes a slight projection on this side, near the middle of the parietal. It is above three inches in length, but not quite so broad, and its centre is just above the juncture of the sagittal and lambdoidal sutures. In this case, the deformed surface is perfectly flat. We have equally satisfactory proofs that this occipital flatness was a characteristic of the skulls of ancient Gauls. It exists in many contained in the Galerie Anthropologique, at the Jardin des Plantes, and is quite obvious in some of those derived from the excavation of the dolmen at Meudon, near Paris. A cast of one of these crania in my possession, is perhaps the most marked example of parieto-occipital flatness I have seen, and at the same time it indicates most convincingly the artificial nature of the distortion. (Fig. 2.) This also is the skull of a man, and is remarkably short. The flattened surface is nearly four inches in diameter in each direction, and rises up from just above the tuberosity of the occiput almost perpendicularly. At the junction of the sagittal with the lambdoidal suture there is a slight depression. The flattening is not quite symmetrical, but rather greater on the right side. In this example the plane of the flatness is, as nearly as possible, parallel to that of the *vertical line* of the calvarium, or the line drawn through the centre of the ear and the point of juncture of the coronal suture with the sagittal.* I have observed this peculiar flatness in many skulls of very young subjects, an evidence that it is produced at an early period of life.†

In turning to the *cause* of so general a deviation of form, it becomes at once evident that it must have arisen from the operation of influences which were all but universal. They must have been set in action at the earliest period of infantile life, and upon both sexes; yet there is no evidence that they were used with any express *design* for the production of this deformation. They clearly resolve themselves into the particular mode of nursing infants employed by the women of the ancient Britons, Caledonians, Hiber-

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* It ought not to be omitted to be mentioned here, that the late learned and excellent Swedish craniologist, Professor A. A. Retzius, designated this and the other brachycephalic skulls derived from the Meudon dolmen, "Basque." Arndt, Rask, Rudolf Keyser, Nilsson, and others had argued in an erudite manner, that all Western Europe in the oldest period was inhabited by a so-called *Turanian* race, who had brachycephalic skulls, of which the Finns and the Basques are the only representatives. On the discovery of many crania of this form among the osseous relics of the dolmen, at Meudon, the ardent Retzius regarded this, which is a mere hypothesis, to be fully proved, and he subsequently treated it as an established fact, and boldly asserted that these were the skulls of Basques, *i. e.* of the primeval race now supposed to be represented by the Basques. See his "Blick på Ethnologiens närvarande Ståndpunkt," 1857, p. 8. We may respect the fervid affirmation of so amiable a man, but are not able to allow that these crania are anything more than those of ancient Gauls, of the tribe of the Parisii. Such conclusion is not favourable to this large hypothesis, but it is believed to be in conformity with the facts and sober philosophy.

† It should likewise be particularly noticed that the parieto-occipital flatness is seen to occur in crania from Cists, where they were defended from superincumbent pressure, as well as in those from Barrows. This is a convincing evidence that it is a deformation of a totally different kind from posthumous distortion, which owes its origin to compression after burial. See Cran. Brit. p. 37. Athenæum, Aug. 6, 1859.

nians and Gauls. And, if any further proof were required that such nursing did produce this flatness, it is afforded by an examination of the skulls of those tribes of North American Indians, who adopt cradle-boards for their infants. In the calvarium of a LENNI-LENAPE from an old grave on the Delaware, which is in my collection, exactly the same parieto-occipital flatness is seen, occupying the spot already pointed out. (Fig. 3.) Like European examples, this cranium is asymmetrical, being more depressed on the right than the left side, as is *generally*, perhaps universally, the case; which has arisen from the child having been laid with an inclination to the right, or, more likely, having had by nature greater power in the organs of the right half of the body.*

It seems most probable that the board upon which the women of the so-called "Celtic" tribes placed their new-born infants to be nursed, was not a mere piece of flat board, like that in use by some of the North American Indian tribes. More likely it had a sort of inclined or sloping shelf, or pillow, at its upper part, against which the child's head rested. Some contrivance of this kind is introduced into the cradles of the Flathead-Tribes, on the Columbia River, as is seen in the figure given in Morton's "Crania Americana," p. 204, although, in this case, it is not placed in a sloping position. The different angle at which this inclined shelf for the head was introduced, accounts for the diversities in the direction of the parieto-occipital flatness, as seen in different skulls. Probably with a supply of the soft flocculent *sphagnum*, the child would be secured by straps, and retained in a pretty comfortable position, during the period of suckling, which lasts a long time among all primitive people. And, with a cradle so contrived, the mother would not be confined, like a modern mother, to one spot or apartment in the neighbourhood of her child, which is, in one sense, much of a fixture, but able to take her nursling about with her in all her laborious journeys and occupations, either when attending upon her husband, or engaged in her own family duties.

These cradle-boards among the ancient Britons would be made of thin and light wood, probably willow. Hence, if they were occasionally interred with the mother or child in the barrow, which is likely, there is no reason to expect that any fragments of them would still remain in a recognizable form; but, now that this particular mode of nursing upon a cradle-board is made known, some *traces* of its presence may yet be detected.

* Among the South American tribes the same custom has prevailed. In two prepared heads of QUICHUAS, or CHINCHAS, (men) kindly presented to me by the learned Professor J. Y. Simpson of Edinburgh, from the Chincha Islands, off the coast of Peru, the parieto-occipital flatness is strongly manifested in the same spot, and the same plane as in the LENNI-LENAPE. It is deeply impressed, extensive, and has been produced without counter-pressure on the frontal bone, therefore, no doubt, by the cradle-board.

There has been a good deal of diversity in the effects of this compression against the cradle-board, in different instances. A diversity in great measure to be attributed to the varying obliquity of the shelf for the pillow, already alluded to, and also to the degree of compression. In the case of the Codford skull, "Crania Britannica," (Plate 14, or Fig. 1 here) and in the cast of the Meudon skull (Fig. 2), a greater share of the parietal bones has been flattened. And the deformation has proceeded to such an extent as to render these examples almost parallel to some of those of America. In the "Crania Americana," Plates 8 and 9, are two ancient Peruvian calvaria, from the Temple of the Sun, in which the occipital region has been rendered almost perpendicular from this compression. And in the famous mound calvarium fróm the ancient Mound in the Scioto Valley, (Smithsonian Contributions to Knowledge, Vol. i.; Squier and Davis's Ancient Monuments of the Mississippi Valley, p. 288, Pl. XLVII.) the same result is presented. In some cases the flattening was carried to still more exaggerated lengths. Some instances in my collection are very extreme, as that of an ancient PAKOMAME from Guatemala, No. 378; that of an ancient MUIZCA, from Facatativo, in the plain of Bogátá, No. 306; and that of an ancient PERUVIAN, No. 918. But it is probable that in these tribes a counter-pressure was exercised upon the frontal bone. This was not the practice among the ancient Britons.

The parieto-occipital flatness in ancient British skulls is mostly very moderate in extent, and shows itself as an oblique plane, about the position in which the posterior fontanel was situated. Dr. L. A. Gosse, in his "Essai sur les Déformations artificielles du Crâne," has illustrated at some length the exaggerated form of compression of the occiput, under the title of "Tête déprimée par derrière," but has not paid much attention to the slighter flatness now described. Yet he has this incidental remark:—"Passant dans l'ancien continent, ne tardons-nous pas à reconnaître que ce berceau plat et solide y a produit des effets analogues. Les anciens habitants de la Scandinavie et de la Calédonie devaient s'en servir, si l'on en juge par la forme de leurs crânes." p. 74.

Notwithstanding this parieto-occipital flatness of ancient British skulls, and others of so-called Celtic races, which is the result of the intervention of art, although *without distinct design*, and which may now be considered to have been demonstrated, one usual normal form of these crania is brachycephalic, and that decidedly so. To this form I have applied the epithet *typical*. And it is too obvious to need remark, that the mode of nursing would heighten this brachycephalism. That the impression of the occipital region did so heighten it is indisputable; but, that it had the slightest influence in producing it, is quite contrary to the laws of physiology, and I believe wholly untenable.

POSTSCRIPT.—Although not immediately connected with the subject of this Note, yet closely allied to it, is a very curious distorted skull of an Anglo-Saxon woman, derived from the cemetery at Harnham, near Salisbury. It has been carefully and correctly figured in the "Crania Britannica," p. 40. However improbable in the present state of our knowledge it has seemed, I have always felt myself obliged to regard this as an example of *artificial* deformation, and have referred to the distorted skull of an ancient Peruvian woman ("Crania Americana," plate 3) as closely resembling it in form. The latter presents the peculiar ridges which indicate the position of the compressing bandages in Peruvian skulls. These are also present, although slight, in the Harnham specimen. It is, perhaps, in some measure to be attributed to the great improbability of the Saxon tribes having employed artificial means to distort the cranium, that we owe another attempt at explanation. In his recent valuable work, "Zur Morphologie der Rassenschädel," Professor J. C. G. Lucae, of Frankfort, has the following passage:—"Der in der ersten "Decade der Crania Britannica, Chap. iv. pag. 40, abgebildete vers-"chobene Schädel eines Weibes, der nach Angabe der Autoren durch "Kunst entstanden sein soll, verdankt sicher seine Bildung den vor-"handenen Synostosen. Nach der Abbildung ist hier gleichfalls der "grosse Keilbeinflügel mit dem Scheitelbein verwachsen. Da aber "hier auch zugleich der Keilbeinflügel mit dem untere Theil des "Stirnbeines verwachsen ist, so ist hier nicht allein ein Sattel, son-"dern auch das ganze Stirnbein flach gestellt," S. 53. Although distortion by synostosis is an ingenious conjecture, and quite consistent with the rationale of deformation in other crania depicted by Dr. Lucae, to which he refers, it is singularly at variance both with the figure of the Harnham specimen, and with the skull itself. In the woodcut, the spheno-parietal, the spheno-frontal, and the spheno-temporal sutures, so far from being the subjects of synostosis, are distinctly and accurately represented on the left side as quite open. There is even a slight gap in the position of the second, occasioned by the breaking off of a portion of the frontal. And, in the skull itself, these sutures, both on the right and left sides of the head, are seen to be patent and entire without any obliteration. That synostosis could have given rise to the deformation, as the distinguished Professor of Anatomy at Frankfort presumes, is wholly inadmissible.

The skull of a man of about 40 years of age, a Merovingian Frank, from the cemetery at Envermen, near Dieppe, in the Department of Seine-Inferieure, in my collection, No. 209, presents, although in a lesser degree, the same kind of deformation, and that with all the sutures of the alisphenoid open, therefore, without synostosis. The hint thrown out in the description of this Harnham specimen, that further research may probably reveal much more extensive distortion among ancient European tribes, seems to be rather confirmed than otherwise.

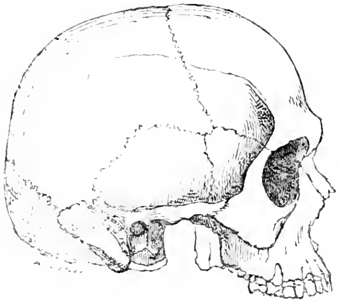

Fig. 1.

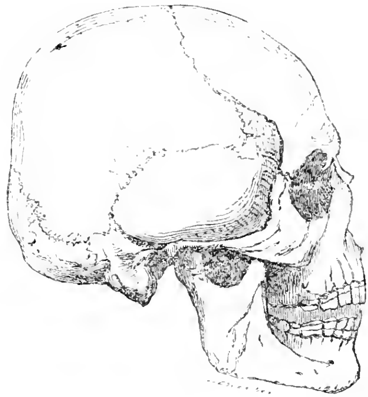

Fig. 2.

Fig. 3.

EXPLANATION OF THE FIGURES.

Fig. 1. Profile of skull of an ancient Briton, from a barrow at Codford, Wilts (region of the *Belgæ*).
The parieto-occipital flatness is nearly equal to that of Fig. 2.

Fig. 2. Profile of skull of an ancient Gaul, from the dolmen discovered at Meudon, Seine et Oise (Region of the *Parisii*), July 1845.
The parieto-occipital flatness is very extensive, and its plane is as nearly as possible parallel to that of the *vertical line*.

Fig. 3. Profile of imperfect calvarium of a Lenni-Lenape, from a grave found, in 1861, at Delaware Gap, Pennsylvania.
The parieto-occipital flatness presents itself at a very different angle from that of Figs. 1 and 2, still one that is common among ancient British skulls.
The figures are all quarter size.

XXIX.—The Structure of the Stem in Dicotyledons; being References to the Literature of the Subject. By Professor Oliver, F.L.S.

It is my aim in the present communication to embrace references, under the heads of the respective Natural Orders, to all the recent literature which I have been able to find, referring to the internal structure of the axis of woody Dicotyledons in respect of the arrangement of the tissues and microscopic character of the cells and vessels.

Upon the subject of the anatomy of the axis—which has not been greatly pursued by English botanists,—we have very numerous observations on record, but these want extending and correlating before any satisfactory generalisations can be based upon them, and the first steps of progress appear to be supplied by the collecting of these scattered data.

These references are mostly very brief and without much abstract or comment, unless my own or other observations have suggested any. When the figures of wood-structure in the elementary works which I have seen appeared to be worthy of mention I have given a reference to them. The plates of Grew,* Malpighi,† Leeuwenhoek,‡ Hill,§ and other of the fathers of phytotomy I have not thought it needful to quote. In the essays of H. v. Mohl, and numerous other writers upon general structural questions, much special information is often included which it would be an endless labour thoroughly to single out and refer to here. I have, however, endeavoured to notice all the more important cases in which wood-structure is thus incidentally described. Brief notes are added upon a few of the specimens and preparations contained in the Museum of the Royal Gardens at Kew, at least in those instances in which they have indicated interesting structural features. I refrain, in this communication, from touching upon the bearing which stem-structure may have upon Systematic Botany and Palaeontological Research, as well as from entering upon a discussion of the obscure and difficult subject of the relations which may be traced between the structure of the tissues and their function, and between the character of the axis generally and that of the floral-organs, upon which latter, indeed, it may be that the operations of systematists have been hitherto a little too exclusively based. I do not apprehend, however, that in respect to practical Systematic Botany, the methods usually accepted of estimating affinity, resting upon floral structure, are likely to derive from the anatomical structure of the stem an aid other than corroboratory, corresponding in some measure to that afforded by the sensible properties of plants.

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* Anatomy of Plants, 1682, with diagrams of the Structure of the Vine, Holly, Hazel, Barberry, Apple, Pear, Plum, Elm, Ash, Walnut, Fig, Pine, Oak, Sumac, &c.

† Anatome plantarum, 1673. ‡ Arcana Naturae.

§ The Construction of Timber, 1770.

The sequence of the Orders in the following list is, in the main that of M. De Candolle.*

RANUNCULACEAE.—*Clematis.* Dutrochet, H. Sur l'accroissement, des Végétaux, 1821, vii. 397. with fig.—Guillard, A. Sur la Moelle,† Ann. Sc. Nat. Ser. iii. viii. tab. xvi. 3. 4.—Buzareingues. Ann. Sc. Nat. xxx. tab. vii. 3, 4, and Ser. ii. i. tab. v.—Schleiden. Principles of Botany, (Eng. Trans.) 251, (fig).—Quekett. Histology, 84, (fig.)--Henfrey, A. Micr. Dict. 'Wood.'—Carpenter. The Microscope, (1856,) 431, (fig.) also (?) sub. nom. *Aristolochia*, p. 440. —*Anemone.* Vaupell, C. über d. peripherische Wachsthum d. Gefässbündel, &c. Leipsic, 1855, p. 21, tab. 2.—*Helleborus.* Link, H. F. Icones Anat. Bot. 1857, fasc. ii. xi. 1-5.—*Cimicifuga* and *Delphinium.* Hartig, Th. Beiträge z. vergleichenden Anatomie der Holzpflanzen. Bot. Zeit. 1859, 93, 96. On absence of medullary rays; the structure of the vascular bundles, &c.; *Thalictrum*, p. 108, Bastcells in the wood.

DILLENIACEAE. Crüger. H. Einiger Beiträge z. Kenntniss von sogenannten anomalen Holzbildungen des Dicotylenstammes.‡ Bot. Zeit. 1850. 166. On the structure of *Doliocarpus Rolandri*, with figures.

MAGNOLIACEÆ.—Goeppert, H. R., Ueber die anatomische Structur einiger Magnoliaceen. Linnæa. 1842, 135. Ann. Sc. Nat. Ser. ii. 18, 317.—*Drimys Winteri.* The wood consists of dotted prosenchyma traversed by medullary rays, the cells of which are punctuated and considerably larger than in Coniferæ.—*Tasmannia aromatica* offers a similar structure.—*Magnolia, Liriodendron* and *Illicium* differ in having dotted vessels traversing the

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* My best thanks are due to Sir W. J. Hooker, for the free access constantly permitted me to his invaluable botanical library, which has been of very great service in the preparation of this list.

† Sections of *Acer, Platanus, Corylus, Fraxinus, Broussonetia, Mespilus, Æsculus, &c.* are figured in this paper.

‡ This important paper of Dr. Crüger's, comprising much information upon the structure and development of lianes, does not readily admit of being usefully abstracted. I have referred under the several orders, to the genera which he describes in detail, noticing those which are illustrated by figures. Among the general conclusions to which the examination of numerous lianes leads this botanist, are the following, (l.c. p. 491). The essential points in which their stems differ from others are —The greater longitudinal extension of the stem in general and of its elementary parts in particular, during the first period of its growth and a proportional retardation of development in a transverse direction; a straighter and more separate course of the vascular bundles by which the medullary rays acquire greater extension; a predominance of parenchyma and vessels, both of which tissues retain their vitality until late,—the parenchyma its capability of multiplying, the vessels of conveying fluids.

By the persisting vitality of the tissues is to be explained the multiplication of the layers in the interior of many lianes. The twistings and angular bendings of many species are also to be ascribed to the same circumstance. The influence of the development and formation of the leaves on the structure of the stem is very marked in Bignoniaceae. The various divisions of the stem are mechanical, and as they are not constant in position, are to be ascribed to several accidental causes.

prosenchyma in alternating, concentric zones as in Dicotyledons generally. —*Winteraceæ*. Miers, J. On the. Ann. Nat. Hist. Ser. iii. 2, 34. Dotting of the vessels.—Henfrey, A. Micr. Dict. "Wood."—*Illicium*. Gray, A. Introd. Botany, 1858, 43. Dots on wood-cells (fig.).—The wood presents the normal dicotyledonous arrangement of tissues. The prosenchyma is minutely dotted longitudinally, on, at least, surfaces transverse to the medullary rays. (D.O.)

ANONACEÆ.—Martius, "Flora Brasiliensis," 64. Brief notes on the wood of *Anona crassiflora* and other species.—*Cyathostemma*. Griffith. Notulæ iv. 708.

SCHIZANDRACEÆ.—Lindley. J. Veg. Kingdom, 305.—Griffith, Notulæ, iv. 715.—*Kadsura Roxburghiana*. The prosenchyma cells bear longitudinal rows of minute, oblique, slit-like dots. A faint circle surrounds these, due to very narrow, lenticular, intercellular cavities, as in *Hamamelideæ*, &c. (D.O.)—*Sphærostema*. Lindley, J. Introduction to Botany, 1 p. 66, and Pl. ii. 20. Markings on wood cells.

LARDIZABALEÆ.—*Stauntonia latifolia*. Lindley, J. Introd. Botany, i. 213. With curved medullary rays. (fig.)

MENISPERMACEÆ.—Gaudichaud. Recherches sur l'Organographie, &c., des Vegetaux, tab. xviii. 13.—J. Decaisne. Sur les Lardizabalees, Arch. de Museum, 1839, i. 143, with figs.—*Menispermum canadense*, p. 154. Descriptions of young and adult stems are given. In the latter the original number of vascular bundles is found to have undergone no increase, the 18–23 fascicles which completed the circle in the first year, have received addition chiefly to their outer extremities and assumed a spathulate outline in section. The liber bundles of thick-walled, tapering cells, on the other hand, have not increased, and are found isolated and opposed to each of the wood-wedges. The wood is formed of dotted tubes varying in diameter; where they border upon the pith, annular and unrollable spiral vessels occur.—*Cocculus laurifolius*, p. 157. Presents up to a certain period an arrangement of parts similar to that of *M. canadense*, the original vascular bundles continuously progressing outwards and the liber remaining unchanged. The vascular wedges do not increase proportionately in breadth with their growth in length, so that the medullary rays become progressively larger. After some years the wood fascicles cease growing, and in the cortical cellular tissue originates a second series of bundles, similar to the first formed, excepting in the absence of spiral vessels at their inner side and of liber externally. After these bundles have attained their maximum development they, in turn, cease to grow, and a third series forms in the parenchym of the bark and so on.—*Cissampelos Pareira*, p. 204. Analogous in structure to *Cocculus*. The first-formed zone of wood alone possesses liber. Between subsequently formed zones there is a thin layer of thick-walled cellular tissue, quite distinct from liber.—J. D. Hooker and T. Thomson. Flora

Indica, i. p. 167. The authors endorse generally M. Decaisne's propositions, and point out that though closely allied genera have often very similar wood, so have more distantly allied ones *(Limacia, Pachygone,—Coscinium, Anamirta)*, while close allies sometimes differ very materially *(Tinospora, Parabæna)*. In the numerous genera examined in respect of stem structure, the pith was found to form a very varying proportion to the diameter of the stem, from one-fifth *(Parabæna)* to three-fourths *(Aspidocarya)*. From the centre towards the wood bundles the cells become denser, vertically elongated, and truncate at their extremities. The wood-wedges vary in number in different species, from about twelve *(Cissampelos)* to seventy (*Coscinium*). They consist of dotted pleurenchyma traversed by barred vessels. The medullary rays are usually narrow and often dense. The liber bundles exterior to each wedge, more or less lunate and isolated, or sometimes confluent. The structure of the stem (usually several years of age) is described in the following genera,—*Coscinium, Aspidocarya, Parabæna (sagittata), Tinospora (crispa), Anamirta, Tiliacora, Limacia (velutina, oblonga, cuspidata), Cocculus (Leæba, villosus), Pericampylus, Stephania (rotunda, elegans), Cissampelos (Pareira), Cyclea (populifolia), Pachygone, Fibraurea (tinctoria, ? hæmatocarpa), Tinomisciam, Pycnarrhena.—Clypæa.* Griffith. Notulæ iv. 305—319.—*Cocculus.* Martius von, Gelehrte Anzeigen, 1842, 387.—*Cocculus laurifolius.* Lindley, J. Introd. Botany, i. 214, (with figs.)—(*C. palmatus*, in text). Schacht, H. Die Pflanzenzelle, p. 284, tab. xix. Der Baum, pp. 95, 199.—Nägeli, C. Beiträge zu Wissen. Botanik, i. 16. Selected as typical of those Dicotyledons which have successively limited rings of cambium tissue in protenchym.*—Radlkofer, L. Ueber dans anomale Wachsthum des stammes bei Menispermeen. Flora, 1858, 193. Ann. Sc. Nat. Ser. iv. 10, 164. Referring chiefly to the second generation of cambium tissue in the cortical parenchyma exterior to the liber zone of the first wood bundles,—originating the new and concentric formation of woody tissue in *Cocculus laurifolius.*—Schacht, H. Lehrbuch, ii. 57.—*Menispermum.* Richard. Nouv. Élemens de Botanique, 1846, 154.—Mohl, v., Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.

BERBERIDACEAE.—*Podophyllum, Diphylleia.* Brown, R. in Tuckey's Congo. 442 (in note).—Agardh. Theoria Systematis Plantarum, 75. On Structure and arrangement of the vascular bundles.

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* Nageli (l. c.) distinguishes two tissues, the cells of which undergo division. That of which each organ primarily consists, and which is also often active to a late period if not during its entire lifetime, he terms *Meristem.* The other tissue is *Cambium.* The original Meristem and all tissues developing immediately from it he calls *Protenchym.* Cambium, and all tissues directly or indirectly derived from it, *Epenchym.* This important essay refers especially to the relations subsisting between the position of the leaves, and the arrangement of the vascular cords in the stem.

NYMPHÆACEÆ. De Candolle, A. P. Sur les Nymphæacées. Soc. Phys. de Genève, i. 2.—Trécul, A. Études anatomiques et organogéniques sur la *Victoria regia*, et anatomie comparée du *Nelumbium* du *Nuphar* et de la *Victoria*. Ann. Sc. Nat. Ser. iv. 1. 145.—J. D. Hooker and T. Thomson. "Flora Indica," i. 236. The central medullary mass is surrounded by a tolerably well-defined zone of vascular bundles. Liber, wood-wedges and medullary rays are absent, and the vascular tissue confused, possibly from the crowded state of the internodes. *Victoria*, in the absence of a pith-like centre is regarded as exceptional.—Caspary, R. Sur la Structure de la tige. (Bot. Zeit. 1857.) Bull. Soc. Bot. iv. 718. — Einige wenige Bemerkungen über den Bau des Stammes der Nymphæaceae. Flora, 1857, 717, also in Bot. Zeit. 1857, 791. The vessels are scattered in the central vascular system of the stem, not arranged in a circle: in the outer portion of the central system they anastomose in short, dense bundles, allowing cords to pass to the leaves, peduncles, roots, &c., through regular openings. — Bonn, Sitzungsbericht. 1858, xv. and Flora 1859, 118. On the formation of cork-cells and absorption of spiral vessels in *Nymphæa gigantea*.—*Nuphar lutea.* Trécul, A. Recherches sur la Structure et le développement du *Nuphar lutea.* Ann. Sc. Nat. Ser. iii. 4, 286. The structure of the rhizome, of which a detailed account is given, is stated to be quite similar to that of Monocotyledons. There are no distinct concentric layers nor medullary rays, the fibrous fascicles being separated by interposed pith-parenchyma. Its density decreases from the circumference to the centre.—Vaupell, C. über d. peripherische Wachsthum d. Gefässbündel, &c. Leipsic, 1855, p. 23.—*Victoria.* Henfrey, A. On the Structure of the Stem of *V. regia.* Phil. Trans. 1852, 289, with 2 Plates. A. N. Hist. Ser. ii. 10, 398. The internal structure is quite monocotyledonous in character. No true woody fibres, no cambium layer, no arrangement of the vascular bundles in zones. The vascular fascicles, composed of spiral vessels, and annular and reticulated ducts, are isolated in the parenchyma of the stem.

NELUMBIACEÆ. Mirbel. Observations Anat. et Physiol. sur le Nelumbo. Ann. d. Muséum. 1809, xiii. 465.—Endlicher und Unger. Grundzüge d. Botanik, 92.—Trécul, A. Ann. Sc. Nat. Ser. iv. 1, 145. Differs from Nymphæaceæ in the anatomical character of the rhizome.

PAPAVERACEAE.—*Chelidonium.* Moldenhauer. Beiträge z. Anatomie d. Pflanzen, 1812, 141.—Amici, J. B. Observations Microscopiques, Ann. Sc. Nat. 1824, vol. i. 224, tab. 13.—Link, H. F. Icones Anat. Bot. 1837, Fasc. ii. xiv. 8.—Schultz, C. H. Die Cyklose,* Nova Acta, 1841, xviii. Suppl. ii. tab. xvi.—*Bocconia.*

* Sections of other herbaceous plants are figured in this essay, viz. *Tropæolum*, *Cochlearia*, *Brassica*, *Impatiens*, *Plantago*, *Valeriana*, *Portulaca*, *Erodium*, *Oxalis.*

Schultz, C. H. Die Cyklose. Nova Acta, 1841, xviii. Suppl. ii. tab. xvii. 1, 2.

CRUCIFERÆ. Hartig, Th. Bot. Zeit. 1859, 109. *Arabis albida.* —Hanstein, J. über den Bau des Dicotylen Holzringes. Pringsheim's Jahrb. i. 231, with figures. Connection of arrangement of the leaves with the wood-formation.

RESEDACEAE.—*Reseda lutea.* Mueller, J. Monographie de la Famille des *Résedacées.* Zurich, 1857. Anatomie, p. 16, tab. 1.- The wood-zone consists of thick-walled prosenchyma traversed by wide dotted vessels and some much elongated parenchymatous cells which are found in the immediate neighbourhood of the vessels. The medullary rays are complete, narrow, and tolerably numerous. The liber cells are very thick-walled, long, and collected usually in groups of 3 to 7.

BIXACEAE.—*Bixa Orellana.* Medullary rays are numerous and narrow. The wood consists of elongated cells, not much thickened and often with abrupt terminations, traversed by very minutely dotted or slit-marked vessels, usually two or three together radially. (D. O.)

POLYGALACEÆ.—*Securidaca erecta?* J. Decaisne. Sur les Lardizabalées. Arch. du Museum, 1839, i. 205. Remarkable from the curvature and irregularity of its wood-zones, is figured (Pl. x.) Destitute of medullary rays. No liber was observed.—Crüger, H. Bot. Zeit. 1850, op. cit. 161. An account of the structure, with figures, of *Securidaca volubilis. Catacoma lucida*, p. 161.

CARYOPHYLLACEÆ.—*Dianthus.* Richard. Nouv. Elemens de Botanique, 1846, 129.—Hartig, Th. Bot. Zeit. 1859, 109. Wood of. —*Acanthophyllum*, &c. Oliver, D. Observations on the Structure of the Stem in certain species of the Natural Orders Caryophyllaceae and Plumbagineae. Linn. Trans. xxii. 289. With 2 plates. Relating chiefly to the arrangement of the tissues in species of *Acanthophyllum.* In *A. spinosum*, in very young internodes of the stem, the pith is found to be much elongated transversely; this elongation increases until it divides the vascular zone, and a belt of cambium cells encloses separately the divided portions. In the older internodes the relative arrangement of the vascular and cellular systems becomes excessively complicated and no true pith is recognisable. Medullary rays are absent. In the adult stems of *A. spinosum* spiral vessels are more or less intermixed with the numerous slit-marked vessels which irregularly traverse the parenchyma, and I have found some reason to believe that, in this and another species, in the early stages of the development of the stem, prior to the dislocation of the concentric zones and tissues generally, that very narrow annular belts of spiral vessels are repeated at intervals concentrically. The arrangement of the woody bundles in other species of *Acanthophyllum* is described, and attention called to the remarkable abundance in the cellular tissue of the stem, of crystals of oxalate of lime.—Regnault. Ann. Sc. Nat. Ser. iv. xiv. 118. —*Dianthus.* The wood is distributed in two, three, or more consecutive zones, often interrupted, or broken into fragments, in transverse section, by more transparent and wider belts of elongated, attenuate, delicate cells with numerous slit-marked vessels. Medullary rays are absent. Stellate crystals of oxalate of lime abound in all the parenchym. In *Arenaria rigida* the form of the woody masses is very irregular; they include no vessels, these being confined to the invading, thin-walled, fibroid tissue. *Silene pseudo-otites* has a nearly continuous wood without alternating opaque and transparent zones. The modification of structure in *Gypsophila saligna,* is also described.—*Acanthophyllum squarrosum.* Boiss. This is the *A. spinosum* of Kotschy, and of my paper in the Linnean Transactions. M. Regnault's observations (l. c. p. 73) led me to re-examine sections of this plant. I have to confirm my previous observations referred to above, on the occurrence of true (unrollable) spiral-vessels in the wood-zone of young branches, intermediate to the yet distinct pith parenchyma, and the cortical tissue. Slit-marked vessels traversing parenchyma, constitute the mass of the 'wood,' and the spirals require to be carefully distinguished from them. These spirals are of both extremely minute and tolerably wide calibre, the latter nearly equalling in size the prevailing gashed vessels. I am not prepared to say positively that the spiral vessels occurring in the young stem (prior to the general derangement of its tissues) are arranged in concentric and narrow rings, as in the paper above-noticed I suggested they might be.—*Acanthophyllum* (Griffith's Affghan Coll. 1562) possesses very numerous spiral vessels of small calibre. These accompany the slit-marked vessels which form the bulk of the wood. I continue to think they may be more or less distinctly disposed in concentric rings around the pith. (D.O.)

Linaceæ.—*Linum.* Link, H. G. Elementa Phil. Bot. 1837, tab. ii. —Reissek, S. Die Fasergewebe des Leines, &c. Ext. Denkschf. K. Ak. Wiss. Wien. vi. with plates. An account of the development and structure of the bast-cells.

Sterculiaceæ.—*Adansonia.* Walpers, G. Ueber *Adansonia digitata.* Bot. Zeit. 1852, 295. Description of wood structure and especially of liber.—*Bombax pentandra.* Schleiden. Wiegman's Arch. 1839, pt. 3. A. N. H. iv. 245. Wood almost entirely of parenchyma, spiral annular and reticulated vessels, with rarely prosenchyma in exterior part of annual rings.—*Delabechea rupestris.* The wood, of which an imperfect specimen is in the Kew Museum, presents zones at unequal intervals of large tubular cavities, the greater diameter of which is radial. These appear to result from the decay or resorption of enormous cords of delicately thin-walled cells. The firmer portions of the wood consist of thin-walled parenchyma through which are scattered, between the numerous medullary rays, small and narrow clusters and belts of thick-walled, elongated, tapering cells, with dotted vessels. The bark I have not seen. (D.O.)—Schleiden. Principles of Botany, 60, 62.—Henfrey, A. Micr. Dict. 'Wood.'

TILIACEAE. Kieser. Mem. Sur l'organisation des plantes, 1814. tab. 17. Structure of Tilia.—*Tilia.* Mirbel. Sur l'origine, &c. du Liber et du Bois. Mem. du Museum, 1828. xvi. 26, with figs., also Elemens de Phys. Végét. tab. xiv. 19, 20.—Mohl, H. v. Ueber d. Bau der porösen Gefässe der Dicotyledonen. Abh. Ak. Wiss. München, i. 445, with figs.—Link, H. F. Icones Selectae, 1840. Fasc. ii. t. ii. 7-12.—Schultz, C. H. Die Cyklose. Nova Acta. 1841. xviii. Suppl. ii. tab. xxxiii. —Mohl, H. v. Bot. Zeit. 1855, 878. On liber of.—Henfrey, A. Micr. Dict. 'Wood.'—Schacht, H. Lehrbuch. i. 338. Der Baum, 95, 199.

MALPIGHIACEAE. Martius, von. Gelehrte Anzeigen, 1842, 389.—Richard. Nouv. Elémens de Botanique, 1846, 153.—Lindley, J. Introd. Botany, i. 212. Figure of liane-stem.—Crüger, H. Bot. Zeit. 1851. op. cit. 465. An account of wood structure, with figures of *Stigmaphyllon* and *Tetrapterys.*—(*Malpighiaceae ?*) Wigand, A. Einige Beispiele anomaler Bildung des Holzkörpers. Flora, 1856, 673. With fig. — *Banisteria.* Gaudichaud. Guillemin's Archives, ii. 502 Pl. 19.—*Banisteria paniculata.* Mohl, H. v. Ueber de Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.—*Banisteria.* Karsten, H. Vegetations-organe der Palmen, 1847, 140. —*Malpighia nitens.* Link, H. F. Icones Anat. Bot. 1837. Fasc. ii. xi. 6-8. — *Stigmaphyllon.* Gaudichaud. Recherches sur l'organographie, de des Végétaux. tab. xviii. 11.—Jussieu, Ad. de. Monograph des Malpighiacées, p. 100. Ann. d. sc. Nat. Ser. ii. 15, 234. The stem in this order is always ligneous, and either independent (especially the genera with fleshy fruits) or a climbing *liane* (the greater portion of the winged-fruited genera). In the *liane* species the wood, instead of presenting a continuous zone around the pith, is usually found to be interrupted by prolongations of the cortical layers, which extend sometimes to the centre and divide the stem into several distinct fascicles, each invested by its proper, or by a common bark. In others (*Stigmaphyllon*) the cellular tissue of the bark forms a network extending to the medullary sheath, dividing the wood circle into very numerous compartments, more or less irregular in form and size. The wood is generally characterized by the large development of dotted vessels.—In *Byrsonima coccolobaefolia*, p. 101., an arborescent species, the structure of the wood scarcely differs from that prevailing in Dicotyledons. Numerous medullary rays of uniform thickness part from a central pith. In cross section concentric zones, alternately pale and dark, traverse the wood. In the former, dotted vessels preponderate, in the latter, thick-walled prosenchyma.—*Bunchosia* *nitida* presents a similar structure. In *Stigmaphyllon marginatum*, a climbing species, the accession of an irregular arrangement of the ligneous mass is traced from young, herbaceous branches, which exhibit nearly the usual structure. In older stems the ligneous mass presents a sinuous outline, with projecting angles. It consists of dotted prosenchyma and elongated, smooth, thick-walled fibroid cells, traversed by very wide-mouthed, dotted vessels. The medullary rays, formed usually of a single row of dotted cells, pass from the pith sometimes in straight radial lines, sometimes interrupted and crossed by flexuous and irregularly concentric processes of similar composition. There are two distinct cortical layers, the outer suberous, marked by several dark, concentric lines, the inner compact and paler. Liber is absent, except from the oldest layers where scattered fibres occur.—*Tetrapterys Guilleminiana*, p. 106 and fig. presents a wood regularly lobed, with 8 sinuses which follow vertically a spiral direction. From the pith, extending to each groove, is a broad ray, distinguishable only from the rest of the wood by the absence of large vessels. In old branches the regular contour of the woody axis is lost. The wood consists of plain or slightly dotted, thick-walled, ligneous fibres traversed by wide, dotted vessels. The medullary rays are straight and continuous. Liber occurs in large bundles in the bark.—*Banisteria nigrescens*, p. 107 and fig. Different stages in the development of the stem are described. In the older branches the continuity of the wood is interrupted by several very deep projections of cortical tissue advancing towards the pith, the principal lobes are less deeply divided by similar processes. Vessels, small and few towards the axis, are wide and numerous in the lobes. The bark consists of a small number of layers each with its liber deposit, the fibrous cells of which are described. In a stem of 7 centimetres diameter, a cross section presents the appearance of several branches twisted together; one ligneous bundle is central, with pith and medullary sheath; the surrounding bundles are destitute of these, consisting of dotted vessels and prosenchyma.

ERYTHROXYLEÆ. Martius. Beiträge z. Kenntniss d. Gattung, *Erythroxylon*. Abh. K. Bayer. Ak. iii. Abth. ii. (Ext.) Holz. p. 12.

CANELLACEAE. Miers, J. On the Winteraceae. Ann. Nat. Hist. Ser. iii. 2, 34. Dotting of the vessels.

DIPTEROCARPEÆ. Korthals, P. W. Over eenige soorten van de Familie der *Dipterocarpeae*. Temminck's Verhandel. 1839-42. p. 49.

ZYGOPHYLLACEAE.—*Guaicum*, &c. Lindley, J. Veg. Kingdom, 479.

SIMARUBACEAE. *Ailanthus*. B. Mirbel. Élémens de Phys. Végét. tab. xiii. 1.

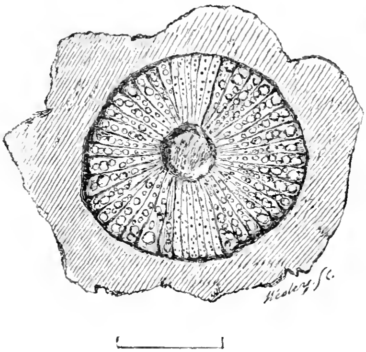
ACERACEAE.—*Acer*. Schultz, C. H. Die Cyklose. Nova Acta, 1841. xviii. Suppl. ii. tab. xxiv.—Gray, A. Introd. Botany (1858), 118-19. (with figs.)—*Negundo*. Gray, A. Introd. Botany (1858), 121. (with figs.)—*Acer*. Henfrey, A. Micr. Dict. 'Wood.' (and fig.)—Schacht, H. Der. Baum. 195.—Jussieu. Élémens de Bot. pp. 49, 52 (figs.)

SAPINDACEAE. Richard. Nouv. Élémens de Botanique. 1838, 136. —Gaudichaud. Recherches Generales, 1841, tab. xiii.—Martius, von. Gelehrte Anzeigen, 1842. 390.—Treviranus. Ueber einige Arten anomalischen Holzbildung bei Dicotyledonen. Bot. Zeit. 1847, 393.—Ann. Nat. Hist. Ser. ii. i. 126. On the origin, &c. of the accessory wood-masses, in *Paullinia pinnata, Serjania 3-ternata, and S. Selloviana.*—Gaudichaud in Guillemin's Archives, ii. 501, Pl. 19.—Gaudichaud, Recherches sur l'Organographie, &c. des Végétaux, tab. xiii. 1-4, and tab. xviii. 14-21.—Schleiden. Principles of Botany, 253.—Crüger, H. Bot. Zeit. 1851, 481. On the structure of *Paullinia* and *Serjania;* detailed observations, with figures.—Schacht, H. Lehrbuch, ii. 57.—*Serjania paniculata.* Mettenius, G. Einige Beobacht. über den Bau der Bignonien. Linnæa, 1847. 582. Three peripherical wood-cords are included within the outer cortical and a liber layer of the central axis. In these cords the centre is occupied by elongated cells with brown contents, surrounded by a few spiral vessels. The central axis possesses a true pith.—*S. cuspidata.* Jussieu, Ad. de, Monograph des Malpighiacées, p. 110. The branches are acutely triangular; the angles each occupied by a ligneous bundle, separated from the axial bundle by interposed cortical tissue.

HIPPOCASTANEAE.—*Aesculus.* Link, F. H. Icones Anat. Bot. 1837. Fasc. i. vii. 6-12.—Henfrey, A. Micr. Dict. 'Wood.'

CEDRELACEAE.—*Chloroxylon Swietenia.* The medullary rays are very numerous, vertically of small extent, though usually two or three cells in diameter. The vessels traversing a wood of normal Dicotyledonous character, are of small calibre and very minutely dotted. (D.O.)

AMPELIDEAE.—*Vitis.* Schultz, C. H. Die Cyklose. Nova Acta, 1841, xxviii. Suppl. ii. tab. xxxii.—*Vitis vinifera.* B. Mirbel. Élémens de Phys. Vég. tab. xii. 1.—Henfrey, A. Micr. Dict. 'Wood.' Schacht, H. Der Baum. 200.



Vitis. (sp. indeter. foliis pedatis. Malacca. Coll. Griffith.) The stem, from 3-8ths to ½ in. in diameter, presents a very unusual development of the suberous layer of the bark, which is vertically fissured. Some portions are nearly equal in thickness to the wood-zone. In cross-section, as figured, the latter is found to be divided by two opposite, vertically-continuous, plates of comparatively dense tissue, destitute of wide-mouthed vessels, which abound in the rest of the wood, and traversed by wide medullary rays. Vessels of small diameter are scattered through their thickened prosenchyma. The structure of the wood-zone immediately around the pith resembles that of the two plates. In drying, the bark and pith have slightly separated from the wood, and the medullary rays of the more vascular portions of the latter are fissured.—*Cissus hydrophora.* Gaudichaud. Ann. Sc. Nat. ii. Ser. vi. 143. Medullary rays of.—Voyage de la Bonite. Bot. Atlas, tab. 132-3.—Recherches sur l'organographie, &c. des Végétaux, tab. xiii. 5.—Crüger, H. Bot. Zeit. 1850. op. cit. 141. Observation on structure of *Cissus.*

BALSAMINEAE.—*Impatiens.* Kieser. Mém. sur l'organisation des plantes, 1814, tabb. 11-12.

PITTOSPORACEAE.—*Pittosporum.* Treviranus. L. C. Phys. d. Gewächse, 1835. i. tab. iii. 31-2.

ANACARDIACEAE.—*Pistacia, Rhus.* Kieser. Mém. sur l'organisation des plantes, 1814, tab. 16, 17.—*Schinus, Rhus.* Schultz, C. H. Die Cyklose. Nova Acta, 1841, xviii. Suppl. ii. tab. xx.—*Rhus typhinum.* Richard, A. Nouv. Élémens de Botanique, 1838. 109.

JUGLANDEAE.—*Juglans.* Mohl, H. v. Bot. Zeit. 1855. 879. On liber of.—Schacht, H. Der Baum. 196.

CELASTRACEAE.—*Celastrus scandens.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.—*Celastrus.* Jussieu, Ad. de, Monograph des Malpighiacées, p. 117. A climbing species from India, presents the woody axis parted into three lobes, indicated externally by spiral grooves.—*Euonymus tingens.* Lindley, J. Introd. Botany, i. 213. (with fig.)

ILICINEAE.—*Ilex.* B. Mirbel. Élémens de Phys. Végét. tab. xii. 2.

RHAMNACEAE. Crüger, H. Bot. Zeit. 1850. op. cit. 126. Observation on structure of *Gouania.*—*Rhamnus.* Carpenter. The Microscope, 1856. 433. (figs.)

LEGUMINOSAE. Hartig, Th. Bot. Zeit. 1859. 109. Eccentric wood-formation in.—*Adesmia.* Unger, Frz. Beiträge z. Kenntniss d. Parasit. Pflanzen, 1841, tab. ii.—*Amorpha fruticosa.* Treviranus, L. C. Phys. d. Gewächse, 1835, i. tab. iii. 33.—*Apios.* Duchartre, P. Compt. Rend. 1853, t. 37. 780.—*Astragalus.* Mohl, H. v. Untersuchungen über die Enstehungs-weise des Tragacanthgummi. Bot. Zeit. 1857. 33. Ann. Nat. Hist. ii. Ser. 20. 165. Referring to structure of pith and medullary rays.—*Aedemone mirabilis.* Hallier, E. Ueber ein neues Schwimmholz vom weissen Nil. Bot. Zeit. 1859. 153. (With 1 plate.) The wood-cylinder is formed principally of a lax, thin-walled, regular parenchyma, traversed by isolated ligneous fascicles, and numerous complete medullary rays. The vessels are either separately scattered in the ligneous parenchyma, or, several together, are surrounded by prosenchyma, forming fibro-vascular bundles. Numerous liber-cells traverse the cortical parenchyma, many of them ramified.—*Glycine sinensis.* Jussieu, Ad. de, Monograph des Malpighiacées,

p. 361. In a stem 10 cent. diam. may be counted five zones of wood separated by as many concentric rings of violet-coloured liber-cells. The wood-rings are irregular in width, often sinuous in outline, and traversed radially by cellular bands. A second ligneous zone does not form until the stem has reached about eight years of age, to which period but one ring of bark envelopes its central cylinder. About this time, exterior to the first ring of liber, the stem becomes laterally thickened by ligneous fascicles, which extend and ultimately meet each other, forming a second zone concentric to the first. After the lapse of some years a third belt originates in a similar manner, and so on with the rest. —*Glycine caribaea* and *Phaseolus*. Mohl, H. v. Ueber d. Bau ** der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.—*Halodendron*. Link, F. H. Icones Selectæ, 1839. Fasc. i. viii. 1—2. —*Phascolus*. Kieser. Mém. sur l'organisation des plantes, 1814. tab. 13.—*Haematoxylum Campeachianum*. Unger, F. Ueber den Grund der Bildung der Jahreslagen dicotyler Holzpflanzen. Bot. Zeit. 1847. 268. Observation on the alternation of parenchymatous with prosenchymatous tissue in the wood.—*Phaseolus*. Kieser. Mém. sur l'organisation des plantes, 1814, tab. 13.—*Sophora japonica*. De Candolle, A. Introd. à la Botanique, tab. ii. 1.—*Cytisus Laburnum*. Hanstein, J., über den Zusammenhang der Blattstellung mit dem Bau des Dicot. Holzringes. Pringsheim's Jahrb. i. tab. xvii. 14-16.—*Ulex, &c.* Kieser. Mém. sur l'organisation des plantes, 1814, 306, tab. xxii.—*Bauhinia*. Richard. Nouv. Élémens de Botanique. 1846. 155.—Schleiden. Principles of Botany, 254.—Gaudichaud. Recherches sur l'organographie, &c. des Végétaux, tab. xviii. 1-3.—Jussieu, Ad. de, Monograph des Malpighiacées, p. 118. The woody axis is frequently divided into fascicles by invasions of the cortical tissue; the whole usually united by a common bark. In *Schnella macrostachys* the numerous fascicles are spirally wound; some of the outer bundles finally separate completely as distinct branches. Vide also p. 124.—*Schnella*. Martius, von. Gelehrte Anzeigen, 1842. 388.—Crüger, H. Bot. Zeit. 1850. 122. Detail, with figures, of the structure of *Bauhinia (Caulotretus)*, and *Rhynchosia phaseoloides*. Also 1851. p. 469—*Cassia 5-angulata*, and p. 471 *Entada polystachya*.—*Mimosa (Entada)*. Dutrochet. Mém. Anat. et Physiog. des Végétaux, &c. 1837. tab. xiv. 3-4.—*M. pudica*. Schultz, C. H. Die Cyklose. Nova Acta, 1841. xviii. Suppl. ii. xviii-xix.

Rosaceae.—*Mespilus*. Link, H. F. Icones Selectae. 1839. Fasc. i. viii. 3-5. Structure of the spines. Also figured from *Rosa*, *Ribes*, *Berberis*, &c.—*Pyrus Malus*. Mirbel. Mém du Muséum. 1828. xvi. 30. (fig.)—*Prunus Cerasus*. Mirbel. Mém. du Muséum. 1828. xvi. 29. (fig.)—Link, H. F. Icones Anat. Bot. 1837. Fasc. i. vi. 1-3. 'Icones Selectæ,' 1839. iv. 4, 5.—*Pyrus*, *Prunus*. Schacht, H. Der Baum. 195.—Mohl, H. v. Bot. Zeit. 1855. 879.

On liber of.—*Prunus* (*Avium*). Wigand. über die Deorganisation der Pflanzenzelle. Pringsh. Jahrb. iii. 115. The first section of this paper relates, principally, to the transformation of certain tissues both of the wood and bark into cherry-gum,—a compound of gum arabic and cerasin.—*Rosa*. Meyen, F. J. F. Anat. und Phys. d. Gewächse. 1836, tab. iii. 11.—*Rubus*. Kieser. Mém. sur l'organisation des plantes, 1814. tab. 16.—Schultz, C. H. Die Cyklose. Nova Acta, 1841. xviii. Suppl. ii. tab. xxv.

CALYCANTHEAE.—*Calycanthus*. Mirbel, M. Sur l'organisation de la tige d'un très-vieux *C. floridus*. Ann. Sc. Nat. 1828. 14. 367. (With 1 pl.) Noting the occurrence of fibro-vascular bundles occupying the angles of the stem. Each of these fascicles possesses a proper cortical envelope, superimposed woody layers (thicker towards the axis of the stem), medullary rays and pith. —Treviranus, L. C. Phys. d. Gewächse, 1835. i. tab. 1. 10.—Link in Froriep's, N. Notiz. xxxiv. Flora, 1845. 558. Observations on the structure of the accessory axes of *C. floridus*.—Treviranus. Ueber einige Arten anomalischer Holzbildung bei Dicotyledonen. Bot. Zeit. 1847, 379. On the formation of vascular bundles in the bark, and their connection with the leaves. *Vide* also Henfrey, Ann. N. Hist. Ser. ii. 1. 125.—Mettenius, G. Einige Beobacht. über de Bau der Bignonien. Linnæa, 1847. 580. Referring to the peripherical woody centres occurring in Calycanthaceae. Their minute structure is detailed in *Calycanthus floridus*, in which they are found in yearling stems as four liber-bundles isolated in the cortical parenchyma. Each bundle towards the axis of the stem is accompanied by a formation of spiral vessels, and, within these, by wood-cells and dotted vessels. In stems of five years old the liber bundles are found unaltered, while the wood has laterally extended itself to about twice its size in the first year. Small bast-bundles are distributed round the central woody axis.—Gaudichaud. Guillemin's Archives, ii. 493. Origin of accessory wood bundles.—Lindley, J. Introd. Botany, i. 209. On excentrical woody axes.—Lindley, J. Veg. Kingdom, 541.—Hartig, Th. Bot. Zeit. 1859. 109. Cortical vascular bundles of.

CHRYSOBALANEAE. Crüger, H. Westindische Fragmente. Bot. Zeit. 1857, 281, with pl. On the structure of the siliceous bark of a *Moquilea* (*Caraipa augustifolia*), called *Cauto* or *Cauta*. Also, p. 298, on wood of same. The vessels are irregularly scattered through a wood of the usual Dicotyledonous character, excepting that, at short intervals, the prosenchyma is interrupted by very numerous vertical bars of thin-walled cells, transverse to radius; these are tolerably continuous concentrically, though often broken by the openings of the vessels. The remarkable siliceous bark ('*el cauto*') of this (?) tree is fully described by Crüger.—See also H. v. Mohl. Bot. Zeit. 1861, 211, and Wicke, p. 97.

RHIZOPHOREAE. Schleiden, Principles of Botany, (pith.) 65.

HALORAGEAE.—*Trapa natans.* Barnéoud, F. M. Sur l'anatomie et l'organogenie du *Trapa natans*, L. Ann. Sc. Nat. ser. iii. 9. 227. (figs.) In adult stems the vascular bundles of the medullary sheath, consisting of wide annular vessels, are numerous, forming a continuous circle. There are no unrollable spiral vessels.—*Cucurbita, Bryonia.* Kieser. Mem. sur l'organisation des plantes, 1814. tab. 6—10, 12.—*Cucurbita.* Mohl, H. v., Bot. Zeit. 1855, 889. On liber of.—Nägeli, C. Ueber die Siebröhern von Sitzungsb. H. b. Ak. München, 1861, 212.

PASSIFLORACEAE. Mohl, H. v. Ueber d. Bau * * der Ranken und Schlingpflanzen, Tubingen, 1827. § 75.

PAPAYACEAE. Crüger, H., Bot. Zeit. 1851. Observation on the structure of *Carica Papaya.*

PORTULACEAE.—*Portulacaria.* Link, H. F. Icones Selectae, 1839. Fasc. i. vi. 5-14.—Regnault, Ann. Sc. Nat. Ser. iv. xiv. 106. *Talinum speciosum* possesses isolated liber bundles, a fibro-vascular wood zone interrupted transversely and obliquely by belts of thinner tissue (arrested as it were in their development), and medullary rays. The prosenchyma of the wood is punctate chiefly towards the rays. The structure of *Anacampseros, Claytonia, Portulacaria,* and *Portulaca,* more or less diverse from the above, is described.

PARONYCHIEAE. Regnault. Ann. Sc. Nat. Ser. iv. xiv. 106. *Paronychia bonariensis* presents a continuous circle of elongated, thick-walled cells representing liber, exterior to the wood, which is formed in two distinct zones. The inner consists of prosenchyma uninterrupted by medullary rays, with numerous vessels surrounding the pith: the outer, of ligneous fibres and vessels, not in a continuous circle, but in uninterrupted, radiating plates. The vessels are regularly dotted, as also the wood-cells, between which are very minute, rounded cavities, arranged in regular series along the cells. Modifications of structure in *Anychia dichotoma, Telephium Imperati,* and *Corrigiola littoralis* are described.

TETRAGONIACEAE. Regnault. Ann. Sc. Nat. Ser. iv. xiv. 101. In *Tetragonia expansa,* liber is absent. The wood, consisting of prosenchyma traversed by numerous vessels, in adult stems presents an inner continuous zone uninterrupted by medullary rays. Exterior to this, towards the angles of the stem are successively superimposed independent masses, forming from two to five incomplete belts. These isolated woody masses are separated concentrically by zones of generative cells.

MESEMBRYACEAE. Regnault. Ann. Sc. Nat. Ser. iv. xiv. 95. The group offers a peculiar epidermal structure. The liber-layer and medullary rays are absent. Cords of tissue corresponding to portions of the 'couche génératrice' occur in the wood, on the inner face of which, around the pith, are vessels, chiefly spiral, arranged in radiating rows, sometimes isolated, sometimes in fascicles. The differential characters presented by the species have but a secondary importance.

CACTACEAE. De Candolle, A. P. Revue de la Famille, in Mem. du Museum, 1828, xvii. Latige, p. 5.—Schleiden, Wiegmann's Arch. 1839, pt. 3, A. N. H. iv. 245. In *Melocactus*, *Echinocactus*, *Mammillaria*, the wood consists almost entirely of short, broad, thin-walled cells, obtusely conical at ends, with very thick annular or spiral cells.—Also in Beiträge zur Anatomie der Cacteen; with 10 plates. The vascular bundles occur under three modifications. 1. Possessing liber, and corresponding to the usual structure of the vascular bundle in Dicotyledons, excepting that in the later-formed wood-layers spiral vessels are found. 2. Bundles in which the liber is replaced by gum-canals. 3. Vascular bundles with cells having flattened, projecting rings in the interior and spiral vessels. These cells are wanting in *Pereskia*, *Rhipsalis*, *Cereus*, and flat-stemmed *Opuntias*; they form the main part of the wood in *Echino-* and *Melocactus*. In *Mammillaria*, with a few spirals in the medullary sheath, they form the entire wood-mass. Annual zones do not occur. Rings of wood formation answering to considerable periods of time are found: their cause is uncertain. A detailed account is given of the various tissues of the stem.—*Echinocactus*, *Melocactus*. Brongniart, A. Obs. sur la structure du *Sigillaria*, *&c.* Arch. du Muséum (1839), i. 442. Tab. xxxv. Independent vascular bundles are found scattered in the pith of some species. — Meyen, F. J. F. Neues System d. Pflanz. Physiol. (fig. tab. i. and iii.)—Harting, P. Bijdrage tot de Anatomie der Cacteën., v. der Hoeven und Vriese, Tydschrift, 1842, 181, with 2 plates —Gaudichaud, Guillemin's Archives, ii. 502. pl. 19.—Schleiden, Principles Bot. 255.—A. Trécul, Extrait d'un Mémoire inédit sur les formations spirales, annulaires et réticulées, &c., Bull. Soc. Bot. i. 67. Referring especially to the structure and development of the spiral fibres in the wood cells.—Trécul, A. Compt. Rend. 1854, t. 38, 1145.—*Cactus*. Meyen, F. J. F. Phytotomie, 1830. tab. x. 1. 4.—Corda. Bau des Pflanzenstammes, in Weitenweber's Beiträge z. Nat. und Heilwiss. Prag, 1836.—*C. chilensis*. Meyen, F. J. F. Anat. und Phys. d. Gewächse, 1836, tab. viii. 24-5. (other *Cactaceae*) tab. ix.—*Cactus*. Meyen, F. J. F. Neues System Pflz.-Physiologie, 1837, tab. i. 1, 5, 8-10.—*Cereus*. Turpin, P. J. F. Analyse Microscopique du tissu cellulaire de la moelle et de l'écorce, &c. Ann. Sc. Nat. 1830, 20-26—Link, H. F. Anatomia plantarum, 1843. tab. iii. 1-6, *Epiphyllum*, *Opuntia*, *Cereus*.—Link, H. F. Icones Selecta, 1840, Fasc. ii. iii.—*Rhipsalis*, *&c.* tab. iv. 5-11.—*Melocactus*. Miquel, F. A. W. Monographia generis *Melocacti*, Nova Acta Ac. Caes L. C. 1841. xviii. Suppl. i. *Truncus*, p. 115.—also Anatomische Bemerkungen über den Bau der Melocacten. Linnaea. 1842, 165. Ann. Sc. Nat. ii. Ser. xix. 164. Supplying a lacune in Schleiden's observations. A minute account of the internal anatomy of *M. microcephalus.*—*Opuntia.* Link, H. F. Icones Anat. Bot. 1837. Fasc. ii. xv. 4-5.

RIBESIACEAE.—*Ribes.* Hanstein, J. Ueber den Zusammenhang der Blattstellung mit dem Bau des Dicotylen Holzringes, Pringsheim's Jahrb. i. tab. xvi. 10.

ALANGIACEAE. Lindley, J. Veg. Kingdom, 720.

CRASSULACEAE.—*Sempervivum,* and other Crassulaceae. Brongniart, A. Obs. sur la Structure du *Sigillaria, &c.* Arch. du Muséum, (1839) i. 437. On the absence of true medullary rays, and relation of medullary vascular bundles to the leaves.—*Crassula portulacea.* p. 445. Destitute of a ligneous zone. The fascicles of the medullary sheath, consisting of spiral vessels and spiral, annular and reticulate ducts, increase in number and size without admixture of wood-prosenchym.—*Cotyledon.* Link, H. F. Icones Selectae, 1839. Fasc. i. vii. 1-2.—Wiegmann's Arch. 1839, 224. A. N. H. iv. 241. Wood formed of prosenchym destitute of vessels, traversed by vertical cords of thin-walled parenchym which include spiral vessels.—Lindley, J. Veg. Kingdom, 345.—*Sedum.* Henry, A. Ueber die Bildung der Wurzel-zasern v. S. *Telephium, &c.* Verh. N. H. V. 1860-1. Chiefly referring to the structure of the tuberiform root-fibres. That of the stem which offers no peculiarity, is described.—Regnault, Recherches sur les affinités de Structure des Tiges des plantes du groupe des Cyclospermées. Ann. Sc. Nat. Ser. iv. xiv. 87.—*Sempervivum arboreum.* A woody stem several years of age presents a cellular cortical zone, including outer suberous and inner herbaceous layers. Wood consisting of crowded, thick-walled and irregularly dotted prosenchyma, traversed by isolated vessels. Zones, consisting of vessels and elongated, quadrangular, delicate cells, destitute of markings, are disposed concentrically through the wood, which is destitute of medullary rays. Vascular bundles, consisting of annular vessels, unrollable spirals and elongated cells occur in the wood around the pith, which offers no unusual character. Other Crassulaceae present a similar type with modifications noted in *Rochea falcata, Sempervivum Haworthi, S. leucoblepharum, Sedum deltoideum, S. oxypetalum, Crassula portulacea, C. rubens, Umbilicus pendulinus.* The Order is generally characterised by the absence of liber, and of medullary rays in fully developed wood; by the presence of cords of soft, fibroid cells and vessels (corresponding to isolated portions of the generative zone) in the midst of the wood, and the prevalence of parenchymatous tissue, giving the character of succulence to the group.

BEGONIACEAE. Link. H. F. Anatomia Plantarum, 1843, tab. ii. 4-5. Figures of pith cells.—Treviranus, Bot. Zeit. 1847, 398. Ann. N. Hist. Ser. ii. i., 29. (Report by Henfrey.) On the unsymmetrical arrangement of the wood-bundles in climbing species.—Vaupell, C. über d. peripherische Wachsthum d. Gefässbündel, &c. Leipsic, 1855, 28. tab. 1.—Hildebrand. De

Caulibus Begoniacearum imprimis iis qui vasorum fasciculis in parenchymate medullari dispersis sunt praediti, 1858. Berlin; and also Anatomische Untersuchungen über die Stämme der Begoniacien. Berlin, 1859. With 8 plates. Referring especially to the structure of the wood-mass, presence of vascular bundles in the pith (out of 128 species observed, 28 had medullary vascular bundles), and course of the fascicles.

UMBELLIFERAE. Buzareingues, C. G. d., Ann. Sc. Nat. 1833. 30. Sur l'ordre de distribution des fibres dans le corps central de la tige, p. 347.—Jochmann, E. G. De Umbelliferarum Structura et evolutione nonnulla. Breslau, 1855. § 3. The normal type presents a wood-zone surrounding the pith, which latter in progress of growth disappears, leaving a cavity from node to node. This wood-zone is usually continuous, traversed by very narrow medullary rays and made up of primary fascicles formed by the cambium of the bud and secondary ones subsequently developed. The former each have two liber bundles opposed to them, the latter but one bundle each. In *Silaus pratensis* the pith is traversed by scattered vascular cords.—Hartig. Th. Bot. Zeit. 1859. 96.—*Angelica, Cicuta.* Schultz, C. H. Die Cyklose. Nova Acta, 1841, xviii. Suppl. ii. tab. xxi.-ii.—*Anthriscus,* Link. H. F. Icones Anat. Bot. 1837. Fasc. ii. x. 6.*—*Heracleum,* Link. H. F. Icones Anat. Bot. 1837. Fasc. ii. xii. 1-3.

ARALIACEAE. *Aralia racemosa.* Gray, A. Introd. Botany (1858,) 118. Vascular bundles in the pith (in note).—*Hedera.* Unger, Fr. Beiträge z. Kenntniss d. Parasit. Pflanzen, 1841, tab. vi.

LORANTHACEAE. Korthals, P. W. Verhand. over de op Java, &c. verzamelde *Loranthaceae,* p. 210.—also Aanteekeningen over eenige Soorten van *Loranthus* in v. der Hoeven und Vriese, Tydschrift, 1836. (stam.) p. 189. — W. Griffith. Parasitism of. Linn. Trans. xviii. 78.—Karsten, H. Beitrag zur Entwickelungsgeschichte der. Bot. Zeit. 1852 (Holz.) 361. With fig.—*Viscum.* Kieser, Mém. sur l'organisation des plantes, 1814, 305, tab. 22.—Bischoff. Lehrbuch, ii. 62.—Link, H. F. Icones Anat. Bot. 1837, fasc. ii. x. 7-8. Icones Selectae, 1842, fasc. iv. viii. i. 7.—Unger, Frz. Beiträge z. Kenntniss d. Parasit. Pflanzen, 1841, tab. iii. vi.—Chatin, G. A. Anat. Comp. d. Végét. (Parasites) tab. lxxix.-lxxx. Plates only received.—Decaisne, M. De la Structure ligneuse du Gui. Compt. Rendus, 1839, 204.—also Mémoire sur le Développement du Pollen, de l'ovule et sur la Structure des Tiges du Gui. Ext. Mem. Ac. Roy. Bruxelles, 1839, xiii. With figures. The pith is immediately surrounded by eight fascicles, corresponding to the inner edges of the eight primary wood-bundles, these consist of elongated fibrous cells, similar to those of the cortical liber fascicles; they are accom-

* The root structure of other Umbelliferae is figured in 'Icones Selectae,' tab. iii. & iv.

panied by annular vessels. True spirals are not found either sheathing the medulla or in the wood. The wood-bundles which are traversed by extremely numerous and very narrow medullary rays, are composed of stout, thick-walled, dotted fibres, amongst which are scattered much longer, tubular, attenuated cells, with thick, transparent walls destitute of markings. Opposite and external to each of the eight ligneous fascicles are isolated bundles of liber, plunged in the green parenchyma of the bark. These liber-bundles, which do not increase with age, are attenuated towards the extremities of each internode of the stem, and are not continuous through the articulations, where the wood-fibres of the contiguous internodes interlace. M. Dutrochet was mistaken in supposing the joints to be separated by a transverse layer of cellular tissue.—Willshire (Dr.) Contributions to Structural Botany, Ann. Nat. Hist. 1842, ix. 84. Confirmatory of Decaisne's Observations on the Structure of the Nodes.—Pitra, A. Ueber die Anheftungsweise einiger phanerogamen Parasiten an ihre Nährpflanzen. Bot. Zeit. 1861, 53. With figs.—*Myzodendron*. R. Brown, Linn. Trans. xix. 231 (in note).—Dr. J. D. Hooker in 'Flora Antarctica,' ii. 289, tab. cvii.; Ann. Sc. Nat. Ser. iii. 5, 193. In the important essay on the structure of this genus a full account is given of the internal anatomy of *M. punctulatum* and *M. brachystachyum*, also brief notices of that of *M. quadriflorum* and *M. linearifolium*. The first two species named differ so remarkably in structure, "that no one, from an examination of their wood alone, would hesitate in pronouncing them to be plants widely separated in a natural system." In *M. punctulatum* there is no pith; the axis is formed of a dense, thick-walled prosenchymatous tissue of very small cells, from which wedge-shaped plates are projected after the manner of medullary rays into the surrounding tissue (the zone usually occupied by prosenchyma in woody dicotyledons) which is wholly, or almost wholly, formed of elongated tubes of nearly equal diameter, dotted, annular, transversely barred, or containing more or less interrupted spirals. Ordinary prosenchyma and true spiral vessels were not observed either in the medullary sheath or inner portion of the annual layers.—*M. brachystachyum* has a pith of soft cellular tissue communicating with the bark by broad medullary rays. These are separated by woody plates in two concentric series, formed almost entirely of scalariform tissue, with, sometimes, prosenchym; the series are separated by a broad belt of parenchyma. The formation of the two concentric wood-zones is described at length (p. 299).—Chatin, G. A. Anat. Comp. d. Végétaux (Parasites), tab. lxxiv.-vi. The anatomy of *M. brachystachyum*, *M. oblongifolium*, *M. linearifolium* and M. *punctulatum*, with sections showing the attachment of the parasite to *Fagus*. The text has not reached us.—*Arceuthobium oxycedri*. Chatin, G. A. Anat. Comp. d. Végét (Parasites), tab. lxxvii. Text is not to hand.—*Antidaphne viscoidea.* Chatin, G. H. Anat. Comp. d. Végét. (Parasites), tab. lxxviii. Plate only received.

COMPOSITAE.—*Arctium.* Buzareingues, C. G. de. Ann. Sc. Nat. 1833. 30. tab. vi.—*Arctium* and *Onopordon.* Hartig, Th. Bot. Zeit. 1859. 91.—*Centaurea.* Chatin, G. A. Anat. Comp. d. Végétaux. Livr. iii. 9. (In note) absence of medullary rays in. —*Dahlia.* Mohl, H. v. Bot. Zeit. 1855. 889. On liber of.—*Helianthus tuberosos.* Turpin, P. J. F. Sur l'organisation intérieure, &c. Mém. du Muséum, 1839. xix. 1.

HAMAMELIDEAE. Griffith, Asiatic Trans. xix.—*Bucklandia,* (p. 95) *Sedgewickia* (p. 99.)—Oliver, D. On *Sycopsis.* Linn. Trans. xxiii. 83. With woodcuts. Observations based upon an examination of *Bucklandia, Rhodoleia, Trichocladus, Hamamelis, Sycopsis, Eustigma, Distylium, Corylopsis* and *Liquidambar,* in which genera a close uniformity in respect to minute wood structure was remarked. The discs of the prosenchyma are due to the presence of minute lenticular cavities between the adjoining wood-cells; the canals opposed on each side to these cavities are almost invariably elongated laterally, though sometimes nearly circular and very minute. The wood is traversed by numerous vessels which are generally transversely barred. The medullary rays are numerous and narrow.—*Bucklandia.* The markings on the prosenchyma are very distinct. The medullary rays are numerous, usually one cell in diameter; vertically they are very variable in extent, commonly presenting 10-12 superimposed cells, though I have counted about 45. (D. O.)

CINCHONACEAE. Weddell, H. A. Histoire Naturelle des Quinquinas. Paris. 1849, p. 18. Tab. i. ii. (*C. Calisaya*) 24-30. Also structure of the cortical layers of other species. The wood presents annual zones traversed by medullary rays radially, vertically by dotted vessels. Radial, thin plates of thick-walled, muriform parenchyma also occur, termed by M. Weddell, "faux rayons medullaires," and regarded by him as analogous with the cellular partitions in many *liane* stems. They occur in other Rubiaceae. Large *lacunes* bounded by proper walls are found in the pith. The liber cells are often of much wider diameter than the cortical cells which they traverse, are very thick-walled, and isolated, grouped 2-5 together or disposed in interrupted, radiating plates.—*Cinchona* (*succirubra* and *lucumaefolia*). Klotzsch. über d. Chinarinde. With plates. Abhand. K. Ak. Wiss. Berlin, 1857, 62.—*Poederia.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen. 1827, § 75.—Crüger, H. Bot. Zeit. 1851, 470. On the structure of *Sabicea hirta,* with figures.

RUBIACEAE.—*Rubia tinctorum.* Decaisne, J. Sur la Garance, Recherches Anatomiques et Physiologiques. Bruxelles, 1837. Stem Structure, p. 19, tab. v. Anatomy of an etiolated stem, tab. vii. —Schultz, C. H. Die Cyklose. Nova Acta. 1841, xviii. Suppl. ii. tab. xxv.

EBENACEAE.—*Diospyros Ebenum.* Schacht, H. Der Baum. 198.

LOGANIACEAE.—*Strychnos toxifera.* Large cords of extremely thin-walled parenchyma (often more or less oblong transversely to radius), traverse the wood. In these occur minute prismatic (?) crystals. (D. O.)

CAMPANULACEAE. Payer. Bull. Soc. Bot. v. 343. Occurrence of liber-fibres in the pith.—*Cyphea.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75. —*Trachelium.* Link, H. F. Anatomia Plantarum, 1843. tab. ii. 1-3.

MONOTROPAEAE. Unger, Frz. Beitrage z. Kenntniss d. Parasit. Pflanzen, 1841, tab. ii. iii vi.—Chatin, G. A. Anat. Comp. d. Végétaux, Livr. 8e. 244. Stem structure is described in detail in *Pterospora Andromedea, Monotropa uniflora, Hypopitys lanuginosa, H. multiflora, Schweinitzia odorata, Sarcodes sanguinea.* The stem, distinguished from the rhizome, has its fibro-vascular fascicles frequently separated by medullary plates, the vessels, of various form, being collected into bundles without having the true spirals, (which are rarely wanting) arranged in a special zone around the medulla, excepting in *H. lanuginosa.* A distinct fibro-cortical system fails both in the stem and rhizome. *vide* also Compt. Rend. 1857, t. 44, 713.

PRIMULACEAE. Vaupell, C. Ueber d. peripherische Wachsthum d. Gefässbündel, &c. Leipzig, 1855, p. 5.

MYRSINACEAE.—*Edgeworthia.* Falconer, H. Linn. Trans. xix. (lignum) 100.

SOLANACEAE.—*Nicotiana.* Richard, A. Nouv. Élémens de Botanique, 1846. 130. On the structure of the cells of the medullary rays.

OLEACEAE.—*Fraxinus.* Link, H. F. Icones Anat. Bot. 1837. Fasc. ii. xv. 6, 7.—Schacht, H. Der Baum, 195.—*Fraxinus excelsior.* Dippel, über die Entstehung und den Bau der Tüpfel. Bot. Zeit. 1850. 335, with figs. Referring to the pores in the septa of the vessels.

JASMINACEAE. — *Jasminum gracile.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827. § 75.

CAPRIFOLIACEAE.—*Sambucus nigra.* Link, H. F. Anatomia plantarum, 1843. tab. v.—*Sambucus, Viburnum.* Mohl, H. v. Bot. Zeit. 1855, 879-80. On liber of.—*Lonicera caprifolium.* Mohl, H. v. Ueber d. Bau * * Ranken- und Schlingpflanzen, Tubingen, 1827, § 75.

APOCYNACEAE. — *Echites, sp.* Jussieu, Ad. de. Monograph des Malpighiacées, p. 117. A structure similar to that of *Gymnema sylvestre.*—' Mulongo,' (*Malouetia furfuracea*, Spr. *β. grandifolia.*) This wood, used for fishing-floats on the Uaupés, consists of elongated very thin-walled cells, many of them with transverse septa, usually sparingly dotted, with here and there vertically superimposed series having their walls covered with minute dots.

These do not differ in size or in other respects from the surrounding tissue in which they appear as the representatives of vessels. In cross section the wood almost precisely resembles that of Coniferae owing to the absence of ducts. The medullary rays are numerous.

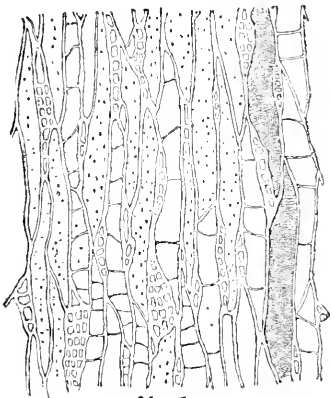


fig. 1.

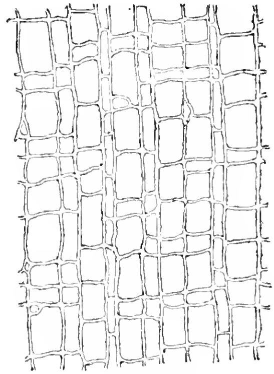


fig. 2

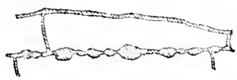


fig. 3.

Fig. 1, longitudinal. Fig. 2, transverse sections of 'Mulongo' wood. Fig. 3, shows irregular thickenings of the cell-wall, more highly magnified.

—*Nerium.* Link, H. F. Anatomia plantarum, 1843, tab. viii. 1-5.—*Vinca* (liber). Schacht, H. Pflanzenzelle. 217. t. 8.

Asclepiadeae.—*Asclepias fruticosa.* B. Mirbel, Elémens de Phys. Vég. tab. xi. 2.—*Cynanchum, Asclepias.* Mohl, H. v. Ueber d. Bau * * Ranken- und Schlingpflanzen, Tubingen, 1827, § 75.—*Gymnema sylvestre.* Jussieu, Ad. de. Monograph des Malpighiacées, p. 117. Under a thick, suberous layer is a second, whitish cortical zone, which projects unequal, radial plates into the woody axis, lobing its contour.—*Hoya carnosa.* Link, H. F. Icones Anat. Bot. 1837. Fasc. ii. xii. 4-5.

Convolvulaceae. Crüger, H. Bot. Zeit. 1850. p. 177. An account of the structure of *Argyreia speciosa*, in detail.—Jussieu, Ad. de. Monograph des Malpighiacées, p. 123. *Convolvulus malabaricus.* The wood is almost entirely composed of large dotted tubes arranged in 8 or 9 concentric circles, separated by as many cortical zones, which communicate with each other by irregular prolongations in a radial, oblique, or sinuous direction. The structure of the root of *C. Turpethum* and of the stem of one or two other undetermined Convolvulaceae is described.—Hartig, Th. Bot. Zeit. 1859, 108. Wood cells in bast.—*Ipomaea.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.—*Cuscuta europaea.* Unger, Frz. Beiträge z. Kenntniss d. parasit. Ann. Wien. Mus. ii.—*Cuscuta.* Unger, Frz. Beiträge z. Kenntniss d. Parasit. Pflanzen. 1841. tab. vi.—Chatin, A. Compt. Rend. 1856. t. xlii. 269 .— also in Anatomie Comp. des Végétaux. Livr. iii. i. with figs. Noting the absence of medullary rays, of unrollable spiral vessels and of a cortical fibrous layer. Modifications of structure are described in *C. Epithymum*, *C. major*, *C. densiflora*, *C. reflexa*, *C. americana.* In *C. monogyna* true spiral vessels occur; also a zone of large dotted fibres.—Uloth, W. Beiträge z. Physiologie der Cusceuteae. Flora, 1860, 257, 273, with figs. The connection between the parasite and its prey is minutely described.—Pitra, A. Ueber d. Anheftungsweise einiger phanerog. Parasiten, Bot. Zeit. 1861, 72.

ACANTHACEAE.—*Thunbergia.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.

BIGNONIACEAE. Martius, von. Gelehrte Anzeigen. 1842, 390.—Richard, Nouv. Elémens de Botanique, 1846, 152.—*Bignonia Lindleyana.* Mettenius. G., Einige Beobachtungen über den Bau der Bignonien. Linnæa, 1847, 567. With 1 pl. The only notable peculiarity in young shoots is presented by the liber, of which four large bundles, isolated at right angles from each other, traverse the outer layers of cortical parenchyma, forming longitudinal ridges on the exterior of the stem. The rest of the liber formation is deeper in the cortical cellular tissue. In cross section of the adult stem it is found that the formation of the wood-zone has been arrested at an early period, at four distinct spaces in its circuit, each opposite to one of the isolated bast-bundles; that, at these portions, the cambium layer appears to have formed, principally, alternating zones of liber and parenchyma, while, over the rest, wood-cells and vessels have been formed. The four alternating bark and wood formations are separated radially by medullary rays of 3 or 4 series of cells, between rows of which a fissure is found to have originated co-extensive with the dissimilar formations. The wood is traversed by wide-mouthed vessels, isolated, or in radially disposed groups; where these border on the pith, spiral vessels occur.—Treviranus, Bot. Zeit. 1847, 398. Ann. Nat. Hist. Ser. ii. 1. 129. On structure of *Bignonia capreolata.*—Gaudichaud. Guillemin's Archives. ii. 501. Pl. 19.—also in Recherches sur l'organographie, &c. des végétaux, tab. xiv. 4. Other species of *Bignoniaceae*, tab. xviii. 4-10.—Voyage de la Bonite. Bot. Atlas. tab. 132. 16, 17. —Schleiden. Principles of Botany, 251-2. (with figs.)—Jussieu, Ad. de. Monograph des Malpighiacées, p. 118. Many of the climbing species are remarkable from the very deep, longitudinal channels in their wood-mass, filled by the cortical tissue, which forms radiating plates from the circumference towards the centre. Usually these plates are four in number. In *Bignonia capreolata* (p. 119) the annual wood formations are separated by circles of wide vessels. In older stems the original, symmetrical, 4-lobate, woody axis becomes broken up, the four lobes being separated by a cross of parenchymatous tissue, and each, deeply groved in its margin, gives off into the cortical tissue ligneous bundles which again unite and merge into the parent mass. Each of the lobes retains a portion of the original medullary sheath at its inner angle. Generally the Bignoniaceae are distinguished by a symmetrical regularity. The invading plates and cones (in cross section) of cortical tissue consist almost entirely of liber.—Crüger, H. Einiger Beiträge z. Kenntniss von sogenannten anomalen Holzbildungen des Dikotylenstammes. Bot. Zeit. 1850, 101. A detailed account of the structure of *Spathodea corymbosa*, *Bignonia unguis* (liane species), with figures, and of *Tecoma 5-phylla* (arborescent.)—*Bignonia.* Lindley, J. Introd. Botany, i. 213. Figure of 4-lobed woody axis. — Schacht, H. Lehrbuch. i. 342. ii. 59. Der Baum. 103.

Boragineae.—*Borago.* Cassini, H. Opuscules phytologiques, 1826, ii. 517—Crüger, H. Bot. Zeit. 1851, 468. On structure of *Tournefortia hirsutissima.*—*Pulmonaria*, *Omphalodes.* Vaupell, C. Ueber. d. peripherische Wachsthum d. Gefässbündel, &c. Leipsic, 1855. 22, 26.

Labiatae. Mirbel, Mem. sur l'Anatomie, &c. d. Labiées, Ann. du Muséum, 1810, xv. Tige, p. 223, with figures.—A. Kirchhoff, De Labiatarum Organis Vegetativis commentarium Anatomico-Morphologicum. Erfurti, 1861.

Verbenaceae.—*Avicennia.*—Schleiden, Wiegmann's Arch., 1839, pt. 3, A. N. H. iv. 245. The wood consists almost wholly of porous vessels. Principles of Bot. 63.—Henfrey, A. Micr. Dict. 'Wood.'—*Petræa.* Crüger, H. Bot. Zeit. 1857, 305. Structure of the wood of. Also *Tectona*, p. 304.

Scrophulariaceae.—*Rhinantheae.* Chatin, A. Comptes rendus. 1857, 470, and Ann. Nat. Hist. Ser. ii. 19, 331. Bull. Soc. Bot. iii. 14.—also in Anat. Comp. d. Végétaux, Livr. 5, 137, with plates. Various modifications of stem-structure are described in detail in *Obolaria virginica*, *Castilleja arvensis*, *Schalbea americana*, *Bartsia viscosa*, *B. latifolia*, *B. alpina*, *B. chilensis*, *Trixago Apula*, *Odontites rubra*, *O. Jaubertiana*, *O. lutea*, *O. longiflora*, *Euphrasia officinalis*, *E. minima*, *E. tricuspidata*, *E. alpina*, *E speciosa*, *E. paludosa*, *Cymbaria dahurica*, *Rhinanthus glabra*, *Rhynchocorys Elephas*, *Pedicularis palustris*, *P. sylvatica*, *P. Perrotetii*, *P. verticillata*, *P. foliosa*, *P. comosa*, *P. sceptrum-Carolinum*, *P. striata*, *P. grandiflora*, *Melampyrum* *arvense, M. cristatum, M. pratense, Tozzia alpina.* A true fibro-cortical system is generally absent in the Rhinantheae. In several genera the medullary sheath becomes confounded or confused with the ligneous zone, which is destitute of medullary rays, excepting in the rhizomes of some species of *Pedicularis.* General observations on the anatomy of *Rhinantheae* (*vide* p. 209).—Pitra, A. über d. Anheftungsweise einiger phanerog. Parasiten, Bot. Zeit. 1861, 65, with figures.—*Orobancheae.* Unger. Frz. Beiträge z. Kenntniss d. Parasit. Pflanzen, 1841, tab. iii.—Duchartre, Ann. Sc. Nat. Ser. iii. 474. Compt. Rend. 1844, i. 93.—Lory, Ch. Observations sur la Respiration et la Structure des Orobanches, &c. Ann. Sc. Nat. Ser. iii. viii, 15, 165. Present a central pith passing insensibly into the ligneous zone; medullary sheath and rays are absent. The narrow wood-zone is made up of triangular fascicles of elongated, thick-walled cells, surrounding annular and unrollable spiral vessels.—Henfrey, A. On the Structure and Habits of the Orobanchaceae. Ann. Nat. Hist. Ser. ii. iii. 29. — Chatin. A. Compt. Rend. 1856, tab. xlii. 792. — Anatomie Comp. des Végétaux, Livr. iii. 44, with plates. The stem-structure is described in *Orobanche cruenta, O. Epithymum, O. Galii, O. pruinosa, O. Teucrii, O. amethystea.—Phelipeae*, p. 66, *P. ramosa, P. indica, P. arenaria, P. cærulea.—Epiphegus*, p. 78, *E. Virginianus.—Conopholis*, p. 81, *C. americana.—Anoplanthus*, p. 84, *A. uniflorus, A. comosus, A. Bieber-steinii. — Clandestina*, p. 89, *C. rectiflora. — Lathræa*, p. 95, *L. Squamaria.—Boschniakia*, p. 99, *B. glabra.—Aeginetia*, p. 103, *Æ. indica.—Hyobanche*, p. 105, *H. sanguinea.* General observations on the Anatomy of Orobanchaceae, p. 108. In *Orobanche* the vascular bundles form a series of bundles in the midst of a continuous layer of woody fibres; in *Philipæa* the slender woody fibres are exterior to the vascular bundles of the stem. *Conopholis* and *Epiphegus* have their fibro-vascular bundles isolated by medullary plates. Spiral vessels are absent in the vegetative organs of *Clandestina* and *Lathræa;* the number and form, in section, of the vascular bundles differ in these genera. In *Boschniakia* the fibro-vascular system is traversed by medullary rays. *Aeginetia* and *Hyobanche* have the fibro-vascular bundles isolated by parenchyma; these genera differ from true *Orobancheae* in the form and arrangement of their fascicles in the rhizome.—*Lathraea Squamaria.* Bowman, J. E. On the Parasitical Connection of, &c. Linn. Trans. xvi. 399.—Duchartre, M. Anatomical and Organogenical Researches on *L. Clandestina.* Ann. Nat. Hist. 1845, xv. 410. Remarking the absence of medullary sheath, of spiral vessels, and of medullary rays. The arrangement of the vessels (reticulated or dotted) in the wood-zone is described.—also Observations sur la, in Mem. Sav. Etrang. x. 1847, with plates. A detailed account of the anatomy.—Chatin, A., Anatomie du *L. Squamaria* comparée a celle du *Clandestina* *rectiflora.* Bull. Soc. Bot. iii. 242.—*Clandestina.* Chatin, A., Bull. Soc. Bot. iii. 242.—*Lathraea.* Pitra, A. über d. Anheftungsweise einiger phanerog. Parasiten. Bot. Zeit. 1861, 64, with figures.—*Philipaea.* Pitra, A. über d. Anheftungsweise einiger phanerog. Parasiten. Bot. Zeit. 1861, 72.

SALVADORACEAE.—*Salvadora persica.* The arrangement of the wood-tissues is remarkable, and deserves examination. (D. O.)

PLUMBAGINEAE. Ebel, W. De Armeriae genere Prodromus, 1840. —*Armeria. Plumbago.* De caule. p. 6—*Plumbago.*—Barnéoud, F. M. Sur le Developpement des Plantaginées et des Plumbaginées, Paris. 1844. 26. tab. ii. 26.—also Entwickelung und den Bau der. Compt. Rendus, 1844, Juli 30.—Oliver, D. Observations on the Structure of the Stem in certain species of the Natural Orders Caryophyllaceae and Plumbagineae. Linn. Trans. xxii. 292, with figures. The wood of *Armeria maritima*, *Acantholimon diapensioides*, and perhaps *Statice arborea*, is destitute of medullary rays. In the latter species the pith is traversed by cords of thick-walled tissue. The arrangement of the wood in species of *Acantholimon* is described. In *A. diapensioides* and *Statice arborea*, apparently minute intercellular cavities were observed in the wood-prosenchyma.—*Statice.* Hartig. Th. Bot. Zeit. 1859, 96. Structure of the wood, and absence of medullary rays.

PLANTAGINEAE. Barnéoud, F. M. Sur le Developpement, &c., des Plantaginées. Paris, 1844, p. 14. tab. i. 28.—*Plantago.* Endlicher and Unger. Grundzüge d. Botanik, 101. Vascular bundles scattered through parenchyma of stem.

POLYGONACEAE.—*Polygonum.* Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.—Link, H. F. Icones Anatomico-Botanicae, 1837. Fasc. i. tab. iv. 5-10.—*Rumex. Rheum.* Schultz, C. H. Die Cyklose, Nova Acta. 1841, xviii. Suppl. ii. tab. xv.

NYCTAGINEAE. Meyer, E. H. F. De Houttuynia, &c. 1827, p. 40.—Unger. Fr. Ueber d. Bau und d. Wachsthum des Dicotyledonenstammes.* St. Petersburg, 1840, with plates. Link. Jahresber. 1840. In *Mirabilis*, the author distinguishes a double vascular system—an inner and an outer. The former is simple, consisting of a vascular zone and its included central vascular bundles which pass into the leaves. The latter is made up of several superimposed vascular belts, formed independently of each other and of the former, and connected only by anastomosis.—Martius, von; Gelehrte Anzeigen, 1842, 391.—Lindley, J. Veg. Kingdom, 507.—Schleiden, Principles of Botany, 251.—Henfrey. Mic. Dict. 'Wood,' on *Pisonia.*—*Boerhaavia.* Lindley, J. Observations on

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* In Section viii. of this treatise, based upon the investigation of wood-structure in *Salix*, Unger discusses the relations of the inner and outer series of vascular bundles in woody Dicotyledons, and their relation to the system of herbaceous species, &c.

pith of *B. repanda.* Introd. Botany, i. 192, also in Penny Cyclop. x. *Exogens.—Mirabilis.* Bernhardi. Ueber Pfl. Gefässe, 1805, 12, 20, tab. 1. fig. 1.—Bischoff, Lehrbuch, ii. 64.—*Pisonia, &c.* Schleiden, Wiegmann's Archiv. 1839, 223.—Lindley, J. Introd. Botany, i. 215. with fig.—Crüger, H. Bot. Zeit. 1850. p. 164. Observations on Structure of *Pisonia.*—Regnault, Ann. Sc. Nat. Ser. iv. xiv. 144. *Pisonia fragrans.* Within the double, cellular, cortical layer, is a fibrous circle, often interrupted, however, and sometimes concealed by the crystalline concretions which abound in this part. The wood is divided by a few medullary rays, each consisting of a single row of cells with dotted walls. The wood prosenchyma is thick-walled and finely dotted; its mass presenting, in cross-section, a series of rounded spaces, elongated parallel to the circumference, and disposed so as to form interrupted concentric circles around the pith. In each of these islets in the wood are found two layers—the outer (towards the bark) of tolerably large and rather long cells: the inner, elongated, fibroid, and closely packed—together recalling the arrangement of tissue in the generative zone. The vessels are always disposed on the inner face of these islets, where they form irregular, radiating trains, plunged in the wood-prosenchyma. Isolated fibro-vascular bundles, corresponding to those found scattered through the wood, are found in the pith. Their structure is described in detail. *Oxybaphus viscosus and Mirabilis* present essentially the same structure; the liber-fibres, however, seem absent in the former.

CHENOPODIACEAE.—*Chenopodium.* Link, H. F. Ann. du Muséum, 1812, xix. 339. Note on.—Elementa, Phil. Bot. 1837, i. 245.—Bischoff, Lehrbuch, ii. 57.—Unger, Fr. Ueber d. Bau, &c. des Dicotyledonen-Stammes. St. Petersburg, 1840, with plates.—Link, Jahresb. 1840. Absch. vii. Structure and growth of Chenopodiaceae (and Amaranthaceae). As in *Nyctagineae*, there occurs a double vascular system. An interior in the pith and immediately around it, continuous through the entire stem, and supplying the appendicular organs with vessels: and an exterior system, essentially distinct from the former in its composition, likewise continuous through and proper to the stem, especially forming the wood-mass.—*Beta.* Gaudichaud, Recherches sur l'organographie. &c. des Végétaux, tab. xii. 1-4.—Schacht, H. Pflanzenzelle, 283, t. xv.—Brongniart, A. and others. Report on Mem. of M. Decaisne 'Recherches sur l'organisation anatomique de la Betterave,' Ann. Sc. Nat. Ser. ii. 11, 49.—Lindley, J. Veg. Kingdom, 512-3. Schacht, H. Pflanzenzelle, 283.—*Anobasis* (*Haloxylon*), *Ammodendron.* M. Basiner, über.—in 'Reise durch die Kirgisensteppe,' in Baer und Helmersen's Beiträge, z. Kenntniss d. Russ. Reiches. xv. 93.—C. A. v. Gernet. Notizen über den Bau des Holzkörpers einiger Chenopodiaceen. Moscow Bull. Soc. Imp. Nat. 1859, 164, with 1 plate.—*Chenopodium album* and *Salsola Kali* agree in the absence of liber and of medullary rays, in the presence of continuous woody zones, and of cambium tissue between its several layers. The wood of the *Salsola* appears, in cross section, to be spirally continuous, unfolding itself from the pith outwards, so that a line drawn radially crosses several (five are figured) of its folds. The coils are separated by a continuous cambium-layer, which, on approaching the periphery, divides, enclosing several scattered vascular bundles. The vessels are chiefly disposed towards the exterior margin (towards the bark) of the wood-spiral. Modifications of a structure, essentially the same as in the above species, presented by *Haloxylon*, *Ammodendron*, *Atriplex*, *Halimus*, and *Halostachys caspia*, are described. (In the *Atriplex*, M. Regnault states M. Gernet to have found thirty alternating zones of wood and generative tissue. I do not find him saying so: he figures a smaller number. But in speaking of the structure of the 'false' medullary rays of this species he points out that these consist of as many as thirty vertically superimposed cells, which apparently confirms their character as medullary rays, but as they are absent in the inner layers of the wood he cannot accept them as such. D. O.) In *Halostachys*, the parenchymatous rays, resembling medullary plates, found in *Atriplex* are absent. The wood occurs in concentric zones, apparently answering to years of growth, alternating with corresponding parenchymatous rings. . . . . Important general observations are affixed, and attention called to the manifold variety in the arrangement of the cambium system in the various types of structure exhibited by the different genera. M. Gernet calls wood in which the alburnum and duramen are readily distinguishable 'heteroxylous,'—those in which the distinction is not apparent 'homoxylous.'—Hartig, Th. Bot. Zeit. 1859, 108. Wood of.—Regnault, Ann. Sc. Nat. Ser. iv. xiv. 133. Closely resemble Amarantaceae in respect of the arrangement of parts. They tend to differ in the structure of the epiderm and suberous layers. Medullary rays are absent. *Camphorosma monspeliaca* is said to differ remarkably from the rest of the family; its structure is not detailed.

AMARANTACEAE. Link, H. F. Ann. du Muséum, 1812, xix. 339. Note on.— *Amarantus*. Link, H. F. Icones Anat. Bot. 1837, Fasc. ii. x. 4-5.—Unger, Fr. *vide Chenopodiaceae*, (Unger) *supra*. —Lindley, J. Veg. Kingdom, 510.—Hartig, Th. Bot. Zeit. 1859. 108. Wood of. — Regnault, Ann. Sc. Nat. Ser. iv. xiv. 127. *Lestibudetia syphilitica* offers an uninterrupted liber-circle of thin cells in groups of two or three: wood distributed into more or less completely concentric zones, separated by belts of a composition identical with that of the outer generative layer and destitute of vessels. The vessels, marked by delicate punctuations disposed in transverse lines, are arranged in radiating series amongst the wood-prosenchyma, the cells of which are slightly dotted. The structure of *Amarantus spinosa*, and of an unknown Mexican Amarantacea, is described. They all agree in the presence of liber; of a generative layer composed of two kinds of elements, masses of which are also variously disposed in the wood; of medullary rays, and intra-medullary, fibro-vascular fascicles. *Deeringia* differs remarkably in some respects, the wood consisting of isolated, fibro-vascular bundles, completely surrounded by parenchyma, in which they are arranged in concentric circles. These bundles are separated radially by the broad medullary rays, concentrically by layers of cells apparently proceeding from them and identical with them in structure.

PHYTOLACCACEAE.—*Phytolacca dioica.* Martins, C. De la Croissance du Bel Sombra. Rev. Hort. 1855, 122. Noting the formation of seven ligneous layers in five months, in the stem.—Treviranus, L. C. Noch Etwas über den Stammbau der *Phytolacca dioica.* Bot. Zeit. 1856, 833. The spongy wood consists of concentric, unequal fibrous layers, separated by intermediate zones of cellular tissue. Vascular bundles occur in the pith. The structure of the wood-zones, &c. is briefly described, and compared with that of allied orders.—Nägeli, C. Beiträge z. Wissenschaft. Botanik, i. 14. The structure of the stem is minutely described; it is selected as the type of those Dicotyledons which possess successively limited rings of cambium tissue in 'Epenchyma.'—Regnault, Ann. Sc.Nat. Ser. iv. xiv. 139. *Phytolacca icosandra.* The fibres of the cortical zone exterior to the 'couche génératice' terminate abruptly by plane surfaces. The wood consists of fibro-vascular masses, which regularly alternate with the medullary rays; these are nearly equal to them in size, composed of thickened cells pierced with numerous minute canals. The woody bundles are formed of much thickened and very minutely dotted parenchyma. Young stems have but one wood zone; in older stems another is superimposed, with this remarkable alternation that the fibro-vascular bundles of the external zone continue the medullary rays of the inner. *P. esculenta* presents a similar structure. *Rivina laevis* is also described.

EUPHORBIACEAE.—*Euphorbia.* Schultz, C. H. Die Cyklose, Nova Acta, 1841, xviii. Suppl. ii. tab. v. vi.—*E. erosa.* Link. H. F. Anatomia Plantarum, 1843, tab. ix. 4, x. xi.—Schacht, H. Die Sogenannten Milchsaft-Gefässe der Euphorbiaceen u. s. w. sind Milchsaft führende, nicht selten verzweigte Bastzellen. Bot. Zeit. 1851, 513. Bast-cells of.—Crüger, H. Bot. Zeit. 1850, 126. Observation on Structure of *Omphalea.*—*Buxus.* Baillon, H. Monographie des Buxacées, 1859, 8. The relation of the quadrangular form of the stem to the development of woody fascicles in the cortical layers from each pair of leaves. The structure of the adult wood is described and figured.—*Pachysandra*, p. 10. Structure of the rhizome.—*Buxus.* Schacht, H. Der Baum, 195.—*Sarcococca.* Baillon, H. Monographie des Buxacées et des Stylocérées, 1859. Structure des rameaux, p. 7. The stem presents the usual anatomical structure of Dicotyledons.

GARRYACEAE. Lindley, J. Bot. Register, xx. 1686. also Ann. Sc.

Nat. ii. Ser. ii. 157. The wood is destitute of concentric zones, consisting chiefly of dotted tubes, traversed by a few annular or reticulated vessels, and disposed in plates separated by broad, radial, medullary processes.—Lindley, J. Veg. Kingdom, 295.

PHYTOCRENEAE.—*P. gigantea.* Griffith, W., in Wallich's 'Plantae Asiaticae Rariores,' iii. 11, pl. 216, and in Griffith's 'Icones,' ccccxc. No description farther than references to plates. The 'medullary rays,' so-called, are represented as symmetrically disposed, enormously thick, and at equal distances apart; in a young stem about 9 in number. They are composed of elongated, tapering cells, traversed by barred vessels. The wood is very porous, from numerous, wide, slit-marked ducts immersed in its dotted prosenchyma. Distinct concentric zones form in the wood, each with its own 'rays,' which are independent of those of the adjoining zones.—*P. macrocarpa.* Griffith, Notulae, iv. 324.—Treviranus Bot. Zeit. 1847, 400. Ann. Nat. Hist. Ser. ii. i. 131. (Report by Henfrey.) Jussieu's arguments do not disprove the view that the plates projecting inwards from the bark-layers originate in the liber.—*P. palmata.* A. de Jussieu. Monog. des Malpighiacées, 122. The solid, radially-disposed plates (regarded by Griffith as medullary rays) M. Jussieu considers to belong to the wood system, and that they form the innermost portion of a second ligneous ring which would develop concentrically, exterior to the first.—Lindley, J. Introd. Botany, i. 211. with fig.—Mettenius, on Structure of *Phytocrene.* Beiträge zur Botanik, 1850, p. 50.—Mohl. H. v. Einige Andeutungen über den Bau des Bastes. Bot. Zeit. 1855. Referring to the vertical plates traversing the wood, which the author considers to correspond to the liber-plates of *Bignonia.*—Radlkofer, L. Ueber das anomale Wachsthum des Stammes bei Menispermeen. Flora, 1858, 206.

LACISTEMACEAE. Schnitzlein in Martius, 'Flora Brasil.' p. 280.

PLATANACEAE. Link, H. F. Recherches sur l'Anatomie des Plantes. Ann. du Museum, 1812, xix. 340, with figs.—*Platanus orientalis.* B. Mirbel. Élémens de Physiologie Végétale, 1815, tab. ix. 1. —*P. occidentalis.* Gray, A. Introd. Botany, 1858, 37 (figs.)—Henfrey, A. Micr. Dict. 'Wood,' and Elements of Botany, 534 and fig.—Schacht, H. Der Baum, 200.

CORYLACEAE.—*Quercus.* Kieser. Mém. sur l'Organisation des Plantes, 1814, tab. xiv.—Mirbel. Mém. du Muséum, 1828, xvi. (fig.)—Buzareingues. Ann. Sc. Nat. xxx. tab. vii. 1, viii. & ix. —Mohl, H. v. Ueber die Entwickel. des Korkes, &c., 1836.—Dutrochet, l'Institut. No. 192.—Bischoff, Lehrbuch, tab. ii.—Mohl. H. v. Ueber den Wieder-ersatz des Korkes bei *Q. Suber.* Bot. Zeit. 1848, 361.—Hoffmann, H. Zur Kenntniss des Eichenholzes, Flora, 1848, 369, 1 pl. A detailed account of the general and minute structure of the pith, wood, medullary rays, and cortical layers of *Q. pedunculata.*—*Fagus.* Mirbel. Mém. du Muséum

1828, xvi. 31 (fig.)—Treviranus, L. C. Physiol. d. Gewächse, 1835, i. tab. iii. 34-6.—Mohl. H. v. Bot. Zeit. 1855, 880. On liber of.—*Fagus*, *Carpinus*, *Quercus*. Hartig. Bot. Zeit. 1859, 94, 97.—*Fagus Forsteri*. J. D. Hooker. Flora Antarctica, i. 300, t. cvii. 11 and 12.—*Corylus*. Carpenter. The Microscope, 1856, 434 (fig.) — *Corylaceae*, several genera. Schacht, H. Der Baum, 191-8. — Henfrey, A. Micr. Dict. 'Wood.' (*Fagus*, *Carpinus*, *Quercus*).

BETULACEAE.—*Betula*. Link, H. F. Elementa Phil. Bot. 1837, tab. iv. 1.—*Betula alba*. Link, H. F. Icones Anat. Bot. 1837, fasc. i. vi. 4-15.—Schulz, C. H. Die Cyklose. Nova Acta. 1841. xviii. Suppl. ii. tab. xxxiii.—Mohl. H. v. Bot. Zeit. 1855, 880. On liber of.—Henfrey, A. Microg. Dict. (*Salix*, *Populus*, Hazel, Alder) 'Wood,'—also Schacht, H. Der Baum, 198. — *Salix* (*vide* note p. 25.) Unger, Fr. Ueber d. Bau, &c. des Dicotyledonen-Stammes, St. Petersburgh, 1840, Absch. viii.

LAURACEAE. Nees v. Esenbeck. Systema Laurinearum, 1836. Brief mention of wood structure, p. 6.—*Laurus Sassafras*. Kieser. Mém. sur l'Organisation des Plantes, 1814, tab. xiii.—*Hernandia*. Schacht, H. Ueber eigenthümliche * * * Erscheinungen in den Verdickungs-schichten gewisser Holz-zellen. Bot. Zeit. 1850, 697. On the wood cells of.—*Cassyta*. Mohl, H. v. Ueber d. Bau * * * der Ranken- und Schlingpflanzen. Tubingen, 1827, § 75.—Chatin, A. Compt. Rend. 1856, tab. 42, 329, Anatomie Comp. des Végétaux, Livr. iii. 27, with figs. Modifications of structure are described in *Cassytha brasiliensis*, *C. casuarinae*, *C. filiformis*, *C. glabella* and *C. triflora*. Unrollable spiral vessels appear to be wanting, except in the last two species. Medullary rays and liber are absent.

MONIMIACEAE. Tulasne, L. R. Monographia Monimiacearum. Arch. Mus. d'Hist. Nat. viii. 1855, 282. The slender prosenchyma cells are irregularly dotted, and traversed by vessels of very variable diameter, slit-marked or dotted.

SANTALACEAE.—*Thesiacées*. Chatin, Anatomie. Comp. d. Végétaux, Livr. 9e, 297 (with plates). The stem-structure is described in detail in *Thesium humifusum* and 8 other species, in *Comandra*, *Fusanus*, *Leptomeria*, *Arjona*, *Quinchamalium*, *Choretrum*, *Nanodea*, *Osyris*, *Henslovia*, 5 spp., *Santalum*, 4 spp., *Mida*, *Rhoiacarpos*, *Pyrularia* (*Sphærocarya*), *Myoschylos*, *Buckleya*, *Anthobolus*, *Exocarpus*. *Nanodea* differs anatomically from other Santalaceae. Its ligneous system does not form a continuous zone, but is usually very irregularly broken up into segments by interposed parenchymatous processes. It consists (1) of dotted prosenchyma radially disposed; of (2) other fibrous cells, some square, some compressed in section, also radially disposed, and separating the former; and (3) a few dotted vessels. Spirals are absent (?) In *Buckleya* the fibro-cortical bundles, in an annual stem forming almost a continuous circle, subsequently become broken up into isolated portions, with increase of the stem in diameter. The annual (?) wood formations are regularly formed of two broad, concentric belts, the inner vascular, the outer prosenchymatous. Medullary rays are numerous. (The conclusion of the *Santalaceae* has not yet reached us.)—Chatin, A. Sur l'Anatomie des. Bull. Soc. Bot. iv. 978. The stem structure of the following genera is described—*Arjona*, *Quinchamalium*, *Nanodea*, *Osyris*, vol. v. 39.—*Cervantesia*. Anat. Comp. d. Végétaux (Parasites), tab. lxxiii. 7, 8. The text has not reached us.—*Osyris*.—Planchon. Bull. Soc. Bot. v. 289, 446, also in Compt. Rend. July 26, 1858 and Ann. Nat. Hist. Ser. iii. 2, 225.—*Henslovia*. Lindley, J. Bot. Register xx. 1686. The wood is regularly zoned, filled with dotted ducts like those of *Ulmus*.—*Thesium*. Pitra, A. über d. Anheftungsweise einiger phanerog. Parasiten. Bot. Zeit. 1861, 69, with figs.

Thymelaceae.—*Daphne*. Link, H. F. Anatomia Plantarum, 1843. Tab. viii. 6. Various forms of liber-cells.—*Aquilaria Agallocha?* 'Aquila Wood.' Certain scattered cords of tissue, in section elongated transversely to radius, traverse the wood (which in other respects agrees with the ordinary structure of Dicotyledons.) Their minute structure requires further examination. (D. O.)

Proteaceae.—*Dryandra*, *Hakea*. Link, H. F. Icones Selectæ, 1839. Fasc i. vii. 3-10.—Crüger, H. Bot. Zeit. 1851. 471. Observations on structure of *Rhopala*.

Aristolochiaceae. Mohl, H. v. Ueber d. Bau * * der Ranken- und Schlingpflanzen. Tubingen. 1827. § 75. —*Aristolochia labiosa*. Gaudichaud, in Guillemin's Archives, ii., 501, pl. 19. 1833.—J. Decaisne. Sur les Lardizabalées. Arch. du Museum, 1839, i. 143, with figures. *A. Labiosa*, p. 152. The woody bundles are formed of porous tubes of various diameter, irregularly intermixed. Each bundle divides like the rays of a fan. There is no trace of concentric zones. The liber occurs in isolated fascicles, immersed in the cortical parenchyma, each corresponding to a division of the wood mass.—*A. Sipho*, p. 153. Annual zones are obvious, owing to the formation of the wider vessels in the early growth of wood of each year. The medullary rays are numerous. The liber, at first continuous, becomes broken up into bundles and isolated with age in the cortical cellular tissue. —*A. Clematitis* exhibits an arrangement of woody bundles, similar to that presented by *A. labiosa*.—Lindley, J. Veg. Kingdom, 793, fig.—Schleiden. Principles, 253.—Duchartre, P. Compt. Rend. 1854, t. 38, 1141.—*Asarum* (1142), *Bragantia* (1142), *Aristolochia* (1143). The stem of *A. cymbifera*, presents a compressed pith, surrounded by a fibro-vascular zone, in the fascicles of which the large vessels are irregularly scattered. The liber-zone, at first continuous, is progressively divided into numerous small bundles, which do not stand in any relation of number or position to the wood-bundles.—In *A. Sipho* the large dotted vessels are arranged in concentric circles, resembling annual zones, but corresponding to different periods of vegetation. —*Asarum*. Vaupell, C. über d. peripherische Wachsthum d. Gefässbündel, &c. Leipsic, 1855, 25.—*Asiphonia*. Griffith, Linn. Trans. xix. 334.

NEPENTHACEAE. Korthals, P. W. Over het Geslacht *Nepenthes*, in Temminck's Verhandel. 1839-42, with numerous figs, tabb. xx, xxi. The anatomy of *N. ampullaria* is minutely described. The adult stem presents a tolerably wide, parenchymatous pith, traversed vertically by isolated spiral vessels, woody bundles, with primary medullary rays, and a series of inosculating secondary plates, one cell in thickness, forming an irregular network between the primary rays. The wood-bundles consist of dotted prosenchyma with, especially towards the periphery, rather wide, dotted vessels; towards the pith spiral vessels occur scattered through the prosenchyma. Exterior to the cambium-layer is a rather thick belt of spiral vessels; others are found scattered through the cortical parenchyma.—Treviranus. Ueber einiger Arten anomalischer Holzbildung bei Dicotyledonen. Bot. Zeit. 1847. 400.—Henfrey. On Progress of Physiol. Bot. A. N. H. 2 ser. i. 131. Bark, wood, liber, and pith are full of spiral-fibrous cells. —Lindley, J. Introd. Botany, i. 211. *N. distillatoria*. The pith abounds in spiral vessels; a dense layer of ligneous tissue occupies the place of the medullary sheath. There are no medullary rays, and the wood has no concentric zones. Between the wood and bark is a thick parenchymatous layer, "in which an immense quantity of very large spiral vessels is found." Veg. Kingd. 287.—Miquel, F. A. W. Journ. Bot. Ned. 1861. p. 278.

(To be concluded in our next.)

XXX.—REMARKS ON THE TRANSLATION OF THE FIRST CHAPTER OF ARISTOTLE'S HISTORY OF ANIMALS. By John Scouler, M.D. F.L.S.

IT is to be regretted that we have no English translation of the History of Animals, and that a work which should be studied by every naturalist, is inaccessible to all who are not acquainted with the original language.* The French translation of Camus is as good as an excellent scholar could render it who was ignorant of Natural History. The Germans possess not only a translation of the Natural History, but also one of the treatise on comparative Anatomy (De Partibus). The translation of the Natural History is

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* This article was written before the appearance of Mr. Cresswell's Translation, recently published by Mr. Bohn.—(Ed N. H. R.)

by Dr. Strack, and is a faithful version of the text, but with very few notes. The English version, by Taylor, we have not seen, and if the Stagyrite has not met with better usage at his hands than Plato and Plotinus have done, our loss is small. As Lobeck says of him, "saepe grammaticam, saepissime sensum pervertit."

The qualifications required on the part of a translator of the Natural History of Aristotle, are much more varied than those which suffice for rendering an ordinary classic into a modern tongue. In translating such a work, the scholarship is the smallest difficulty, as the language is the easiest to master of any Greek author, and the text is now nearly as perfect as it ever can be. In executing a translation, the edition by Schneider should be chosen, as being the one naturalists are in the habit of consulting, and because it is followed by a Latin translation, and a valuable apparatus of notes and dissertations, and we may add, because the editor was both an able naturalist, and a learned scholar. But while Schneider should serve as the basis, a constant reference should be had to the more recent and amended text of Ritter.

An indispensable requisite on the part of a translator is, that he should possess the most familiar acquaintance with the other Aristotelian treatises on the physical sciences. He must know not merely the Greek language, but the Aristotelic language, and be master of his philosophy of nature. In the History of Animals there are many things which are but briefly indicated, and apparently out of all natural connection with the subject, which can only be understood by the more copious illustrations to be found in other works. To understand the natural history, we must consult the long series of treatises from the Meteorology to the De Anima. Of the danger of neglecting this we shall soon have to give examples. In addition to this, an extensive knowledge of zoology and comparative anatomy is essential. In this respect such knowledge as is drawn from books alone is insufficient; the translator must be a practical anatomist, and from long experience, skilful in the diagnosis of species. With this preliminary discipline, even a moderate amount of scholarship will enable a naturalist to overcome difficulties which would perplex a Scaliger or a Bentley. Unless he know the structure of the ovum of the cuttle-fish, the history of the Hectocotyle, the envelopes of the embryo in the different classes, he will find great difficulties in mastering the text of Aristotle.

It is time to apply these remarks to the translation of the first chapter of the History of Animals, which appeared in the last number of the Review. We are surprised to find the word νεῦρα translated *nerve*. Now in Aristotle and all authors before him up to Homer, this word is never used in the sense of our English word nerve, it always means ligament or tendon. This is a serious error; for a knowledge of the nervous system was the weakest point in the anatomy of the Stagyrite. Of the nerves he knew almost nothing; and it was Erasistratus, said to have been the grandson of our philosopher, who first recognised the character of the nerves, and traced their origin to the brain and spinal marrow. Again, p. 144. Review, we have in the translation "salt-water and fresh-water marshes." Now there is not a word about salt-water in the original; the proper rendering is lakes and marshes. If the translator had turned to VI. 13, he would have found that if salt-water marshes be correct, then the Perch, the Carp, and the Silurus are marine fishes. At p. 145, the Greek word ἰλυσπαστικὰ, is, strangely enough, translated wriggling. Aristotle is classifying the different modes of locomotion as flying, walking, and swimming, and then adds the *ilyspastic* as a species of the genus. This error is surprising, as the precise meaning of the term is given by Aristotle himself. If we consult the treatise de Incessu, we find it signifies to crawl like an earth-worm, and expresses the mode of progression of gasteropods, caterpillars, and worms.

It is surprising that the translator should find any difficulty respecting the two well-known words εἶδος and γένος, of such frequent employment in the writings of Aristotle, and so familiar to both naturalists and metaphysicians. It is true they are sometimes used rather loosely in the History of Animals, but this seldom gives rise to any difficulty. The word εἶδος, in the language of Aristotle, signifies not merely form but species, and also the essence of a thing, that which constitutes it what it is. As to γένος, there is no difficulty whatever. Aristotle knew as well as we what classes and orders mean, though he did not use our phraseology; but he speaks of a summum genus and subaltern genera. Thus, birds form an order, or summum genus, and palmipeds are a subaltern genus.

We are told by the translator, p. 142, that parts differ according to their capabilities of distinction. If the Stagyrite had expressed himself in this way, he would never have been

"Il maestro di color che sanno."

The sense is very obvious, that he means to express their qualities, and in the categories he tells us that qualities admit of contraries (black and white), and differ in degree, or more and less. The whole of the passage respecting analogous parts is completely misunderstood, although a most important part of our author's doctrine. The analogy between a scale, a feather, and a hair, was first mentioned by Empedokles, as quoted by Aristotle in the treatise de Anima. The passage is interesting, but too long for insertion. Although the facts were admitted by both philosophers, the difference between Empedokles and Aristotle is as great as that between Oken and Cuvier. According to Empedokles, animals are modified by external agents, and the scales and fins of a fish might be changed into feathers and wings of a bird. Aristotle, on the other hand, resting on final causes, asserts that the function determines the organ, and that different structures may perform the same function. When he says parts are different and the same, the words have a very different meaning from that which Goethe would affix to them. When the translator has the rendering "a hand with a claw," he has lost the meaning of the passage; it should be, a hand and the forceps of a crab, both analogous as to function.

The akalephe or Actinia has been a stumblingblock to the translator. In one place, 144, he translates it the jelly-fish, he then correctly renders it by Actinia, and again the rendering akalephe is a Medusa. Now akalephe always signifies the Actinia, and never the Medusa; it was also called *κνίδα*, and was used as food. The description of Archistratus leaves no doubt as to this; he mentions them in the same verse, and compares their feelers to leaves.

κνίδας ὀψωνεῖν τας ἀμφικόμους ἀκαλήφας.

As to the wandering of the akalephe it is well-known that the Actinia can move from place to place.

The Holothuria has also been misunderstood by the translator. It is a Medusoid animal, and has no relation to the animals which have obtained that name in modern times. When Aristotle brings the sponge and the Holothuria together, his intention has escaped the translator. The free Holothuria and the adherent sponge agree in this, that they are incapable of locomotion. If this is not strictly true of the Medusa, it holds good of some other animals.

We shall notice only two other mistakes. At p. 145, the sentence beginning, "There are some animals which for the first part of their "existence," &c. The meaning of Aristotle is, there are insects which pass their larval state in the water, and afterwards become winged insects. The gnat and the *oistroi* are not different animals, but different states of the same animal.

The translator has thrown no light on the opinion of Aristotle respecting the supposed animal nature of the sponge, nor has he succeeded in finding the solution of the difficulty. As the subject is of some interest, we shall endeavour to explain the mistakes into which many writers have fallen respecting the opinions of Aristotle. With respect to the sponges, properly so called, we think his opinion is that they are truly plants, *παντελῶς ἔοικε τοῖς φυτοῖς*, viii. 1. 3. When he speaks of their shrinking when laid hold of, he subjoins his usual sceptical *ὥς φάσι*, as they say. He also says their contractility is denied by the people of Torone, where he himself must have examined the sponges in his youth. On the other hand, however, he mentions another kind of sponge, called *Aplysia*, because it could not be cleaned. This kind has great ducts or pores, but their tissue is compact, and when cut up their substance is found to be more dense and glutinous than that of other sponges, and resembles lung. It is agreed on all hands that this kind lives for a long time, v. 14. 6. This kind, although called a sponge, is obviously the *Alcyonium digitatum*, or some allied species. When it is remembered that the Alcyonium is endowed with motion and sensation, Aristotle's discussion respecting the nature of the sponge becomes intelligible.

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(1861, continued.)

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Miscellanea.

XXXII.—NOTE ON THE CO-EXISTENCE OF MAN WITH THE DINORNIS IN NEW ZEALAND.

Mr. WALTER MANTELL obtained strong, if not unequivocal, evidence that *Dinornis elephantopus* and *D. crassus* existed contemporaneously with Maori natives in the Middle Island of New Zealand. The bones " are in a recent and most perfect condition. " They retain the usual proportion of animal matter, and have under- " gone no mineral change. . . . . . Remains of native ovens, with "the baking stones, were not far from the chief collection of bones of "*D. elephantopus*. . . . . . . Both were covered by drifted sand from "three to seven feet in thickness. Some of the bones have been "scorched by fire."* Again in his interesting "Note on the locality, affording the femur of the *D. gracilis*," Mr. Cormack says,† "At the "same spot there was a kapura maori, or native cooking fireplace, "dug into the surface of the substratum, and full of stones that had "once been heated (to convey the heat to the food laid upon them), "and left, just as similar cooking-places are left at the present day "by the natives—about two feet from which lay the bones. Close to "the fireplace, and similarly imbedded, were bones of smaller birds, "and of fishes similar to those found at present in the sea adjacent; "all, including those of the Moa, having been evidently the remains "of the food cooked here at a former period and eaten, as my native "attendant remarked, by the then native inhabitants." The evidence afforded by these New Zealand kjökkenmöddings certainly appears to establish satisfactorily the co-existence of the Moa and the Maori; nevertheless the following letter which I have received from M. Lartet will, I am sure, be read with interest.

"Mon cher Monsieur Lubbock,—Je puis aujourd'hui, avec l'assentiment de M. Serres, Professeur d'Anatomie comparée au Jardin des Plantes, vous fournir les renseignements que vous souhaitez sur les ossements de Dinornis et autres accessoires donnés au Museum d'histoire Naturelle, le 29 Oct. 1858, par M. W. Mantell. Ces ossements avaient éte trouvés, en 1857, en creusant un lit de sable renfermant de l'angite de fer titanifère, &c. a Te-rangataque, Waingogoro au coté ouest de North Island de la Nouvelle Zelande; une partie des accessoires parait provenir d'une autre localité indiqueé, par M. W. Mantell, sous le nom de Ruamoa.

"Le morceau capital donné par M. W. Mantell, est un membre entier qu'il rapporte à une espèce nouvelle (*Dinornis elephantopus*).

"Parmi les morceaux non classés et sur lesquels M. W. Mantell n'a pas laissé de renseignements écrits, on peut reconnaître des portions de femur, des phalanges et tout la partie superieure d'un crane de Dinornis dont les cavités sont encore remplies d'une mélange de charbon et de cendres, il y a aussi une phalange unguale offrant un état de carbonisation tel que l'on doit supposer qu'au moment où elle a été soumise à l'action du feu elle retenait encore beaucoup de substance gélatineuse.

"Avec ces ossements d'oiseaux se trouvent quelques restes de mammifères sur les quels je n'ai pas trouvé de renseignements écrits, mais classés comme de même provenance. C'est d'abord une demi-mandibule d'un carnassier du genre *Canis* que j'ai pu rapprocher de celle attachée à un crâne de *Canis australis* que possède notre collection, sans y remarquer d'autre difference qu'un peu moins de grandeur.

"Il y a aussi plusieurs dents de phoque et un humerus d'un jeune individu de cette famille qui parait avoir été soumis à l'action du feu. Les dents m'ont paru appartenir au *Phoca leptonyx*.

"J'avais oublié de mentionner que Mr. W. Mantell a également donné de nombreux fragments de coque d'œuf très minces qu'il attribue au Dinornis.

"Voici maintenant en quoi consistent les accessoires donnés par Mr. W. Mantell comme se rattachant circonstanciellement et synchroniquement, à ces débris de Dinornis.

"1°. Un caillou ovalaire et dont la surface altérée par l'action du feu ne permet

* Owen, Trans. Zool. Soc. Vol. iv. p. 156.
† Trans. Zool. Soc. Vol. iv. p. 146.

pas de bien déterminer la nature minéralogique—il me parait être de roche plutonique; ce caillon de la forme et de la grosseur d'un petit œuf de poule, ou mieux encore de la forme d'un œuf de Palmipède, avait dû servir, suivant M. Mantell, à faire cuire les oiseaux.

"2°. Un grand éclat de silex noirâtre, offrant sur l'une de ses faces presque plâne, le renflement en cassure conchoidale si characteristique des éclats de silex obtenus artificiellement; l'autre face présente deux plans obliques séparés par une arête médiane et longitudinale: l'un des bords est plus tranchant que l'autre. Suivant M. Mantell ce silex taillé a dû servir à couper les chairs.

"3°. Plusieurs éclats d'obsidienne à bords plus ou moins tranchants mais sans forme definable. M. Mantell n'a donné d'autre renseignement sur ces éclats d'obsidienne que leur provenance de Rangataque.

"4°. Un autre fragment de *grès lustré* à plans de cassure multiples et une seule facette lisse, simplement indiquè comme provenant de Ruamoa."

These additional facts will, I think, be read with interest, and fully justify the conclusion,* that in all probability the "Moa was exterminated, like the Irish gigantic Deer and the Dodo, by the "agency of man."

Parthenogenesis in the Silk-worm Moth.

In the Philosophical Transactions for 1856 I have endeavoured to record all the species of Articulata in which virgin females have produced fertile eggs. Among the Lepidoptera the genera *Psyche* and *Solenobia* multiply generally by Parthenogenesis, while in other genera this only occurs as a rare and exceptional phenomenon. While, however, some cases seem to be satisfactorily established, we have no observations on the conditions of their occurrence. In the Comptes Rendus for the 16th December, M. Jourdan records the results of some experiments on the silk-worm moth. There is a tradition among some of the ancient families of silk-growers in the south of France, that one of the best ways of regenerating their races of silk-worms was to employ what is called "virgin seed," that is to say, unimpregnated eggs.

To test the truth of this statement M. Jourdan made the following experiments. He isolated 300 cocoons of a variety which has four moults, and only gives one yearly silk crop; and from these he obtained 147 female moths and 151 males. Out of these 147 females only six laid fertile eggs—two gave 7, two 4, one 5, and one 2. These 29 eggs were the only ones which were hatched, though many others passed through the early stages of embryonic development. The whole number of eggs laid was about 58,000, so that the proportion of fertile ones was about one in two thousand.

He made a second experiment on a variety which, instead of one generation in a year, has five or six, and undergoes three moults. Out of 50 cocoons he bred 23 females and 26 males. Seventeen out

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* Rupert Jones, in Mantell's Wonders of Geology, 7th edition, p. 129.

of the twenty-three females laid fertile eggs, though M. Jourdan is convinced that neither in this experiment nor in the former one can any impregnation have taken place. The good eggs were in the proportion of one to seventeen. M. Jourdan does not mention the sex of the young thus produced; he promises, however, to repeat his experiments on a larger scale. I. L.

Botanical Information.—Fruiting specimens have been received by Sir W. J. Hooker, of a very remarkable plant, growing in the Dammar country, West Africa, evidently closely allied to the genus *Tumboa*, alluded to by Dr. Welwitsch (Linn. Proc. Bot. v. 185), though probably specifically distinct from his plant. A coloured sketch by its discoverer Mr. Baines was forwarded with the specimens. The plant is represented as destitute of the curious tubular stem described by Welwitsch, but the huge riband-like spreading leaves, several feet in length, and the character of the infrutescence correspond very well with his account. Instead, however, of a single pair of leaves, Mr. Baines represents the plant as possessing at least two pairs crossing each other at right angles. The female flowers are arranged in lanceolate, closely-imbricating, squarrose cymes, 2—3 inches in length. Dr. Hooker, who is describing the specimens, considers the *Tumboa* to be undoubtedly *Gnetaceous*. The structure of the young fruits agrees very closely with that observed in *Gnetum* itself.

Common Ling (*Callema vulgaris*) in Massachusetts.

That "America has no heaths" is a botanical aphorism. It is understood, however, that an English surveyor, nearly 30 years ago, found *Callema vulgaris* in the interior of Newfoundland. Also that De la Pylaie, still earlier, enumerates it as an inhabitant of that island. But this summer, Mr. Jackson Dawson, a young gardener, has brought us specimens of living plants (both flowering stocks and young seedlings) from Tewkesbury, Massachusetts, where the plant occurs rather abundantly over about half an acre of rather boggy ground, along with *Andromeda calyculata, Azalea viscosa, Kalmia angustifolia, Gnatiola aurea*, &c., apparently as much at home as any of them. * * * * It may have been introduced, unlikely as it seems, or we may have to range this heath with *Scolopendrium officinarum, Sabularia aquatica*, and *Marsilea quadrifolia*, as species of the old world so sparingly represented in the new, that they are known only at single stations,—perhaps late-lingerers rather than new comers. Asa Gray, in Silliman's Jour. xxxii. (1861.) 290. We have seen a specimen of the American *Callema*, forwarded to Dr. Hooker. It does not seem to differ in the least from the common Ling of our moorlands.

THE

NATURAL HISTORY REVIEW:

A

QUARTERLY JOURNAL OF BIOLOGICAL SCIENCE.

Reviews.

XXXIII.

1. Bericht über die Zusammenkunft einiger Anthropologen, in September 1861, in Göttingen. Leipzig, 1861.
2. Zur Morphologie der Rassen-Schädel. Von Dr. J. C. G. Lucæ. Frankfurt, 1861.
3. The Mensuration of the Human Skull. By J. Aitkin Meigs, M.D. Philadelphia, 1861.
4. Le Kephalographe. Nouvel Instrument destiné à déterminer la Figure et les Dimensions du Crane ou de la Tête Humaine. Par P. Harting. Utrecht, 1861.
5. Essai sur les Déformations Artificielles du Crane. Par L. A. Gosse. Paris, 1855.
6. Craniometrie of onderzoek van den Menschelijken Schedel bij verschillende Volken, in Vergelijking met dien van den Orang Oetan. Door J. A. Kool. Amsterdam, 1852.
7. Untersuchungen über Schädelformen. Von Dr. Joseph Engel. Prague, 1851.
8. Observations on the Human Crania contained in the Museum of the Army Medical Department, Fort Pitt, Chatham. Crania Britannica. By J. Thurnam and J. B. Davis, 1858-62.

[With Plate VIII.]

The above long list of comparatively recent works, chiefly on the subject of Craniometry, or on the various modes in which the dimensions, proportions, and form of the Human Cranium may be estimated and defined, and to which numerous additions of prior date might be made, will alone suffice to show, how much importance is now deservedly attached to this branch of Comparative Anthropology. A term, first proposed, we believe, by the illustrious v. Baer, and under which is comprehended that department of the great science of General Anthropology which embraces more particularly the study of the physical characters of the different varieties of the Human Race, and which has of late assumed more and more the features of a definite branch of Science.

Long confined in great measure to Ethnologists, and not very sedulously, and by no means very successfully cultivated even by them, it has in more recent times begun to claim its due importance in the eyes of the Zoologist and Comparative Anatomist. It has also become one of the most useful aids to the Archæologist, and even, it may be said, to the Geologist, whose pursuits seem at length to be converging to a common point.

The great questions embraced by Comparative Anthropology, concern not only the true nature and value of the diversities so manifestly exhibited in the different varieties of the existing races of mankind, but also those relating to the connection between them and the priscan populations whose remains have of late years more especially occupied the attention of philosophical enquirers.

Much has been done and great labour has been expended on this branch of science, but, nevertheless, some of the most important problems connected with it still await solution. Its hitherto limited progress may be assigned to several circumstances, amongst which it may chiefly perhaps be noticed that the purely physical enquiry—with which, regarding Comparative Anthropology as a part of Zoology, we alone have to do,—has been in great measure postponed as it were to the philological; a course which a little consideration will, we think, show to be unlikely to lead to any satisfactory result. But it is also attended with inherent difficulties of its own, regarded simply as a physical enquiry. The difficulties attending the investigation of the diversities of human beings, it is scarcely necessary to observe are far greater than are met with in other branches of Zoology. In the case of animals and plants, copious collections can be made and stored up in museums for accurate and leisurely examination and comparison, but it would be impossible to make similar collections of the different forms of the human race. At best but few perfect specimens of pure or unmixed races (to use an indefinite term) can be obtained, and the Anthropologist at home is compelled to rely for the materials of his studies upon the incomplete descriptions and imperfect figures of travellers, or upon such fragmentary portions of the body as can be easily obtained and transported.

A Gorilla or a Chimpanzee can be caught and sent alive to the Zoological Gardens, or killed and forwarded in a cask of rum to the British Museum, but loud would be the outcry were similar attempts made to promote the study of Anthropology.

It follows that the principal part of our materials for this study can consist only of the more permanent and portable portions of the frame. Amongst these it is manifest, for many reasons, that the *cranium* taken singly is by far the most important, and it is to this part of the skeleton, therefore, that the labours of the Comparative Anthropologist have necessarily been mainly devoted.

The study is of course chiefly of a morphological nature, and depends therefore for its data upon *measurement* and *delineation.*

Hence have arisen the arts of CRANIOMETRY and CRANIOGRAPHY, which form the subjects of the following observations.

Easy as it might at first sight seem to be to contrive such a system of measurement, as would suffice to give a tolerably good notion of the capacity and relative proportions of the cranium, it has not been found so easy in practice; and although to an artist it may appear a facile task to produce a faithful picture of a skull, experience has shown that the great majority of figures hitherto given are absolutely worthless for accurate comparison, or in fact for any scientific purpose.

For these reasons it happens that the expensive and valuable materials for craniological enquiry collected in many places, have as yet not been rendered so available to science as they might have been, no means having hitherto been devised by so describing and delineating the objects contained in them as to render it needless for enquirers to visit the collections themselves, if they desire to institute exact comparisons.

This has arisen mainly from the want of a precise and common plan of investigation, and of recording the observations made.

Without some common plan of operations, it is extremely difficult, and in some respects impossible to institute such comparisons between the data of different observers, as are alone sufficient for the deduction from them of reliable general results.

The necessity of some such accord among Anthropologists has long been felt, and has daily become more and more imperative, as the importance of their science has become more extensively perceived. Inspired by this need, Prof. v. Baer, to whom science is already so deeply indebted, in conjunction with Prof. R. Wagner, issued in August, 1861, an invitation to a select number of German and other Craniologists to meet, in the, to them, classic town of Göttingen, and confer upon the general interests of Anthropology, but more especially to agree, if they could, upon the adopting of some uniform system of measurements, and upon some plan of making drawings, casts, or other representations of the cranium. This meeting, which, as a preliminary one, was purposely confined to a few, accordingly met in the month of September, and consisted of Prof. v. Baer, R. Wagner, Vrolik, Lucæ, Bergmann, Meissner, and E. H. Weber, and one or two others, whilst communications were received from Prof. Schaffhausen and Prof. Harting. Names alone sufficient to show the reliance that may be placed upon the result of their deliberations, and highly auspicious for the future progress of Anthropology.

After some introductory observations from Prof. v. Baer, who worthily occupied the chair in such an assembly, in which he gave a general and very interesting survey of the scope and state of Anthropological enquiry, the following programme of proceedings was proposed.

1. To compare and decide upon the best method and apparatus to be employed in the *graphic* and *plastic representation* of the whole body.
2. To inquire into the best method to be followed in the *measuring* and description of the entire body, and of individual parts.
3. To promote the mutual communication of catalogues of the materials for Comparative Anthropology, collected at various places.
4. To consult about the establishment of a Journal to serve as a medium for the publication of communications relating to Anthropology, and of making known any additions to Anthropological science that might appear elsewhere.
5. To receive divers communications.
6. To consult as to the future development of the Association, as it was desirable, in the first place, that the experience which might be gained in the use of the methods recommended, should after a time be mutually communicated by its members to each other; and secondly, because it might be advisable that the Association should be enlarged, and its objects made more comprehensive.
7. To entertain propositions of any kind.

The first subject submitted to the meeting was Dr. Lucæ's method of making geometrical drawings of the cranium, which appears to have been highly approved of, if not adopted by the meeting. As this method is fully described in Dr. Lucæ's memoir, cited at the head of this article, we will not here enter upon it further than to make some remarks upon its merits in comparison with other modes of delineation, on which a few words will afterwards be given.

Subsequently the subject of *Craniometry* was taken up, when the Chairman explained the system he had adopted and described in his "Crania selecta." Into the nature of this system, which will doubtless form the basis of the much desired uniform plan yet to be agreed upon, we shall enter pretty fully, after making a few observations on Craniometry in general.

The space at our command will prevent our attempting to give any historical review of the various plans and systems of measurement adopted by Craniologists from the time of Spigelius to the present day. And this in fact is the less required, since such a review, very ably and fully drawn up by Dr. Meigs, will be found in his essay, above cited, and which, it may be mentioned, first appeared in the North American Medico-Chirurgical Review, for September, 1861.

The main object of Craniometry is to ascertain and express in numerals so many of the various dimensions of the skull as may suffice to show its proportions as a whole, and the relative proportions to each other of its various parts, either absolutely, or in comparison with other crania. The measure of the *cranium* proper, or brain case, may be taken either on the exterior or the interior. For general purposes the former may be held sufficient, but in cases where the question turns upon the actual size and configuration of the brain, the latter is indispensable. In this point of view it cannot be too strongly recommended to the possessors and curators of craniological collections, that a certain proportion, at any rate, if not all the crania should be bisected in the median plane.

Before stating our own views with respect to cranial measurements, we will now briefly extract from the Göttingen Report the substance of the system proposed by Prof. v. Baer, in the hope that with some modifications perhaps, the scheme proposed by him, and which appears to have been well received by his associates at the meeting, will eventually be generally adopted.

The principles by which Prof. v. Baer was guided in proposing his measurements, were—1. To determine the *points* between which the measures are taken as precisely as possible, so that two persons measuring a cranium at different times, should find their measures closely in accord. 2. To select such *points*, as would afford measures from which the form of the skull could be appropriately estimated. The points, therefore, would not by any means be always homologous for any particular measure, as for instance, the greatest *breadth* of a cranium would be measured between the points on either side at which it really existed, whether the points in question were situated higher or lower—the precise situation of the points, however, being noted. 3. To avoid as much as possible the projecting ridges, which vary much in different individuals according to their muscular development. 4. To select, as respects the proper cranium, those points where the outer surface is nearest to the inner, so as to obtain a nearer approximation to the actual form of the brain. In the case of the glabella, however, he has been obliged to depart from this rule. Any accurate measurement of the brain in its various dimensions, can, in the absence of the recent brain, only be obtained from casts of the cerebral cavity.

To the measurements formerly given by Prof. v. Baer in his *Crania Selecta*, p. 4, et 5, he has since added several others of the cerebral cavity taken in skulls that have been divided in the way just recommended; together with several of the face. In these measurements he has had in view, in as few columns as possible, the expression as it were in numbers of an image, or of dimensions from which the form of the skull might be re-constructed.

He proposes also the employment of certain definite *termini* of the nature of those employed in Zoology and Botany, to express without periphrasis the various views of the cranium, as seen from above, from behind, &c.

1. It is well known that Blumenbach placed great importance in what he designated the "norma verticalis," or the view obtained by

resting the cranium upon its base, and looking down vertically upon the summit. Besides this "norma verticalis," Prof. v. Baer adopts, 2. a "*norma occipitalis*," which is obtained by the placing of the skull in the horizontal position, in the line of sight of the observer who should view it at a certain distance. In this view the most marked and distinctive differences of contour will be observed, although as remarked by v. Baer, the foundation of them all is a pentagon.

3. A *norma frontalis*, or the view obtained by looking at the skull placed in the same position, from the front.

The measures proposed and used by v. Baer are:—

1. The *Length* of the skull measured from the glabella to the most projecting part of the occiput—unless that should happen to be the much developed superior occipital ridge or spine.

2. The *Breadth*—measured at the widest part—the points as to height above the auditory openings on each side where this is placed being noted.

3. The *Height*, measured from the level of the anterior and posterior borders of the *foramen magnum*, to the most distant point of the vertex.

4. But since the height measured in this way does not correspond with that of the cranium, regarded as in a horizontal position, and consequently would not agree with the height as shown in a photographic figure or geometric drawing—this dimension may be measured in a second manner, or in the perpendicular direction as it may be termed. This measure is taken by placing one branch of the stem-compasses (Stengelzirkel), beneath the foramen magnum, and parallel with the plane of the zygomatic arch, and the other on the highest part of the cranium.

5. The horizontal circumference of the cranium measured in the usual way by means of a graduated tape passed round its greatest circumference on a level with the glabella.

6. The cranial arc measured longitudinally in the mesial line, and commencing at the fronto-nasal suture. The entire arc is subdivided into four portions, one extending from the fronto-nasal suture to the junction of the coronal and sagittal sutures, a second corresponding in length to the sagittal suture, a third from the termination of this to the spine of the occiput, and the fourth from this point to the posterior border of the foramen magnum.

7. The chord of this great arc is the distance from the anterior border of the foramen magnum to the fronto-nasal suture. This line may be taken as representing the distance between the root of the nose and the anterior margin of the foramen magnum, but as it includes the width of the frontal sinuses, it cannot be regarded as showing the sum of the bodies of the cranial vertebræ, which can only be properly measured in the sawn skull.

8. The position of the foramen magnum, estimated from the most prominent part of the occiput.

9. The greater or less development of the occiput may also be

estimated, according to the method proposed by Retzius, who measured the distance from the external auditory foramen to the glabella, and to the most projecting part of the occiput.

10. The external auditory foramen is, relatively speaking, a fixed point, as has been pointed out by Carus. But, at the same time, its position must not be regarded as absolutely fixed. At any rate, its position with respect to the *foramen magnum* is liable to vary. Generally speaking, a transverse line drawn through the centre of each opening, would pass over the anterior part of the foramen magnum, and consequently would nearly correspond with the line of support—but sometimes it will run a little in front of this direction, or over the anterior margin of the foramen, or even in very short skulls altogether in front of it. A circumstance which should be noted.

11. Besides the extreme breadth Prof. v. Baer takes three latitudinal measures at different points, viz.: at the forehead, the parietal eminences, and behind the ear, that is to say at the junction of the parietal and occipital regions.

The frontal region is measured first at the narrowest part in front or immediately behind the external orbital process—(not including the temporal ridge) and secondly, towards its posterior part, or close upon the coronal suture, the greatest width at this part being just below the temporal ridge.

12. The distance between the centres of the parietal protuberances.

13. 14. In order to determine the development of the hinder part of the cranium where the occipital region begins, he takes a point on a horizontal level with the auditory opening and in a straight line behind it, and immediately behind the border of the base of the mastoid process, and measures the distance between the corresponding points on either side. This line may be regarded as the chord of the arc measured from the same points over the vertex. The value of the points above indicated is not so arbitrary as it might seem, since it corresponds to the curve of the transverse sinus, and the chord gives an approximate measure of the breadth of the tentorium and of the space for the *cerebellum*. All these measures do not give absolutely the dimensions of the cerebral cavity, but they are comparable *inter se*, and except the *glabella* the points from which they are taken are so selected as to approach near the cavity.

15. In order to estimate the space occupied by the brain, the skull must be sawn in two—which is best done in the medial plane. The length of the bodies of the cranial vertebræ, he says, (not quite truly) can now be measured by a line drawn from the anterior angle of the foramen magnum to the foramen cœcum. The length of the arc from the latter point to the *foramen magnum* is also displayed; whilst at the same time the angle formed between the upper surface of the basilar process with the plane of the foramen magnum, and with the cribriform plate of the ethmoid is clearly seen. The alti-

tudes of the different divisions of the cerebral cavity can be estimated for each vertebra, whose bodies are now fully visible. The length, breadth, and height of the cerebrum may be easily measured, but the solid contents are not so readily determined in this way. Casts of the interior are required to effect this purpose.

Having thus stated the system of measurements proposed by Prof. v. Baer, we would remark that it appears to us defective, principally in the circumstance that it does not afford sufficient data for estimating the relative proportions of the different divisions of the cranium; or, at any rate, not so completely as we think this should be done. Otherwise, we are ready to adopt nearly all his measures, though simply for convenience sake, placing them in a different order of succession, and adding those we deem necessary.

We conceive that a comparatively small number of measures will suffice for the purpose of showing:—

1. The proportions of the entire cranium as regards *length*, *breadth*, *height*, and *internal capacity* (when the skull is sufficiently perfect), and consequently to afford some idea of its comparative dimensions.

2. The comparative dimensions of the *frontal*, *parietal* and *occipital* regions, corresponding to the main divisions of the brain. To which should be added, to complete an ethnological view of the skull, the estimation of,

3. The degree of pro- or orthognathism, or what is equivalent to the so-termed facial angle; the situation of the foramen magnum or rather of its anterior border; the breadth of the face at the level of the external orbital processes of the frontal bone, and of the zygomata; and the width of the ethmoidal bone or between the orbits.

All these measures may be comprised in from 25 to 30 columns at most, and they appear to us sufficient for any purpose to which Craniometry can be applied, while some of them, it is possible, may be omitted without harm. Placed in order they would stand thus:—

1 Cranial.

1. Length.
2. Breadth.
3. Height.
4. Circumference.
5. Longitudinal arc.
6. Least frontal breadth.
7. Greatest ,,
8. Parietal ,,
9. Occipital ,,
10. Frontal radius.
11. Vertical radius.
12. Parietal ,,
13. Occipital ,,
14. Frontal transverse arc.
15. Vertical ,, ,,
16. Parietal ,, ,,
17. Occipital ,, ,,
18. Longitudinal frontal arc.
19. ,, parietal ,,
10. ,, occipital ,,

2. Facial.

1. Orbital breadth.
2. Zygomatic ,,
3. Ethmoidal ,,
4. Fronto-nasal radius.
5. Maxillary radius.

In this table it will be seen that the measurements, so far as the exterior of the skull is concerned, include nearly all those of Prof. v. Baer and other craniologists, with some additions, required, as it seems to us, for the objects above proposed.

But a few words in explanation of it will be required. And, firstly, with reference to the word *vertical*, it will be necessary to define what is meant by a vertical line in the cranium, a thing which does not appear, so far as we are aware, to have been hitherto very precisely laid down. To do this, and before we proceed to measure the cranium, and especially before we attempt to delineate it, it is necessary to determine upon some fixed position in which it is to be regarded, and with reference to which many of the lines in which the measurements are taken are to be conceived as drawn. We have also, in the second place, to determine upon certain fixed points from which certain of the measurements are to be taken. Without these precautions any accurate comparisons are impossible.

1. With respect to the *position* of the skull. It is obvious that this depends simply upon what we are to regard as its vertical or its horizontal plane, either of course being sufficient for the determination of the other. The importance of the determination of this point is acknowledged by all craniologists, although up to the present time there does not seem to have been much accord respecting it among them.

In the Göttingen Report (p. 35), Prof. v. Baer remarks, that, in the delineation of a skull, "it is above all things necessary that an "agreement should be come to respecting the horizontal plane, in "order that different figures should be really comparable." Though this observation is eminently true as regards figures of the cranium, it is scarcely less applicable in the case of taking, at any rate some, of the measurements. The horizontal plane, hitherto most usually adopted, has been one passing through the centre of the external auditory foramen and along the floor of the nostrils. But a little consideration will show that this is not the true horizontal plane of the head. A really horizontal line starting from the centre of the auditory foramen would, in most cases, as remarked by v. Baer (p. 36), pass a good way above the floor of the nose. The plane of the foramen magnum, which some have assumed as the horizontal plane, is still further from the true one, and is besides excessively variable. Professor Lucæ, in his excellent figures, has assumed that the direction of the zygomatic arch, or rather of its upper border, coincides with the horizontal plane. In this we are fully disposed to agree, though we think that the plane in question may be ascertained in a more precise way than by simply taking the zygoma itself, which is often considerably curved, as the indicator, If we are not mistaken the Abbé Frère first proposed to take as a vertical line one drawn from the middle of the auditory foramen to the junction of the coronal and sagittal sutures. At any rate, we have adopted this line invariably as the *vertical* line of the skull, and it will be found in the vast majority of cases really to be so (VV. Fig. 1. Pl. VIII.). Now, if a line be drawn at right angles with this, also through the centre of the auditory foramen (HH. Fig. 1), it will be found to run in the same plane with the zygoma, and to cut the nostrils at a variable distance above their floor;—the distance varying according to the downward development of the superior maxillary bones, and thus affording, in some cases, a useful character. This we regard as the *horizontal* or base line of the cranium.

2. With respect to certain points in the cranium from which some of the measurements are to be taken. The more important of these appear to us to be—

1. The fronto-nasal suture, from which the measure of the longitudinal arc commences, and to which the fronto-nasal radius is measured.

2. The posterior border of the foramen magnum.

3. The most important of all—the centre of the external auditory foramen. If a wire be passed directly through this point, it will enter the cavity of the skull through the internal auditory opening, and pass out at the other side, of course in the same direction, traversing the pons varolii, and thus nearly corresponding with the point at which the crura-cerebri begin to expand. Lines radiating from this point to the surface of the brain will consequently give pretty nearly the depth of that organ in the various directions. In the same way, if similar radial lines can be drawn to points on the exterior of the skull, these will afford a rough approximation to the depth of the brain in the given directions. At any rate, they will afford data for the comparison of one skull with another. From the same point also are measured the transverse arcs, which correspond in direction with the radii of the same denomination, and afford a comparative idea of the greater or less convexity of the cranium in the different regions.

4. The occipital spine.

5. The anterior border of the alveolus of the upper jaw. To this point is measured the maxillary radius, and the difference in length between this and the fronto-nasal radius will be found, perhaps, a better criterion of the degree of projection of the jaws than is afforded by any of the uncertain means hitherto devised for ascertaining the so-termed facial angle.

6. The most projecting points in the zygomatic arches.

7. The external angular processes of the frontal bone.

It will be necessary to add but a few words further explanatory of the measurements in the table; which will, however, better be understood by reference to the figures in the accompanying plate than by any detailed description. In—

Fig. 1. (Plate VIII.) V, V, is the vertical line, and also the direction in which the vertical radius and transverse arc are measured.

H, H, is the horizontal line of the cranium.
m, marks the maxillary radius.
n, „ fronto-nasal „ and tranverse arc.
f, „ frontal „ and „ „
v, „ vertical „ and „ „
p, „ parietal „ and „ „
o, „ occipital „ and „ „
B, B, shows what may be termed, in contradistinction to the *horizontal*, the basal line of the cranium, or, more properly speaking, of the cerebrum: it is a line drawn in the direction of a plane, extending from the level of the occipital spine to that of the glabella.

Fig. 2. *lp* marks the direction of the longitudinal vertical plane; *zz* that of the zygomatic breadth.

Fig. 3. *hh*, corresponding to *lp* in Fig. 2, marks the direction in which the height of the cranium is taken.

Fig. 4. *lp*, longitudinal vertical plane;
tp, transverse vertical plane. The intersection of these lines is the *vertex*.

Fig. 5. *lp* and *tp* signify the same as in Fig. 4, and their intersection, nearly at the middle of the anterior margin of the *foramen magnum*, of course corresponds with the *vertex* above, the distance between the two points being the *height* of the cranium.

Having obtained these measures, the next question is, what is to be done with them? In the first place, they afford the means of roughly estimating the absolute dimensions of any cranium as compared with another; and secondly, they allow of our using precise numerical values, in place of words, in speaking of the comparative proportions of different classes of skulls; that is to say any term so employed may and ought to be associated with a given numerical value.

An idea of this kind appears to have been entertained by Prof. v. Baer, who seems to have been the first to express the proportions or some of the proportions of a cranium in terms of a common module—that chosen by him being the length, and in this we have followed him. It will readily be seen that by the adoption of this plan, the comparative length, or shortness, or height, or any other dimensions of a cranium may be accurately expressed in figures. As, for instance, assuming the length as the standard or modulus, crania, as regards their breadth or height, may be said to have it .6, .7, .8 or .9 of the length—the two former numbers actually embracing pretty nearly all the crania hitherto classed as *dolicocephalic*, whilst under the two latter will be found included all or nearly all the so-termed brachycephalic skulls.* By reference again to the same module, the

* M. Broca also (Bull. de la Soc. d'Anthrop. July 1861,) proposes to take, as "indice céphalique," the proportion of length to breadth; and, as we think very

degree of prognathism and of occipital prolongation, zygomatic breadth, and so on, may also readily be expressed and placed in columns, so that the comparison of one set of forms with another, and their average values, may be seen at a glance.

Having said so much on the subject of measurements, our space will allow of but few observations on that of the graphic representation of the cranium, to which, however, even greater importance should be attached.

The objects to be held in view in preparing figures of crania for scientific purposes, are—1. That the cranium should invariably be represented in a certain defined position; 2. that it should be represented either of the natural size, or reduced to a given proportion alike in all cases; 3. that so many figures should be given of each cranium, as without any perspective may afford a sufficient idea of the outline of a section of the cranium in the three dimensions of *length*, *breadth*, and *height*, together with a view of the *face*, as seen in front, and of the *base*, regarded in the horizontal plane. Five figures of a skull are consequently, in our opinion, indispensably requisite to afford an adequate idea of its conformation.

Three modes of delineation with these objects in view may be followed. 1. That of geometric projection, so ably advocated, and so usefully employed by Professor Lucæ, and described by him in the Memoir above cited, and to which the reader is referred. 2. By photography; and 3. By means of the *camera lucida*. Not having had an opportunity of seeing Dr. Lucæ's apparatus, we can only say with reference to it that it appears extremely well adapted to the purpose, and probably easy of application; and that the figures drawn by its means must necessarily, if carefully done, be faithful transcripts of the object, as seen in a geometric plane. But as we do not naturally see objects in such a plane, it is obvious that figures so represented must to the eye appear unnatural, and unlike the object itself from which they are taken. If a cranium, for instance, be held at the usual distance from the eye, the more distant parts are necessarily seen in perspective—and so far, a figure drawn without allowance for this, must be unlike the original, when placed alongside it. The fact is that no drawing can really represent more than a single plane, so as to admit of distances being measured upon it. And it follows, therefore, that all the objects proposed in geometric drawings, such as those of Prof. Lucæ, will be answered by having figures of each plane, in which it may be desired to take the measure-

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usefully, suggests that crania, as regards their general proportions, might be arranged in three categories:—

I. Crânes dolicocéphales	A. purs	75
	B. sous dolicéphales, entre	75 et 79.6
II. Crânes mesaticéphales		77.7 „ 79·6
III. Crânes brachycéphales	A. sous brachycéphales	80 „ 84.9
	B. absolus	85 et ou dela.

ments. Such figures as these can be very readily and accurately made by means of the ordinary *camera lucida*, and a few very simple contrivances, for placing the cranium in the proper positions and at the proper distances for the proportionate size, only are required.

With respect to the size in which crania should be represented, convenience alone would suggest that one below the natural should be adopted; and for all possible purposes it would seem that they would be answered by figures half the size of nature, as well as by larger ones, which are not a whit more useful, nor in fact more natural, when we consider the usual distances at which a skull and a drawing of it are by most persons respectively viewed. The various views of the cranium we should propose, are:—

1. The side or profile view (*norma lateralis*).
2. The posterior or occipital view (*norma occipitalis*).
3. The anterior or frontal view (*norma frontalis*).
4. The vertical view (*norma verticalis*), and
5. The base view (*norma basalis*).

In taking these five views, the position of the skull on its support, which should be capable of rotation, only requires to be changed once, that is to say, from that in which the vertical line is perpendicular, to that in which it is exactly horizontal and the basal line in turn perpendicular. It is almost needless to observe that in order to ensure accuracy it is necessary that the camera should, as nearly as possible, be opposite the centre of the perspective plane in each position of the cranium.

Many other points connected with craniometry have been left unnoticed for want of space, but which still deserve attention, as much perhaps as those we have so hastily touched upon. Such are, for instance, the internal capacity and the various modes of ascertaining it in the unopened cranium; the form of the nasal opening, with respect to which so much of interest is given in Mr. Williamson's very valuable and interesting account of the collection of crania at Fort Pitt; the shape and position of the orbits; the various forms of the lower jaw; the effects of age, or art, or posthumous change in modifying the form of the skull, &c.—subjects the discussion of which would amply occupy as much space as we have already filled. For the same reason we have been compelled to defer any more particular notice of several very ingenious and valuable instruments that have been contrived to facilitate the measuring of the cranium. Some of these contrivances have for their object, or are capable of being applied not only to the accurate and minute measurement of the skull, but also, by the method of taking a series of abscisses and ordinates, to allow of such a scheme of the various surfaces being laid down that an outline of the curves can be drawn from it. This appears to be the plan followed—as we gather from an observation by Prof. Wagner, in the Göttingen Report (p. 86),—by Dr. Aeby of Basle; and the same object may very readily be carried out by a very ingenious craniometer contrived by Prof. Huxley.*

Prof. Harting's Kephalograph, is an instrument constructed much on the plan of one used by hatters for the purpose of taking the measure and form at the same time of the head; and it is so contrived that the outlines thus obtained can be imprinted on paper, by a series of points affixed to the ends of the little sliding rods.

We have, ourselves, been in the habit of using an instrument or craniometer, contrived on the principle of a shoemaker's guage, and similar in fact to the "Stengel-Zirkel" of v. Baer; consisting, that is to say, of a stem, *a*, *a*, about 12 or 13 inches long, with two branches, *b*, *b*, one of which can open out to a right angle by a fixed hinge at one end of the stem, whilst the other, in the same way capable of being placed at a right angle with the stem, may also be slid up and down it, as shown in the woodcut.

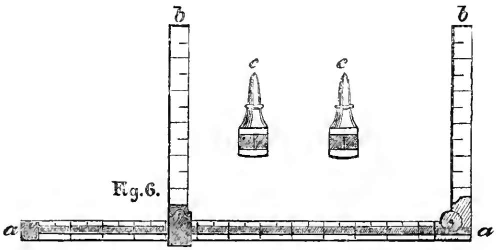

Fig. 6.

The same instrument will also be found useful, if not indispensable, for the taking of the radial measures. It is adapted for this purpose by the addition of a conical plug *c*, *c*, upon each arm, which like the stem are graduated to inches and $\frac{1}{10}$ths, and which plugs can be slid up and down the arms so as to stand at any given distance from the stem. One of these plugs being inserted into each external auditory opening, its centre will of course correspond with the centre of that opening, and the radial distance from this point to any given point on the periphery of the cranium may readily be estimated on the arms of the craniometer, when the stem is made to touch the periphery of the cranium at the desired point.

As regards the measures to be employed, we are inclined, and for the reasons propounded by Prof. v. Baer, to prefer the English inch divided into $\frac{1}{10}$ths, to the French metrical system, which, however, appears, from what passed at the Göttingen meeting, likely to be more generally adopted. It would be very desirable in any case that this point were determined once for all, not only in the interest of craniometry but of science in general.

* A "nouveau cephalographe," apparently on the same principle, constructed by M. Matthieu, is described in the Bulletins de la Soc. d'Anthrop. II. p. 680. And another cephalometer by M. Antelme is also mentioned, but not described.

XXXIV.—Selecta Fungorum Carpologia, ea documenta et icones potissimum exhibens quæ varia fructuum et seminum genera in eodem fungo simul aut vicissim adesse demonstrent.—Junctis studiis ediderunt Ludovicus-Renatus Tulasne et Carolus Tulasne. Tomus primus. Erysiphei. Præmittuntur prolegomena de fungorum conditione naturali crescendi modo et propagatione. Parisiis, 1861. 4to.

This work is well calculated to maintain the credit of the French Botanists as being foremost in the dissemination of sound views upon the subject of Fungi. The notion of Pliny that fungi originated "ex pituitâ arborum," of Bauhin (in 1623), that they were produced by thunder and rainy weather, and of Dillenius (in 1719), that they arose "ex putredinosâ fermentatione," may now create a smile, but such ideas are in reality not far removed from those of more modern writers, who have treated the Uredinei as a diseased condition of vegetable tissue.

In noticing the succession of fallacies which have thus existed from time to time, the authors observe, "Longam hanc opinionum errorumque seriem . . . . . dum moleste contemplemur, hoc tamen non nobis displicet, quod gallici scriptores omni tempore sententias probatiores sæpius tueantur," and they refer with satisfaction to the writings of Jussieu and Bulliard as being in advance of the general ignorance in which the subject was enveloped. Dismissing, however, in a very short space the controversies of the earlier naturalists, the authors start upon the assumption that fungi are now known to originate from seed, that they develop gradually, that they produce fruits of various kinds, and afterwards perish, and that their vitality is of a vegetable not of an animal nature; and although in consequence of the doubts raised by De Bary as to the nature of the Myxogastres, these organisms are excluded from the considerations applicable to fungi in general, and are only casually alluded to throughout the work, the authors do not hesitate to say that De Bary's views are "contra omnem ferme verisimilitudinem."

In the remarks at the commencement of the second chapter relative to the great number of existing fungi, allusion is made to the statements of Fries upon the same subject in the Summa Vegetabilium Scandinaviæ, but the "quadraginta millia formarum," to which Fries' estimate applied, included the whole of the Agaricini, and not (as is stated in the text), only the genus Agaricus. We may observe that Fries' calculation is entirely speculative, and it is not improbable that his conjectural numbers are far too high. With regard to the Pyrenomycetes, of which Fries reckons there may be 100,000 species, no data exist to justify such an assumption. Our own experience would lead us to think that the great Swedish mycologist has considerably over-estimated the number of really distinct forms.

We should have been glad, if space had allowed, to have quoted an interesting note in which the authors combat the views of Linnæus as to the nature of vegetable life. The discussion, however, is of a metaphysical nature, and we must refer our readers to p. 9 of the text. Nor can we do more than refer to the observations on the uses of fungi, which point out their importance as agents in the solution and destruction of defunct organic bodies, dead vegetable matter being by their action made fitter for the sustenance of living plants.

The assumption above alluded to that all fungi originate from seed is qualified to some extent by the subsequent remarks, in which the authors say, "Quare cl. Theodoro Bail libenter assentimus qui verum seu legitimum Fungorum semen nos fortassis tamdiu ignoraturos contendit quamdiu de eorum sexu incerti manserimus." The true nature of the spores of Fungi has been the subject of much discussion. Link contended that nothing could be called a true seed except what originated from an impregnated ovule, and following out this view, applied the term "spores" to the reproductive bodies of cryptogamic plants. Richard, setting out with the assumption that all the Cryptogamia of Linnæus are devoid of sexual organs, says, "Les corpuscules par lesquels ces plantes se reproduisent n'ayant pas d'embryon ne sont pas graines." Gærtner speaks of the spores of fungi as "granula venditata pro seminibus," and says, "meridiano sole clarius (est) quod granula ista de vero semine nihil præter formam externam nacta sint, et quod rectissime habeat Schæfferus qui ea jamdudum ad gemmarum gregem amendanda censuit." Ehrenberg —bearing in mind the fact that the variations from the typical forms in fungi are not less remarkable than in other plants, and that gemmæ, whilst they reproduce the individual, never give rise to such variations--comes to the conclusion that spores have a higher rank than buds. Lastly, the authors of the present work, taking these various views into consideration, give their own opinion in the following words, "Quocumque modo igitur se habeant corpuscula illa quibus propagantur Fungi, semina sunt sui generis, quin imo sincerrima semina sensu Linnæano, nimirum ova, planta nova, singulatim prægnantia, decidua et sæpissime tunicata, aut si malueris, corcula, tot novarum plantarum compendia."

Although the sweeping assertions of Richard and Gaertner have, so far as relates to the higher cryptogams, been entirely disproved, it can hardly yet be asserted that the spores of fungi are "ova planta nova prægnantia." To describe them as "corcula tot novarum plantarum compendia," is a far safer generality.

In speaking of the nature and importance of the spores of fungi, reference is naturally made to Fries' views on the subject. It is well known that that distinguished writer dwells strongly upon the importance of a careful attention to the general phenomena of growth in fungi, and that he is inclined to lay less stress upon the characters derived from the sporidia. For instance, in speaking of the generic distinctions of the higher Pyrenomycetes, we find him writing as follows at p. 380 of the Summa Vegetabilium Scandinaviæ, "Hac differentia rite perspecta, nobilissima Pyrenomycetum genera æque perspicua evadunt, ac maxime naturalia, et ignoscant precor hodierni mycologici, qui omnem vim in subtilissimis notis ponunt, hæc omnibus vegetationis et morphoseos rationibus congrua genera, ut primo obtutu mox recognoscantur, ex sporarum et ascorum differentiis, mihi minime ignaro, impossibile fuisse divellere." We think, however, that the comparison at p. 24 of Fries' observations in the Elenchus Fungorum, with the later views of Fresenius and de Notaris is hardly fair upon the former. It should be remembered that the 2nd volume of the Elenchus was published 20 years at least before the works of Fresenius and de Notaris, and the particular passage alluded to is so caut' usly worded that it could not be objected to at the present day. "Quatenus sporidia septata, etc., ad genera distinguenda sufficiant, dubium sane videatur, cum hic character a multis generibus iisque naturalissimis vilipendatur." In fact, so far as regards the Sphæriacei, which is the family to which Fresenius and de Notaris specially allude, the remarks of the latter writer seem to go too far. That the shape and structure of the sporidia are of immense importance in the distinction of species no one will deny, but the value of these characters as generic distinctions is far less manifest. Those genera of the Sphæriacei, which might be defined by their sporidia, exhibit other features by which, without any assistance from the fruit, they might be separated from their nearest allies.

In the fifth chapter, mention is made of a point which is still in dispute with regard to those spores which mycologists call basidiosporous. If we understand this question rightly, the MM. Tulasne are of opinion that the sterigmata or stalks of these spores are simply prolongations of the basidial cell, the spore itself being the swollen apex of the sterigma cut off by a septum from the lower portion, whereas, according to the views of Schacht and Hoffmann, the spore is formed within the dilated apex of the sterigma, as in a true ascus, the ascus being adnate to the spore. The question is of some systematic importance,* because if Schacht and Hoffmann are right, the fructification of the basidiosporous fungi differs from that of the ascigerous ones only in the fact of the ascus being adnate to the spore. The determination of the question would seem to be capable of solution if we could ascertain the number of membranes of which the spore consists. Although it would be difficult, if not impossible, to do this in most species, on account of the small size of the spores, it might perhaps be effected with the assistance of proper chemical reagents in some of the large-spored Coprini. If the views of the MM. Tulasne be correct, the spore would have two membranes only, whereas, if Schacht and Hoffmann are right, there must be four

* If De Bary's observations on Agaricus melleus (Botanische Zeitung, Dec. 2, 1859), are correct, normal asci may exist in the same plant with normal basidia.

membranes, viz. the outer and inner membrane of the spore itself, and the outer and inner membrane of the ascus or basidium, within which it is produced, and to which it is adnate. If the numbers of membranes could not be ascertained when the spores are first shed, it is possible that, by inducing them to germinate, the observation might be rendered easier.*

In speaking of the manner in which the spores of fungi are dispersed, the authors refer to the observations of the Messrs. Crouan, with regard to the opening of the asci of Ascobolus. In this genus the tip of the ascus sometimes splits at the top in a circumscissile manner, and bends backwards, exhibiting the appearance of a little cap or helmet thrown back and adhering by a hinge. The Messrs. Crouan give figures of this mode of dehiscence in several species of Ascobolus figured by them (see Annales des Sc. Naturelles, 4th series, Vol. vii. Pl. 4, and Vol. x. Pl. 13), and they state that the cap, or operculum as they call it, is often entirely detached by the rapid and instantaneous escape of the spores. The MM. Crouan appear to think this dehiscence worthy of special notice, as they suggest that it affords an additional generic character to distinguish the Ascoboli from the Pezizæ, and the MM. Tulasne speak of it as occurring only in Ascobolus saying "Ascoboli solius, quantum sciamus, theca extrema rescisum dimittit galeolum." We are inclined to think, however, that the fact is not of much importance, for the same thing occurs in Sphæria herbarum, where the asci have been seen to open in a manner precisely similar to that observed by the Messrs. Crouan in Ascobolus. A figure of the fruit of this Sphæria, showing the peculiar dehiscence of the asci is to be found in the Quarterly Journal of Microscopical Science, Vol. iv. Pl. xi. ff. 32, 33.†

The thick gelatinous envelope of the spores of certain Pyrenomycetes forms the subject of a few remarks at p. 44 and 45, and reference is there made to a note in Nylander's "Synopsis methodica Lichenum," where that author, after speaking of the existence of this envelope in Lichens, says, "Parmi les champignons c'est surtout

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* Vittadini's explanation of the formation of basidiospores would seem to be intermediate between that of the MM. Tulasne and that of Schacht and Hoffmann. According to Vittadini, the spore is formed within the ascus or basidium, and is carried outwards by the protrusion of the inner membrane only of the basidium.

† With regard to the question as to whether the asci of Ascobolus are (as its name would imply), really ejected, the authors say (note, p. 32), "Omnes apud Ascobolos quos novimus, thecæ equidem supra discum hymeninum, singulæ saltem sua vice debitoque tempore, vertice emerso prominent et paraphyses plus minus excedunt, strato autem supposito cui ab origine imponuntur semper quodam modo hærent, nec secus evacuantur atque Pezizarum et cæterorum Discomycetum asci, nisi quod ita vulgo præresciindantur seu decacuminentur, ut galericulus tintinnabuliformis amoveatur." Mons. Coemans, in his recent able monograph of the genus Pilobolus in the "Memoires couronnés," of the Belgian Academy, also expresses doubts as to the emission of the asci in Ascobolus, a fact which, he says, has been rather assumed than proved.

chez le Sphæria scoriadea Fr. qu'elle est d'une epaisseur remarquable." We do not think that Sphæria scoriadea is more remarkable than several other species in the thickness of this envelope, which as far as our observation goes is as well if not more fully developed in *Sphæria Tiliæ* Fr., *Sphæria profusa* Fr., *Sphæria putaminum*, Schwein. and several others. A striking instance of a similar envelope is figured by the MM. Crouan in the spores of *Ascobolus macrosporus* Cr.*

In the sixth chapter of the present work, a good deal of space is devoted to an attack upon the opinions of Fries as to the fructification of Cytispora, and some analogous genera. Fries supposes (or did suppose at the time when the Summa Vegetabilium Scandinaviæ was written), that all Pyrenomycetes with simple naked spores were abnormal or atypical, and that the conversion of asci into spores was a circumstance of common occurrence. The MM. Tulasne, on the other hand, contend that the Cytisporæ and the analogous kinds of fungi are normal but transitory forms, constituting a peculiar reproductive apparatus, and being, as it were, a primary sort of fructification. It is probable that the latter view may be the correct one, but we doubt if sufficient consideration has been given to the other side of the question. The argument from the supposed age of the great Swedish observer, savours somewhat of an anachronism, for although now "in crepusculo vitæ suæ,"† it must be remembered that the observations in question were written 14 years ago. Nor do the remarks at p. 54 appear to us very convincing, where it is said, "Quis non miraretur tot fungillorum millia fera semper atypica et "abortiva occurrere." And again, "In harmonia naturæ et nos ipsi, "Linnæi exemplo, maxime confidimus, quare tot monstra tot abortivos "fœtus exstare negamus." We think it might be objected that atypical and abortive forms are not so uncommon amongst fungi as to make Fries' suggestion so unnatural as it is argued to be. With regard also to the possibility of the reduction of asci to spores, we think that the observations of Messrs. Berkeley and Broome on *Stillospora macrosperma* (supported as they are by what has been since noticed in *Sphæria Cryptosporii* (which seems identical with *Sph. suffusa* Fr.), *Steganosporium cellulosum*, and *Patellaria atrata*,)‡ are rather too summarily dismissed.

In the Botanische Zeitung for 1854, Dr. De Bary brought forward some observations to show that the common *Eurotium herbariorum*, and *Penicillium glaucum* are two forms of fruit of the same fungus. The difficulty of ascertaining this satisfactorily can only be appre-

* Annales des Sc. Nat. 4th Series, Vol. vii. Pl. 4, fig. 8.

† "Sub vitæ meæ crepusculo meminisse juvat, quantas voluptates perfectiorum fungorum studium per quinquaginta et quod excurrit annos continuatum, mihi paraverit." Fries, in Preface to the "Monographia Hymenomycetum Sueciæ." p. xi.

‡ Quarterly Journal of Microscopical Science, Vol. iii. p. 272, Vol. iv. p. 197, and Vol. vii. p. 228.

ciated by those who have attempted to trace the two forms of fruit from the same mycelium. The late Professor Henfrey had commenced some observations on the subject not long before his lamented decease, and was disposed to doubt the correctness of De Bary's conclusions. We find, however, that the MM. Tulasne appear satisfied upon the point, for they say (note 2, p. 63), "Novissimis his temporibus propria experientia percepimus mira illa ab oculatissimo Baryo observata cum vero ni fallimus quadrare." They add that the conidiiferous fruit varies to a great extent, so much so as to pass from the form of *Aspergillus glaucus* to that of *Penicillium glaucum.*

In connection with the question of the double fructification of moulds, we find some important remarks upon the Genus Azygites of Fries. The authors have observed that the flocci produce simple or forked stems, each surmounted by a whitish vesicle filled with minute spores, and that upon the same mycelium fruit occurs of a more imposing appearance, globose, pyriform, or elongated and lageriform in shape, consisting of a dark membrane, which is sometimes very minutely tuberculate, and which encloses a number of dark spherical spores. "His omnibus perpensis (they add), nonne videbitur vesiculam solitam unde fungilli mucorini dicti principem suam notam hactenus traxerunt minoris esse dignitatis quam vulgo æstimatur?"

This question, which, if answered in the affirmative, involves the abolition of the order of Physomycetes, must be left for the consideration of mycologists, but it may be observed that the fact of the occurrence of two sorts of vesicles containing different kinds of sporidia has not escaped the notice of Mr. Berkeley, who, nevertheless, retains the order which was first established by himself.*

The eighth chapter of the work is devoted to the consideration of the mode of germination of the spores of fungi and the different kinds of mycelium. It is strange that after the numbers of observations which have been made upon germination, it should still be a disputed question whether that process takes place by extension of the outer membrane of the spore, or by the protrusion of the inner one. Gaertner, Richard, Ehrenberg, Corda, Schmitz and Schacht maintained the former view, but notwithstanding this array of authorities, the MM. Tulasne remark, "Suadet autem analogia germen semper ex endosporio oriri." No one can, we think, dispute that in the cases cited, viz., Puccinia, Hypoxylon and Xylaria, there is no extension of the outer coat, and to these might have been added Helminthosporium, Coniothecium, Steganosporium, and others, in which the germ-filament is certainly a prolongation of the endosporium. It is difficult to suppose that the mode of germination is not uniform throughout the fungi, and yet Mons. Coemans, in his recent monograph of the genus Pilobolus, states that the germi-

* See Introduction to Cryptogamic Botany, p. 297.

nation of spores in *P. crystallinus* takes place, or at least commences, by enlargement of the *outer* membrane.* Judging also by the figures only, it would seem that Bail supposes the same to be the case in the germination of the spores of *Sphæria typhina* Pers.,† but we cannot assert positively that such is his opinion. *Sphæria thelebola* is alluded to by the authors as emitting terminal and usually oblique germs. We have not ourselves seen the germination in this species, but it may be observed that the spores are furnished at each extremity with an extremely delicate ciliary appendage, which is not easily visible without careful illumination. These appendages might easily be taken for germ-filaments, but they are exactly terminal, not oblique, and would seem to be of the same nature as the appendages to the spores of *Sphæria talcola* Fr., which are ranked by the authors with other setiform processes, such as those which occur in Pestalozzia, Dilophosphora, &c.

One of the subjects discussed at some length in this work is the nature of those numerous fungi which, although in reality belonging to different genera, and even families, have got classified together under the general name of Sclerotium. We have only space to notice one or two of special interest; those mycologists whose attention is directed towards solving the difficulties which still exist upon many points in the economy of those productions, will find a mine of information in the MM. Tulasne's pages. The general nature of Sclerotia is so well described by Mr. Berkeley in his Outlines of British Mycology, that we quote his words here. At p. 57 he says, "Not only do many fungi remain long in the state of spawn without forming fruit, but they give rise occasionally to productions quite at variance with the characters of the perfect plant;" and after noticing instances where the spawn assumes a root-like form, he adds, "Sclerotium, on the contrary, is formed by the concentration of threads into solid wart-like bodies or nuggets, entirely devoid of fruit, but which on occasion give rise to various kinds of fungi, as Agarics, Pistillariæ, Pezizæ, &c. . . ."

One question of difficulty connected with Sclerotia, and upon which the MM. Tulasne are at issue with other authors, is as to the production of different kinds of fungi from the same Sclerotium, or of the same fungi from different Sclerotia. *Agaricus tuberosus* is an instance of this.—Fries has stated in the Syst. Mycologicum ‡ that this Agaric is produced from *Sclerotium cornutum*, *S. Fungorum*, *S. muscorum*, and others indiscriminately, upon which the MM. Tulasne remark (p. 108, note), "Verbis his, nota nunc vera Sclerotiorum natura, non minus offendimur, quam si quis, nobis adstantibus, uvas de spinis aut de tribulis ficus collegisse contenderet," and they ex-

* It would seem that the MM. Tulasne have themselves noticed something of this kind, for they say at p. 94, "Semina plurima sub germinationem, solitam molem non mutant; e minimis vero pleraque tunc plus minus augentur."

† See Bail in Nova Acta, Vol. xxix.

‡ Syst. Myc., Vol. i. p. 133.

press the like surprise with regard to Mr. Berkeley, who has said that the same species of Pistillaria is produced by *Sclerotium complanatum*, Tod., and *Sclerotium scutellatum*, A. and S.

Here it may be observed that the first volume of the Systema Mycologicum was written more than 40 years ago, and Fries cannot fairly be assumed to retain all the opinions expressed in that work. Indeed, upon turning to the account of *Agaricus tuberosus* given in his latest work, the "Hymenomycetes Sueciæ," we find no mention of the several Sclerotia alluded to in the Systema Mycologicum; the plant is there described as "semper innatus tuberi solido, glabro, sclerotioideo, lutescenti."

Whether the authors or their opponents are right is a matter upon which it is very difficult to form an opinion. We cannot think the matter is so clear as the former consider it to be. Fries and Berkeley may have been mistaken; it may be that *Ag. tuberosus** is never produced except from *Sclerotium cornutum*, and that the Pistillaria of *Sclerotium scutellatum* is more delicate and branching than that of *Sclerotium complanatum;* but the instances alluded to in a former number of this Review,† of the apparent production of two different sorts of Claviceps by the ergot of Phragmites, and of Agaricus papillatus by the ergot of rye, still remain quite unexplained.

Before parting with the Sclerotia we must notice the case of the Peziza which is produced from *Sclerotium sulcatum*. This Sclerotium inhabits the pith of the stems of Carices, and has been observed by Mons. Durieu de Maisonneuve to produce a small brown Peziza, which is described at length at pp. 103 and 104 of the present work, and to which the authors have given the name of Peziza Duriæana. The account communicated by Mons. D. de Maisonneuve to the MM. Tulasne, is so interesting that we have been induced to translate that part of the note in which it occurs. He says, "Carex arenaria of Linnæus occupies "a well-defined space‡ of about 100 acres, forming a dense mass. "When it has commenced forming spikes it all at once becomes with-"ered and lank from the effects of the fungus of which it has long "been the nidus. In this state it bears a wonderful resemblance to

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* Vol. i. p. 11.

† We would call attention here to a paper by St. Schulzer v. Müggenburg, in the 10th vol. of the Transactions of the "Zoologisch-botanische Gesellschaft" of Vienna, on the Sclerotium of Ag. tuberosus. The author seems to be of opinion that the Sclerotium and the Agaric are independent organisms, and that the growth of the Agaric from the Sclerotium is analogous to that of Hydnum auriscalpium from fir-cones.

‡ We do not know how to translate the expression for the exact locality of this plant. The words used are, "in prato Fargensi." In a previous part of the note the locality is spoken of as "ad Garumnæ ripas in pratis arenosis aridisque agri "Sirionensis, haud procul a Vasatum finibus, et antiquo Fargarum castello, nunc "funditus everso." The "Ager Sirionensis" must be the country round the ancient Sirio, which stood at or near to the confluence of the Ciron and the Garonne.

" *Carex ligerica* Gay, and it usually dries up entirely before the " flowers are fully developed. This whole mass of Carex is so entirely " occupied by the propagula, or rather the mycelium of the stranger, " that it is difficult to find even a single culm within the limits above " defined which is free from the parasite. It follows that it would " remain barren unless propagated by rhizomata, and I can easily " imagine that the whole mass has originated from a single Carex " which in the first instance admitted the fungus, and then in suc- " ceeding years crept far and wide in every direction. For *Carex* " *arenaria* L. abounds everywhere in the country about Bourdeaux, " but bears the Peziza only at "Fargæ," in the particular spot above " mentioned. You should know also that a single Sclerotium, or " more rarely two or three are produced in each culm above the base, " and that the culms are at the same time almost invariably marked " above the middle by from ten to fifteen punctate distinct rings, " placed almost at equal distances and formed by the very minute " *Epidochium ambiens* Desm. May we not conclude that some rela- " tion exists between this phoma-like pyrenomycete and the co-existent " Sclerotium of the Peziza?" Upon this latter suggestion of M. Durieu de Maisonneuve, the authors remark that they have found *Epidochium affine* Desm. (a plant hardly differing from *Epidochium ambiens*) in *Schœnus nigricans* L., and in some Carices, and they consider it possible that the Epidochium and the Peziza are different forms of fruit of the same fungus, although the question as to their production by the very same mycelium is not yet settled. The point is very interesting, and one which may be recommended for the consideration of those botanists who have the opportunity of watching *Carex arenaria*.

The authors did not succeed in their attempts to produce the perfect fruit of *Sclerotium varium.* They sowed it in the summer of 1860, and in the February following, numerous smooth delicate "cauliculi" were produced, which afterwards assumed the form of very acute funnels, but they all died long before arriving at perfection. Mons. Muenter of Greifswald, who has lately given an account of his experiments in the XIth Vol. of the second series of the Reports of the Belgian Academy,* was more successful. He sowed some specimens of *Sclerotium varium* in the month of December, 1857, and after the lapse of *a year and a half*, viz. in July, 1859, the Sclerotium produced a Peziza, apparently allied to, but distinct from, *P. tuberosa* Bulliard. M. Muenter has given figures of his Peziza in the volume above referred to. *Sclerotium sulcatum* Desm. and the Sclerotium of Typhula have also been observed to lie dormant for more than a year, as is mentioned at p. 106, (note 2) and p. 140, (note 1) of the MM. Tulasne's work.

We have not space to notice the interesting remarks upon Rhizomorpha and other forms of mycelium, which the reader will find dis-

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* Bull. de l'Acad. Royale des Sciences, &c. de Bruxelles, Vol. xi. p. 215.

cussed in the concluding portion of the 8th chapter, where there will also be found some comments upon the questions, whether Fungi have true roots, and whether such a thing as a unicellular fungus exists. To both of these questions the authors incline to give a negative answer, qualifying the latter however with the remark, ". . . . . . merito quærat quispiam cur Fungi quum Algis indubia, imo proxima conjungantur necessitudine, parem structuræ simplicitatem quandoque etiam non exhibeant."

The controversy with regard to the existence of sexes in fungi may be dismissed in a few words. Although the recent observations of Hofmeister and De Bary point to the probability of the occurrence of some process such as that which takes place in Achlya and the allied Algæ, it is premature to speak, as Bail has lately done, of the *discovery of sexuality* in the Tuberacei, as if it were a *fait accompli.* With regard to Hofmeister's observations they really amount to little more than the suggestion of a probability, and although De Bary's go somewhat further, much remains to be done for the solution of this great mycological problem. In fact, the opinion (as old as the time of Micheli) which attributes male functions to the cystidia of the Agaricini, and Klotzsch's more recent suggestions as to the paraphyses of the Discomycetes, can hardly be yet said to be displaced. No prudent mycologist will be disposed to quarrel with the authors' conclusions when they say, "Ideo ad hoc ævi non longe processit notitia nostra de Fungorum organis sexualibus, si qua sunt;" nor with their further argument, that inasmuch as no one doubts the existence of sexes in Algæ, there are therefore legitimate reasons for suspecting their presence in Fungi, a suspicion which is confirmed by a well-grounded confidence in the manifest harmony of nature.

The concluding chapter of the "Prolegomena" consists only of a few remarks on the present condition of mycology and the most desirable means of advancing the science. The systematic portion (occupying only about a sixth part of the present volume) is limited to the Erysiphei, and contains copious descriptions, accompanied by exquisite figures, of the typical species. The plates are five in number, and surpass if possible in beauty even those in the "Fungi hypogæi."

That the authors may have health and leisure for the speedy production of the concluding volumes of this remarkable work will, we are sure, be the earnest wish of all mycologists.

XXXV.—On the various Contrivances by which British and Foreign Orchids are fertilized by Insects, and on the good effects of intercrossing. By Charles Darwin, M.A., F.R.S., &c. With illustrations.

Amongst the prominent differences between the animal and vegetable kingdoms, there is one which, though never taught in schools and seldom alluded to in books, cannot fail to occur to the reflecting Naturalist; it is this, that whereas unisexuality is the rule amongst the highest orders of animals, and hermaphroditism becomes more frequent as we descend in the scale, the contrary is the case with plants. It is not our purpose here to discuss this curious contrast, of the significance of which in a scientific point of view we have hitherto been absolutely ignorant; it is enough to say that the results arrived at in the work whose title heads this article, show that amongst many plants apparent and real hermaphroditism are totally different things, and that before reasoning further on the subject, we must begin again not only to observe, but also to experiment.

But our future observations will be of very little use if they are to comprise nothing more than the circumstances of the presence of both sexes in one plant, or on one individual; observations, to lead to any good results, must not only be systematically and carefully, but intelligently made; they must, in fact, be suggested by some previous idea, and collected for the support or the contrary, of some possible or probable truth; and the wider the application of that truth, the more fruitful and suggestive will be the accumulated observations directed to its elucidation.

In the present work Mr. Darwin has given the results of observations made for the purpose of trying his theory, "that no hermaphrodite fertilizes itself for a perpetuity of generations;" his ulterior hypothesis, of the origin of species by natural selection, is, as enunciated by himself, untenable if the contrary were demonstrable. Now one of the most obvious objections to this position lies in the fact that the higher plants are structurally hermaphrodite, and that not only is it the apparent design of that condition to ensure the fertilization of each flower by its own pollen, but that a multitude of minor points in the structure of the flower appear to be as many contrivances to render self-fecundation doubly sure. To controvert this view was a bold idea, under any circumstances; and to show, as Mr. Darwin has done, that in one very large Natural Order of plants, and in that very Order in which the contrivances seemed most directed to ensure self-fertilization, all our previous notions were wrong, and most of our observations faulty, is a great triumph, that cannot fail to secure to its author a more attentive hearing for his ulterior views than these have hitherto gained. Nay further, had Mr. Darwin not investigated this point he would have had no secure foundation for his great hypothesis, for, as we have observed already, this question of structural hermaphroditism is a fundamental one; and the rule that the more perfect plants are so constructed must occur to every one as a notable and insuperable objection to cross-fertilization, in default of its being shown that first impressions are in this, as in so many other cases, utterly fallacious; or, in other words, that we have utterly misinterpreted the phenomena we have hitherto recorded.

In his introductory pages the author indeed states that the primary object of his work is "to show that the contrivances by which "Orchids are fertilized are as varied and almost as perfect as any of "the most beautiful adaptations of the animal kingdom;" and such, no doubt, was his primary object in publishing his observations in the form of a separate treatise, addressed to the general reader; but the real primary object of the investigation, and therefore, in its best sense, of the work too, is involved in his secondary object, "to show "that these contrivances have for their main object the ferti- "lization of each flower by the pollen of another flower." It is under this last point of view that we shall notice its contents, confining ourselves mainly to an endeavour to make them and their importance clear to the readers of the *Natural History Review*, assuming that they, like ourselves, were previously very insufficiently acquainted with the whole subject of the structure of Orchid flowers and the functions of their parts. We must however, *in limine* say, that without an accurate knowledge of many Orchids, the whole subject is not intelligible, and that to understand it thoroughly requires a practised botanist. The key to the whole lies in the right comprehension of the exact structure, position, and relations of the rostellum to the other parts of the flower in every species commented on: and when we add that this rostellum is usually a very minute organ; that it is a compound and highly differentiated body; that the figures it assumes are seldom comprehensible from descriptions; that it alters much in form during development and suddenly changes its aspect after fertilization; that its homologies are obscure and its functions often intricate and always dependent on external agencies for their exercise;—it will be obvious that Mr. Darwin's is no work for the general reader and our task one of unusual difficulty. To put the matter more plainly, we do not believe that any student can, after his three months course of botany as usually taught in Europe, describe accurately the rostellum of any British genus of Orchids; and yet we must assume that our readers can. Such being the case, it may be wondered why Mr. Darwin chose the popular form for his treatise; for his many and good reasons we must refer to his introduction, adding, that for other reasons we are glad that he has done so, amongst them, because Mr. Darwin's writings afford the best specimen in English biological literature, of rigidly accurate descriptions expressed in perfectly simple language; of a style and language, in short, that are equally admirable and charming; we are glad too that the public should have in an available form the means of seeing how varied are the accomplishments, how laborious the investigations, and how sharpened become the faculties of a working naturalist with a theory to establish, and how subservient the latter may always be kept to the sternest demands of facts and their teachings.

The book opens with a brief description of the structure of Orchid flowers, and of the terms applied to their organs, and is divisible into three parts, of which the first is devoted to British Orchids, the second to exotic forms, and the third to general considerations on the structure, morphology and physiology of Orchids. Such at least would be our division of the work, but the author has disposed of the whole matter in seven chapters, without concise headings, somewhat arbitrarily, as if the conception of putting forth the treatise as a separate work were an after-thought; an arrangement that does not recommend itself to the general reader, who thus loses sight of the grand divisions of the Order as well as of the subject.

The general results obtained from all Orchids then are—1. That the structural obstacles to self-fertilization are almost insuperable. 2. That the adaptation of all parts of Orchid flowers is for cross impregnation of one flower by the pollen of *another of the same species o*[illegible]. 3. That insects are the agents of fertilization almost invariably. 4. That the labellum is the landing place of the insects, and contains the object of attraction to them in the shape of a honey-bearing spur, or sweet pulpy excrescences, or nectar-distilling hairs. 5. That the relative position of the labellum to the reproductive organs is such, that an insect to reach the attractive object in the former, places head or thorax in contact with the latter. 6. That an insect on its first visit to a hitherto unvisited flower, must in its search for honey usually so place itself as to close the stigmatic cavity, while at the same time it removes the pollen. 7. That in numerous cases, so long as the insect remains on the plant whose flowers it has sucked, the pollen retains such a direction as that it cannot reach the stigma of any flower it visits; and that, as owing to its unerring instinct it never visits the same flower twice, it cannot reach the stigma of that from which the pollen was taken. 8. That in many cases, after a certain period, generally longer than that spent by the insect in one flower or plant, the pollen spontaneously assumes such a direction that it is infallibly applied by the insect to the stigma of another flower of the same species as that from which it took the pollen. Bearing these points in mind we shall now very briefly review the principal modifications in structure and method of fertilization presented by the British genera of Orchids examined by Mr. Darwin.

Orchis mascula, *morio*, *fusca*, *maculata*, *latifolia*, and *Aceras anthropophora*. In these an insect alights on the labellum, and pushing its head into the cavity at the base of the labellum, the rostellum is touched, its membranes ruptured along definite lines, and the viscid balls at the base of the pollinia consequently cement themselves to the insect's head or proboscis, with the pollinia erect. In this position the pollinia cannot touch the stigma of a flower subsequently visited; but they do not retain this position, they gradually become depressed and point forwards, and assume such a position that they infallibly strike the stigma of the next flower visited. The viscid stigmatic surface is not adhesive enough to overcome the attachment of the whole pollinium to the insect's head, but is adhesive enough to overcome the cohesion of the pollen grains, *inter se*, which are consequently detached in masses, and one pollinium may therefore fertilize many flowers. There are many other beautiful little contrivances noticed by Mr. Darwin which are brought into play in this operation, of which we have given an outline only.

Orchis pyramidalis differs considerably from its allies; the most curious point connected with it being the union of the viscid balls of the pollinia into the form of a single saddle-shaped disc, which clasps the antennæ of moths in a most rapid and remarkable manner, causing a divergence of the pollinia: but for this divergence, and their succeeding depression, they could not reach the stigmatic surfaces of subsequently visited flowers. *O. ustulata* presents many points in common with *O. pyramidalis*. A catalogue is given of twenty-three species of Lepidoptera which were found to have pollinia of *O. pyramidalis* attached to their proboscces, one of which bore seven pair.

Ophrys muscifera. In this plant the pollinia have doubly-bent caudicles, the effect of which seems to be the same as that of the movement of depression in *Orchis*.

Ophrys aranifera. The caudicles here are nearly straight, and a movement of depression is hence necessitated.

In *O. apifera* the method of fertilization differs, not only from all others of its genus, but from all other Orchids. The greatest structural difference is in the caudicles, which are so slender as to be flexible with the weight of the pollen itself. The consequence is, that the pollinia hang out of their pouches, and are blown by the wind against the stigmatic surface, and *self-impregnation ensues almost infallibly*. Mr. Darwin finds it almost impossible to escape the conclusion that self-fecundation is here absolute: his discussion of the case is most ingenious, but he can do no more than show that crossing is possible.

O. arachnites. The principal point established regarding this is, that it is certainly not, as supposed by some, a variety of *O. apifera*, but more closely allied to *O. aranifera*, with which it agrees in its method of fecundation.

Herminium Monorchis has flowers highly attractive to insects, and seems adapted to a similar mode of fertilization as *Orchis*.

Habenaria viridis. There is no movement of depression in the pollinia, and it is not apparent at first how the latter can strike the stigma. The explanation is most curious and unique. There are three nectarial spots, and an insect bearing the pollen must, to reach the two lateral of these, so move its head that the pollinia strike the stigmata; the supplementary nectaries thus replacing the power of movement of the caudicles and disc.

Gymnadenia conopsea and *albida* differ in detail only from *Orchis.*

Habenaria chlorantha has a drum-like viscid disc of great functional importance, but its structure and action are far too complicated to be abridged here.

H. bifolia is found to differ in so many characters from *H. chlorantha* as to be considered an undoubtedly good species, and further it is fertilized in a totally different manner.

Epipactis palustris. The labellum is of peculiar structure, the distal half being hinged on the other so lightly that a fly depresses it. An insect entering the flower depresses the distal portion (which closes after it), and reaches the nectarial cavity without touching the rostellum; but, in backing out, the action of raising the said distal portion forces the insect against the rostellum, when it removes the pollen. There is no movement of depression required; for, on the entrance of the insect in another flower, the pollinia it bears are brought into immediate contact with its stigmatic surface. In *E. latifolia,* the distal portion of the lip is not flexible, and the operation is more simple.

Cephalanthera grandiflora presents the all but unique case of an Orchid wanting the rostellum (*Cypripedium* being the only other); its pollen grains are separate and spherical. Here perpetual self-fertilization is *imperfectly* secured by the friable pollen grains reaching the stigma at a very early period indeed; but the structure of the flower and relations of the parts are such that insects must help, so that the flowers are partially fertilized by their own pollen and partly by that of other flowers. The details are very intricate, and the discussion highly interesting and curious.

Goodyera repens is one of the most interesting British Orchids, as connecting several distinct forms; in the development of a caudicle and cohesion of the pollen grains, it approaches the tribe *Ophreæ;* in other respects it is allied to *Epipactis*, *Spiranthes*, and *Orchis*.

Spiranthes autumnalis. The rostellum here bears an erect boat-shaped disc, filled with a viscid fluid, and decked with a membrane endowed with the power of fissuring on the slightest stimulus (but not spontaneously). The pollinia consist each of two brittle, leaf-like laminæ, and are exposed by a contraction of the anther case. The lip, at an early period, moves away from the rostellum, leaving a narrow passage to the nectary. The flowers are visited by bees, which touch the rostellum with their proboscis, causing the boat's deck to burst and expose the viscid fluid which attaches the pollinia to their proboscis. But at the period when the flower is open enough to allow of bees removing the pollinia, the aperture is not sufficiently wide to allow this to be applied to the stigma. The flower thereafter opens wider by the further movement of the labellum; hence it happens that fully expanded flowers are fertilized by newly expanded ones. The analysis of the whole operation is most graphically given by Mr. Darwin.

Malaxis paludosa has flowers with the lip turned upwards, owing to a greater than usual twist of the ovary, and the upper sepal and petal are reflexed instead of protecting the flower. The pollen-masses are almost wholly exposed, and so placed that an insect must withdraw them on visiting the flower, and carry them off lying parallel to its proboscis, and in the proper position for being applied to the stigmatic cavity of the next flower visited.

Listera ovata. The rostellum is here exceedingly curious, being divided internally into loculi, a structure found in no other Orchid but *Neottia.* It is exquisitely sensitive, rupturing suddenly with a touch of the finest human hair, and ejecting a ball of viscid matter at its apex. The pollinia, which lie free and are very friable, have their bases so close to the apex of the rostellum, as to be invariably entangled in the expelled viscid mass. The long lip presents a longitudinal nectarial ridge. Insects visit this, crawl upwards, touch the apex of the rostellum, when the viscid matter shoots out, carrying the pollen masses by their entangled lower ends, and glueing them to the insect's head The insect visits other flowers, and masses of the friable pollen are left on their stigmatic surfaces.

Listera cordata and *Neottia nidus-avis* present essentially the same structure and method of fertilization as *L. ovata.*

To complete this extremely brief and incomplete account of the phenomena in British Orchids we should by right allude to *Cypripedium,* of which genus however only exotic species were examined. This genus, as is well known, differs from all other Orchids in having three confluent stigmata (hence no rostellum), the anther of other Orchids represented by a shield-like body, two fertile anthers, and in the pollen grains being glutinous. Fertilization seems here to take place by insects visiting the flower to extract the sweet fluid from the glandular hairs within the labellum; to effect this they insert their proboscis into a narrow chink which leads to the anthers, the sticky grains of which attach themselves to their proboscis, and are conveyed to other flowers. *Cypripedium* is thus the only genus in which the pollen grains attach themselves not only to the insect's proboscis but to the stigmatic surface, which is not viscid.

We have preferred thus giving a rather extended resumé of Mr. Darwin's observations on British Orchids to reviewing the very extensive and intricate chapters devoted to foreign Orchids, the homologies of Orchid flowers, and general considerations; both because they may be repeated by any observer and extended by many, and because this procedure of ours gives a better idea of the completeness of the work than a more sporadic selection of his observations and experiments, results and conclusions, could have. Those other chapters are however by far the more interesting and important, and to them we shall at some future time recur, if opportunity offer. It remains to add that the work is copiously illustrated with most useful and in general very clear woodcuts, which would, however, have been greatly increased in value had the insects been introduced, in position, on the flowers.

Original Articles.

XXXVI.—A Report on recent Researches into the Minute Anatomy of the Spinal Cord. By W. B. Kesteven, F.R.C.S.

[With Plates IX. X. XI.]

The object of the writer has been to collect in brief compass, from various essays and monographs, the principal results of recent researches into the microscopic anatomy of the spinal cord, embracing, on the present occasion, that portion only of the cord which extends from below the *medulla oblongata*.

The several essays by Mr. Lockhart Clarke have been followed as the basis of the following remarks, and the information is conveyed for the most part as nearly as possible in the words of Mr. Clarke. Lest it should appear that an undue prominence is thus given to the observations of that anatomist, it should be borne in mind that the advances recently made towards an accurate insight into the relations of the elements of nervous structures, are mainly due to the method of preparing transparent sections, which was introduced by Mr. Clarke, and which with some slight modifications has been followed by subsequent investigators, who have all more or less confirmed the accuracy of his observations. Stilling's magnificent and voluminous treatises having been founded upon the results of the examination by reflected light, of thin sections of simply hardened cord, afforded conclusions which have been shown by later observers to be in many points obscure and erroneous. The great diversity of opinion that, until very lately, existed on almost every point of the anatomy of the nervous centres, may be learnt from the historical sections of Schroeder van der Kolk's, Stilling's, and other essays—while a notable approach towards agreement in observations and inferences, has been perceptible since the examination of transparent sections by means of transmitted light.

The following Bibliography embraces all essays or works having reference to the microscopic anatomy of the spinal cord, of which the writer has been able to avail himself.

It is from no want of appreciation of the value of the labours of Grainger, Solly, Bowman, Todd, and other previous anatomists, that this subject has been taken up at a late point in its history. To have done otherwise would have been to occupy the pages of this journal with an historical disquisition foreign to its objects and superfluous to its readers.

J. Lockhart Clarke.—1. Researches into the Structure of the Spinal Chord. *Philosophical Transactions*, 1851.—2. On certain Functions of the Spinal Chord, with further investigations into its Structure. *Philosophical Transactions*, 1853.—3. Further

Researches on the Grey Substance of the Spinal Chord. *Philosophical Transactions*, 1859.

B. Stilling.—1. Neue Untersuchungen über den Bau des Rückenmarks. *Fünf Lieferungen. Frankfurt*, 1856-1859. — 2. Atlas Mikroskopisch-Anatomischer Abbildungen. *Vier Lieferungen*, 1856-1859.

Kölliker.—Manual of Human Histology. *London (Sydenham Society)*, 1853.

Ph. Owsjannikow. — Disquisitiones Microscopicæ de Medullæ Spinalis textura, imprimis in piscibus facitatæ. *Dorpat*. 1854.

R. Wagner.—Neurologische Untersuchungen. *Göttingen*, 1854.

J. Lenhossék.—Neue Untersuchungen über den feineren Bau des Centralen Nervensystems des Menschen. *Wien*, 1858.

Schroeder van der Kolk.—On the Minute Structure of the Spinal Cord, etc. *London*, 1859 (*New Sydenham Society*).

Brown-Sequard.—Lectures on the Physiology and Pathology of the Central Nervous System. *Philadelphia*, 1860.

Fr. Goll.—Denkschriften der Mediz.-Chir. Gesellschaft d. Kanton Zurich. 1860.

J. B. Trask.—Contributions to the Anatomy of the Spinal Cord. *San Francisco*, 1860.

E. Reissner.—Beiträge zur Kentniss von Bau des Rückenmarkes von Petromyson fluviatilis. *Dorpat*. 1860.

L. Stieda.—Ueber das Rückenmark und Einzelne Theile des Gehirns von Esox Lucius. *Dorpat*. 1861.

J. Dean.—Microscopic Anatomy of the Lumbar Enlargement of the Spinal Cord. *Cambridge, U.S.* 1861.

J. Traugott.—Contribution à l'Anatomie Microscopique de la moëlle epinière de la Grenouille. Quoted from the German, in Brown-Séquard's *Journal de Physiologie, Janvier*, 1862.

The subject will be treated under the three heads of:—

1. The structure of the white columns.
2. The form and structure of the grey matter.
3. The origin and course of the nerve roots.

I. Structure of the White Columns.

The anatomical elements of the white columns present different appearances, according as they are examined in longitudinal or in transverse sections.

A *longitudinal* section exhibits the general aspect of a structure consisting of parallel fibres running lengthwise. A minute examination shows them, as described by Mr. Lockhart Clarke, to consist of nerve-fibres taking different directions,—*transversely, obliquely*, and *longitudinally*, together with blood-vessels and connective tissue.

On tracing the *transverse* fibres, these are found to proceed from the grey matter, or from the nerve-roots, and to form a kind of plexus between bundles of the longitudinal fibres, with many of which they may also be seen to become continuous after altering their course. A large number of these transverse fibres approach the surface in fissures which contain connective tissue, and admit the passage of vessels from the pia mater of the surface. Within the grey substance they may be traced in connection with the roots of nerves, with the processes of the multipolar cells, and with the fibres which form the commissures.

The *oblique* fibres may be regarded as intermediate between the transverse and the longitudinal; they form the deeper strata of the cord, lying nearer to the grey matter from which they proceed upwards and downwards, becoming longitudinal after running a variable distance.

The *longitudinal* fibres constitute the greater portion of the mass of the white columns; they are the more superficial, and run nearly parallel to each other.

Dean describes four principal courses of the longitudinal fibres:—1st, obliquely upwards and inwards, penetrating sooner or later into the grey substance: 2nd, fibres which may be slightly oblique at starting, but soon assume a directly transverse course, sometimes varying this by slightly ascending or descending; these fibres are mostly of the finest sort: 3rd, fibres which enter the posterior column at various angles, but very soon bend round, often at quite a sharp angle, descending in a course more or less oblique: 4th, fibres which are looped or recurrent, seeming to unite both ascending and descending fibres. Besides these four classes, the first three of which have already been noticed by Stilling, Dean observes, "every variety of intermediate course will be found, the bundles of fibres being braided together in most complex manner." "The anterior and lateral columns, apart from the anterior roots, are only partially derived from the cells of the anterior and posterior cornua, *some* of the white longitudinal fibres seeming to be direct continuations of the posterior roots, after these have passed through the grey substance: the posterior columns are composed almost exclusively of the posterior roots, a few fibres appearing to be derived from cell processes coming from the large cells, situated on the margin of the posterior cornu: what course these fibres take after leaving the grey substance, I have been unable to determine definitely."—p. 10.

Stilling also points out that the *longitudinal* fibres do not all follow a parallel course, but that many, after a longer or shorter extent, bend in other directions; but whether all or only some are thus diverted, and whether others continue to follow the whole length of the cord, he has not determined. Sometimes horizontal fibres are traceable into the roots of the nerves. The *oblique* fibres he describes, similarly with Mr. Lockhart Clarke, as passing upwards and downwards, and in one of his plates gives an illustration of their crossing one another. The *transverse* fibres, Stilling remarks, are more numerous where the larger nerve roots arise. Their course is not always in exactly the same plane, neither are they always straight, but present frequently a bowed outline as they traverse the bundles of longitudinal fibres, to form the roots of the spinal nerves.

The white columns (*Stränge*), Goll observes,* consist principally of longitudinal fibres running parallel to each other, forming the medium of communication of single portions of the cord with the brain, and intersected by radiating bundles (*Balkenstrahlen*) of nerve-fibre, which he describes as branching off like the veins of leaves for the most part dichotomously, then again subdividing and connected with each other. Coarser radiating bundles may be noticed to divide the fibres into clusters of from twelve to fifteen districts of radiations. Finer bundles subdivide these again into trapezoid or rhomboid shaped clusters of the cut ends of the horizontal fibres. These radiating bundles are the medium of the passage of vessels and nerve fibres from the centre to the surface. The periphery and borders of the anterior fissures are covered with a layer of fine connective tissue, which latter sends inwards processes connecting it with the radiating bundles and the neuroglia. Gall also delineates, in a somewhat exaggerated diagram, two wedge-shaped tracts of the posterior white columns bounding internally the posterior middle line, and on their outer sides being in contact with the posterior roots of the nerves as they pass from the posterior horns of the grey substance. These tracts are not always distinctly marked.

Kölliker† distinguishes in the white substance only horizontal and longitudinal fibres, "running parallel to each other, never interlacing nor constituting small fasciculi. The number diminishes from above downwards, because they successively pass inwards towards the grey substance, presenting the general characters of the central nerve-fibres." The *transverse* fibres are found in those portions of the columns which adjoin the horns, and at the points of entrance of the nerves, and in the white commissure.

Schroeder van der Kolk‡ describes the course of longitudinal fibres in the anterior and posterior columns, and the passage of some of these fibres into the transverse rays connected with the cells in the grey matter. These contain, according to this author, separate filaments for the several functions of sensation, motion, and reflex action, and exist in greater numbers in the cervical and lumbar expansions, where the majority of reflex actions and movements are excited and combined.

A transparent section at right angles to the axis of the cord exhibits very clearly the arrangement of the longitudinal and transverse fibres. (Plate IX. fig. 1.) The latter are seen passing among the cut ends of the former, and, as it were, mapping these out into circumscribed districts of bundles. Stilling has devoted one fasciculus of his folio atlas to the delineation of the divers forms presented by these blocks, or districts, as exhibited in opaque sections. By the employment of colouring matter (*e. g.* carmine or archil), the cut ends of the

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* P. 135. † Vol i. p. 408. ‡ P. 56.

longitudinal fibres are subjected to anatomical demonstration by transparent sections. The axis-cylinder of the nerve-tube becomes tinged with the colouring matter, while its surrounding sheath remains untinged. In this way the transverse fibres become distinguishable as they traverse the bundles of longitudinal fibres, the dyed ends of which thickly dot the field of the object glass of the microscope. (fig. 1.)

By gentle pressure of a fresh nerve the solid cylinder may be protruded, and thus demonstrated in its recent state. This is readily effected in the nerves of fishes (*e. g.* Cod). The author of an elaborate essay on "General Nerve Physiology," in a late No. of the British and Foreign Medico-Chirurgical Review,* observes:—"As to the tubular nature of the axis-cylinder, we once thought that we had convinced ourselves of this in the anterior nerve-roots of the ox. But on examining our preparations, in which the axis cylinder gave the appearance of having a double contour, with a finer microscope, the tubular appearance cannot be made out, and the axis cylinder, under a very high power, appeared to consist of a finely granular homogeneous substance. We have now little doubt that the axis cylinder is a solid or semi-solid fibre, continuous with the contents of the nerve-cell." The same writer expresses his concurrence in Mr. Lockhart Clarke's opinion that Stilling was, in his examinations of nerve structure, misled by his mode of making his preparations.

A transverse section exhibits also the relations of the fissures of the cord—the anterior and posterior median, and several lateral or radiating fissures which admit the passage of vessels. The general distribution of the latter is beautifully shown by the use of transparent injections.† The principal source of supply is by one or, sometimes, two arterial trunks passing down the anterior fissure, piercing the anterior commissure to send a branch on each side of the central canal, then rapidly dividing and subdividing into almost as many and as minute branches as there are nerve processes. So numerous are their ramifications and anastomoses, that a network of minute meshes is formed in the grey matter, and its superior vascularity strongly marked. (fig. 2.) A second source of vascular supply is from the pia mater of the surface. Vessels may be seen traversing the white columns, and passing inwards to the grey matter, giving off branches to their connective tissue and fibres in their course inwards. In the Boa the size of the vessels of the grey matter is, relatively to that of the higher animals, large, and their course distinct.

The connective tissue consists of a fine net-work between the fibres and blood-vessels of the columns. In the calf this tissue may readily be seen to be interspersed with a multitude of minute cells or nuclei, which send out processes or fibres in different directions to assist in forming the net-work of areolar tissue. The smallest cells of the

* July 1862, p. 3.

† The writer has traced the vessels in many exquisite specimens of injected cord. prepared by C. M. Topping, 7, Haverstock Street, City Road.

substantia gelatinosa of the *caput cornu posterioris* are considered by Clarke as belonging to the connective tissue. The outer ends of the epithelial cells which surround the central canal send out delicate processes which radiate in all directions, and by their peripheral ends are always in connection with the areolar or connective tissue. Some processes may be traced to the blood-vessels and pia mater through the grey substance and columns, at right angles to the axis of the cord, joining the connective tissue. We have ourselves seen this connection of the epithelial cells of the canal with the pia mater of the anterior fissure, in a beautiful preparation by Mr. Lockhart Clarke, of the cord of a fœtus of a sheep three inches only in length —leaving no longer any possibility of doubt on the existence of the connection.

Dean* observes—"My own observations are entirely in agreement with the description which J. L. Clarke has given of the connective tissue." "The view which Clarke has taken of the possible relation between connective and true nerve tissue seems very valuable; for I have long been satisfied of the impossibility of fully distinguishing with our present means, between these two tissues, which seem to run into each other so closely as to suggest very strongly the important question, whether there is any actual and essential difference between them, or whether the connective tissue of the cord be intermediate in its nature, passing on the one hand into *nerve* tissue, and on the other into pia mater."

Goll (p. 136) describes the interstitial substance or *Neuroglia* of the white columns as being identical with the finest fibres, forming the sheaths of the nerve fibres, and as continuous throughout the entire length of the spinal cord. This is also shown by Mr. Clarke, Phil. Trans. pl. xxii. fig. 48. At the edges of very thin sections Goll has seen the short sections of axis cylinders fallen out, leaving a honeycomb structure distinctly perceptible. At the borders of the anterior fissure this *neuroglia* is continuous, with a fine fibrillated texture, which is interposed between the white column and the pia mater.

II. Form and Structure of the Grey Substance.

1. *Form.* The general outlines of the grey matter are well known, as are also its division into anterior and posterior horns. It may be noticed that these outlines are not so clearly defined as the cord tapers towards its lower extremity. At the lower part of the conus medullaris, or conical extremity, the posterior grey substance forms a single broad mass, consisting behind of a softer, paler and more transparent lamina or band (the gelatinous substance). The anterior portion of the grey substance of the *conus*, however, retains more of the form of the *cornua*, being divided into two parts by the anterior fissure, near the base of which fibres are seen crossing and decussating to form the

* P. 2.

anterior commissure. In ascending towards the lumbar region the two lateral *cornua*, and the *posterior commissure* begin to appear. In the conus medullaris the central canal is larger than in any other region of the cord. It continues to enlarge through the lower part of the *conus*, nearly reaches the anterior fissure, and extends backwards to the *gelatinous substance*, in front of which it dilates in a lateral direction. The grey substance gradually decreases in quantity, and is encroached upon by the antero-lateral columns. Numerous small cells are scattered throughout it.

The *filum terminale*, in its natural state, appears to be a nearly cylindrical tubule, but, when hardened in spirit, or chromic acid, is more or less flattened at the sides, so that the canal becomes compressed and sometimes completely collapsed. The grey substance is at last reduced to a mere fringe from the edges of which a series of processes extend through the white substance to the pia mater at the surface.

On examining the cord upwards from the *conus* towards the lumbar enlargement, certain modifications are found to take place in the form and disposition of the grey masses. The two halves of the posterior mass begin to separate from each other at the middle line. The rudiments of the posterior cornua begin to be marked out by the separation of the grey matter, and the first appearance of the posterior vesicular columns is an increasing mass of caudate cells a little behind the spinal canal. The changes continue to increase from below upwards, and reach their greatest extent in the middle of the lumbar region, where the posterior cornua are broad and long, and widely separated, while the posterior commissure is reduced in breadth, being $\frac{1}{230}$ of an inch instead of $\frac{1}{50}$ as at the lower end of the cord.

A similar series of alterations takes place also in the form and arrangement of the anterior grey horns, whereby they assume a shape the opposite of what they presented lower down. They now turn rather outwards than inwards, and have a large irregularly clubshaped extremity. The caudate vesicles have become exceedingly numerous, and are grouped together in several large masses, chiefly on the outer and middle parts of the cornua.

In the dorsal region the arrangements of the grey substance are again reversed. The posterior grey substance again consists of a single mass extending uninterruptedly and nearly horizontally across from side to side—on the other hand, the anterior cornua are long, straight and narrow, projecting directly forward. Its caudate vesicles are less numerous and collected in one or two small groups towards their extremities.

From the middle of the dorsal region to the cervical enlargement of the cord, the alterations in the form of the grey substance are again reversed, being nearly similar to those found to take place on proceeding upwards from its lower extremity. The process of division of the posterior mass is renewed, the commissural bands are pressed forward, marking the *posterior cornua*—the *anterior* become broader and longer and contain a larger number of vesicles. The general arrangement of the grey substance has a striking resemblance to that of the lumbar region.

In the spinal cord of Man the form of the grey substance differs somewhat from that of Mammalia. Throughout, the posterior cornua stand completely apart, and are joined only at their bases by a narrow transverse commissure. Each posterior vesicular column occupies the whole inner half of the *cervix*, and in appearance resembles that of mammalia in the upper part of the lumbar enlargement.

Dr. J. Traugott states that before and behind the central canal in the cord of the frog, the grey matter consists of a gelatinous connective tissue and differs notably from its characters in other parts—a difference which is not found in the cord of man or other vertebrates. In other parts the grey substance consists of the cellular and fibrous elements. Its radiated character is due to the processes extending from the epithelium of the central canal, and which belong probably to the connective tissue. The cells are large and small, the larger are more abundant in the anterior horns, the smaller in the posterior —both varieties of the nerve cells are met with scattered together throughout the grey substance.

The anterior commissure is formed of fibres passing across from one side to the other and enclosing longitudinal fibres. The posterior commissure is very slight and is even sometimes wanting. The posterior nerve-roots send processes to the anterior commissure.

The fibres of both commissures are described by Schroeder van der Kolk as consisting of white fibres not in immediate connection with nerve roots, although probably indirectly connected with the anterior roots by means of ganglionic filaments. (Plates X, XI. figs. 4 and 6, L and M.)

The cells of the grey matter present great variation in form, size, (fig. 1 c.), and number of processes, depending much, as observed by Dean, "on the direction of the plane of section with respect to the situation of the cell."

A distinction founded on the size of the cells has been attempted, dividing them into motor, sensitive, and sympathetic, but this is a purely hypothetical and unfounded distinction, since there are many cells, which as Dean justly remarks, should be sensitive in the anterior cornu, and motor in the posterior.

Dean regards the cells as simply an enlargement of the axis cylinder containing a granular substance and a nucleus. The cells however possess such clearly distinctive characters as to justify their being regarded as altogether independent structures giving off prolongations of their outer membrane.

Dean defines the distinctive characters of grey and white matter, or vesicular and fibrous, as consisting in the presence of true nerve cells in the grey or vesicular, while they are absent in the white or fibrous substance. "The so-called *cells of the white substance*, described by Stilling and others," Dean adds, "are nothing more than the cells belonging to the connective tissue, or as sometimes occurs, true nerve cells which have been isolated from the grey substance by the plane of section."

With reference to the connections of nerve-cells one with the other, the following summary of various opinions may be quoted from Dean. "Schroeder van der Kolk describes and figures, for the most part very truthfully, the communications between cells by means of longer or shorter fibres. He states that two cells are often united by more than one fibre, but so far as my own observations reach, this is exceedingly rare. He seems to infer that cells of the posterior cornua are also connected, though he does not mention ever having seen this. Lenhossek speaks of the cells as being multipolar, and connected together in a continuous chain from the apex of the *conus medullaris* to the brain, and figures the union of several cells from the cervical enlargement of the human cord.* Bidder and Kupffer notice the same fact; they were also able to make out cell connections in longitudinal sections. Stilling agrees with the authors cited above, considering these cell connections, however, as independent of those he believes established between all the cells of the *elementary tubuli*. Both Stilling and Schroeder van der Kolk describe the cell-process as bifurcating, distant cells being connected together by this first division, or by means of still further ramifications. Stilling carries this division of the cell-process much further than Van der Kolk, making the branches split again and again, till they are reduced to the finest *elementary tubuli*. My own observations agree in this respect much more nearly with the figure and description of Clarke; his statement that the cell-processes divide and subdivide into smaller branches, so that the space between them appears to be occupied by a minute network of the most delicate fibrils, is entirely correct. I have uniformly seen the cells connected by fibres never smaller than the axis cylinder of the finest nerve fibres of the white substance, being usually (measured at a sufficient distance from the cell for the diameter to be uniform), about ·0001 ·00025″ in diameter."

These connections of the cell processes, indicated by Lockhart Clarke in 1851, may with care and patience be traced in very thin and transparent longitudinal sections of the horns. As the fibres change their plane, a frequent adjustment of the focus is required under the use of the higher powers of the microscope. The analogy of the relations of the fibres proceeding from unipolar cells in lower classes of animals strengthens the conclusions which have been founded upon the careful examination of the apparently inextricable net-work of cell-processes, nerve-fibres, blood-vessels, and connective tissue.

The anterior and posterior cornua are divided by an imaginary line drawn across from either side of the central canal outwards to

* This statement must be taken subject to future confirmation.

the lateral white column. From the upper part of the lumbar to the lower part of the cervical regions of the cord, the lateral portion of the grey substance between the anterior and posterior cornua consists of a peculiar vesicular tract, paler and more transparent than the rest, and which has been named by Lockhart Clarke the *tractus intermedio-lateralis.* (Plate X. figs. 3 and 4.) This tract consists, for the most part, of oval, fusiform, and pyriform cells sending processes to the lateral columns and to the transverse commissures. The *tractus intermedio-lateralis* was first shown by Mr. Clarke, to be in intimate connection with the lower roots of the spinal accessory nerve in the cervical region. It constitutes the motor column of the respiratory muscles of the abdomen and thorax.

"The *tractus intermedio-lateralis*, in Man, closely resembles that of Mammalia, and contains cells of the same kind, but rather smaller. In the upper part of the cervical region, a similar, but somewhat larger, tract reappears in the same situation, and projects in the same way into the lateral column. It increases in ascending to the third pair of nerves, where the form of the entire grey substance presents a very striking resemblance to that in the upper part of the dorsal region. This tract is traversed by several roots of the *spinal accessory* nerve, in their course forwards to the *anterior* cornu, and contributes, with the edge of the posterior cornu, to form a beautiful network in the lateral column, through which the nerve enters. Its cells are triangular, oval, and fusiform in different directions: some of them are elongated in the direction of the transverse commissure, and towards the front of the posterior vesicular column; others extend outwards with radiating fibres through fissures of the lateral column. There is reason, therefore, to believe that this tract forms a part of the *tractus intermedio-lateralis.* In the Sheep and Ox, and probably in all Mammalia, a *peculiar* group of cells, which is traversed by the roots of the spinal accessory nerve, is found in the same situation; and this group, in ascending the medulla oblongata, retires inwards to the space behind the canal, and there contributes to form the nucleus which gives origin to the highest roots of the nerve. The cells of the *tractus intermedio-lateralis* are elongated with their processes in a longitudinal direction, and reached by both the *posterior* and *anterior roots* of the *spinal nerves*, and perhaps by the *spinal-accessory.* The latter nerve extends *forwards* to the cells of the *anterior cornu*, which also send some of their processes *longitudinally*, and are reached by the *posterior roots.*

Mr. Clarke has shown that while *one* portion of the *upper* roots of the *spinal-accessory* nerve, and *one* portion of the *vagus roots* proceed *inwards to their respective nuclei behind the canal, other portions of both bend forwards to the vesicular network into which the anterior cornu has become resolved*, and that some of the roots of the *trifacial nerve descend longitudinally through the caput cornu*, between the transverse roots of the *vagus.* In this course they are probably brought into connexion with the *respiratory centres,* and perhaps also.

like the *vagus*, with the anterior grey substance of the medulla. These extensive and intimate connexions seem to afford an explanation of the mechanism by which impressions made on the vagus and on the incident fibres of the trifacial and spinal nerves, may call into action the whole class of respiratory muscles; and if the tract just described in the upper part of the cervical region be continuous, as it probably is, with the *tractus intermedio-lateralis*, which is reached by the dorsal nerves supplying the intercostal and other respiratory muscles of the trunk, the explanation in question will be still more complete.

The *tractus intermedio-lateralis* is larger at the upper part than in the middle of the dorsal region. On the one hand it projects further into the lateral columns, and on the other tapers inwards, across the grey substance, to near the front of the vesicular cylinder. As it ascends through the cervical enlargement it gradually disappears. In the region of the upper cervical nerves there appears a vesicular tract in the same position as the *tractus intermedio-lateralis*, composed of the same kind of cells, which send their processes outwards through the lateral column, and inwards to join the fibres of the transverse commissure behind the central canal. It is traversed by the fibres of the spinal accessory nerve as they bend forwards on their way to the anterior cornu. (fig. 3.)

To insure accuracy of description Mr. Clarke has further divided each posterior cornu into its *caput* and its *cervix*. The *caput* is its broad expanded extremity, the *cervix* is the remainder of the cornu as far forwards as the imaginary line above described. This distinction is founded on the facts: 1. That the *caput* differs in structure from the *cervix;* and 2. that in the medulla oblongata it is thrown aside from the cervix and after being traversed in succession by the roots of the vagus and glossopharyngeal nerves, becomes the principal nucleus of the trifacial.

The *caput cornu posterioris* consists of, 1. an outer and comparatively transparent portion—the *gelatinous substance*, and 2, the inner, more opaque portion, or base.

The *gelatinous substance* (fig. 4. g.) consists of, *A.* Nerve fibres. *B.* Nerve cells. *C.* Blood-vessels. *D.* Connective tissue.

A. The nerve fibres are transverse, longitudinal and oblique. The *transverse* fibres run out through the posterior border of the gelatinous substance through the posterior columns towards the posterior fissure, to form the posterior roots of nerves. The primitive fibres composing these bundles are not grey fibres, but tubules of small average size, the larger possessing double contours. They vary from $\frac{1}{5000}$ to $\frac{1}{20000}$th of an inch in diameter, intermixed with some of $\frac{1}{1700}$ of an inch within the posterior border of the gelatinous substance. The oblique fibres are intermediate between the transverse and horizontal, of which they are continuations, as well as with some fibres of the posterior roots.

B. *Nerve cells*—these vary much both in shape and size. They are round, oval, fusiform, pyriform, crescentic, triangular, stellate, or otherwise irregular, and have from at least two to eight processes which extend in different directions—transversely, obliquely, and longitudinally—forming part of the longitudinal bundles, the commissures, and roots of nerves.

Nearly the whole inner half of the cervix cornu is occupied by the remarkable and important column of cells, *the posterior vesicular column,* (see M. fig. 3 and 4) extending throughout the whole length of the cord, but varying somewhat in size and appearance in different regions. Both in man and mammalia its diameter is greatest in the upper third of the lumbar enlargement. The processes of these cells are prolonged in every direction—transversely, longitudinally, and obliquely: transversely they are continuous on the one hand with the roots of the nerves, and on the other with the posterior commissure. The smallest cells doubtless belong to the connective tissue.

The anterior, or more opaque portion, of the posterior cornu, continuous with the cervix, presents a large proportion of longitudinal fibres, to which indeed its opacity is owing. Its transverse fibres are continuous with the roots of nerves, and with the longitudinal columns. The cells are of small size, for the most part fusiform or oval, having their long axes in the direction of the opaque or longitudinal nerve roots.

Schroeder van der Kolk, while he does not recognize the independent existence of the posterior vesicular columns, nevertheless speaks of several distinct columns of multipolar cells. In like manner Lenhossek speaks of the cells in the posterior horn being accumulated laterally, but asserts that the existence of Clarke's posterior vesicular column is not established.

In the *filum terminale* a fringe only of grey substance is found surrounding the dilated canal except in front, at the bottom of the anterior fissure. This fringe contains a number of cells which resemble those of the connective tissue. As it ascends, the grey substance increases in quantity and projects forward to form the anterior cornu, at the extremity of which a few large cells are grouped together. Through the lumbar region these large cells increase in number, in proportion to the size of the anterior roots of the nerves and form several large groups, chiefly in the outer half of the cornu. These cells are round, oval, fusiform, triangular, or stellate; their delicate processes are from two to eight or more in number, extend in different directions and divide into numerous branches—some prolonged into the antero-lateral white columns, others into the anterior roots of nerves.

B. *Nerve cells of the gelatinous substance* (g. fig. 4). These are, *a.* large, *b.* small, and *c.* intermediate; the *large* cells are found among the semi-circular fibres which run within the external border of the gelatinous substance, and never extend beyond the middle of its depth. They are more or less oval, fusiform, crescentic and irregular, containing distinct nuclei, and giving off from two to six processes, extending in different directions; many of the finest pass out with the posterior nerve roots into the posterior columns. The *small* cells, many of which are nearly as small as blood discs, abound in every part—they are round or oval, somewhat pyriform and give off two or more processes. The intermediate cells are found chiefly near the verge of the posterior columns; some, although they are still true cells, are so fusiform as to appear like gradual dilatations of the fibres.

2. The *anterior*, or more *opaque*, portion of the *caput cornu posterioris* is continuous with the grey substance of the *cervix*, and is surrounded by the arched lamina of the gelatinous substance. In some parts of the cord, as seen in a transverse section, it has the form of a cone, in other regions it is more or less angular or rounded. It consists of longitudinal, transverse, or oblique fibres and cells. The *longitudinal* fibres are collected into bundles and are the principal cause of the opacity of this portion of the caput. The *transverse* fibres are continuous with the posterior roots of the nerves and the longitudinal cells, and cross each other in a great variety of ways. The *oblique* fibres are continuations of the transverse and longitudinal at different angles and in different planes.

The *cells* are mostly of the smallest and intermediate size—the majority are oval and fusiform and have their long axes chiefly in the direction of the oblique and horizontal nerve roots, and of the longitudinal fibres with which they appear to be continuous. A few larger cells are scattered at unequal intervals.

The *cervix cornu posterioris* (fig. 4) is described by Mr. Lockhart Clarke in considerable detail, "not only on account of its great interest and apparent importance, but in order that we may recognize its parts as the *same* during the *changes* which they undergo in passing through other regions."

The cervix is thus defined by the author:—

"The *caput* cornu posterioris on each side, would be marked off by an imaginary line extending across from the *antero-lateral* extremity of the *gelatinous substance* to the bottom of the posterior median fissure; while the *cervix* is included between this line and another drawn nearly horizontally across from the anterior border of the transverse commissure which arches over the pellucid space surrounding the central canal."

On the inner or median half is found the remarkable longitudinal columns, the *columnæ vesiculosæ posteriores* (figs. 3 and 4). Each consists of a somewhat dark cylinder of fibres interspersed and surrounded by cells and their processes. The fibres are in great part derived from the posterior roots of the nerves, and are much finer than those of the white columns. These fibres interlace each other in bundles in the most intricate manner. The cells are oval, fusiform, and stellate, differing in size, some being as large as those of the anterior cornu. The processes of the cells intersect the cylinder in various directions, sometimes suddenly changing their course to become longitudinal, sometimes escaping directly to surrounding parts. The cells around the cylinder send off their processes into the anterior and posterior cornua, and contribute to form the commissure behind the central canal. In the inner side of the cervix of the middle of the cervical and lumbar enlargements the cells are larger than in any other region—in man and mammalia they are here reduced in size. These columns do not exist in birds.

The posterior roots are intimately connected with the vesicular columns, as will be shown farther on.

Van der Kolk, as already stated, doubts the independent existence of this particular column (p. 37), "As Clarke has correctly stated, several columns of multipolar ganglionic cells extend through the entire length of the spinal cord, those in the anterior being the principal; next in importance, those at the side of the posterior commissure; then those in the middle of the grey matter, between the anterior and posterior horns; and, lastly, those in the posterior horns themselves, as the smallest. These columns, however, are not to be regarded as quite independent; on the contrary, they are all more or less connected."

A band of fibres from the posterior transverse commissure after curving round the front of the vesicular cylinder, runs longitudinally outwards to the *tractus intermedio-lateralis*. Between the latter *tractus* and the *caput* cornu, fibres descend from the roots of the nerves, and run partly outwards to the lateral column, and partly forward to the anterior cornu passing through the intermediate tract. Near the outer border of the vesicular columns, at the base of the *caput*, and near the edge of the cervix, the longitudinal fibres are formed into three or more bundles among, and sometimes embraced by, cells and their processes.

In receding from the middle of the dorsal region towards either extremity of the cord, the posterior cornua gradually separate from behind forwards, receiving between them the deep encroaching layers of the posterior columns, until in the middle of the cervical and lumbar enlargements they are joined by a narrow band of the transverse commissure, immediately behind the canal. The posterior vesicular columns simultaneously undergo changes in form, size, and structure. As they approach the cervical enlargement the cylinder or opaque portion of each is gradually reduced in size. Sometimes the cylinder is intersected by fibres of the transverse commissure; other fibres of the commissure in their passage outwards enclose it, reunite and run backwards through the *caput* cornu, diverge and traverse the gelatinous substance as posterior roots of nerves.

At the upper part of the cervical region, near the origin of the third pair of nerves, a darker mass of cells is found at the base of the cervix on its median border. (fig. 3.) It gradually diminishes upwards, and disappears near the first pair of nerves.

In *descending* the cord from the dorsal to the lumbar region, the posterior grey substance undergoes a series of changes nearly similar to those which are observed in ascending to the cervical enlargement. The posterior cornua become separated in a direction obliquely backwards. At the upper part of the *lumbar* enlargement the posterior vesicular columns are decidedly larger than in any other part of the cord. Its larger cells are more numerous, and do not form a circumscribed group, but lie scattered through the whole inner half of the cervix which their processes traverse in different directions and planes. Through the remaining half of the lumbar enlargement, the posterior vesicular columns are gradually less encircled by their processes, which are also fewer in number, but are still traversed by the divergent fibre of the transverse commissure, and by a plexus of the posterior roots which sweep round on their outer sides.

In descending the lower portion of the lumbar enlargement, the border of the grey substance between the posterior cornua is gradually drawn backwards, so that in the same proportion the space behind the canal, containing the transverse commissure becomes deeper.

Near the level of the second pair of sacral nerves is a peculiar group of cells, which was pointed out by Clarke in 1851, and was regarded by him as the commencement of the posterior vesicular column, but that anatomist now concurs with Stilling in regarding it as a distinct group. It is more or less oval, but is not entirely isolated from surrounding cells. The principal part of the group is intimately connected with the anterior roots of the nerves.

Dean, who had independently examined the cells of the horns in the lumbar region before he had seen Clarke's paper (1859), observes, that his "observations are entirely in agreement with his statements in all important particulars."

The central canal, as first exactly described by Clarke in 1851, is lined with columnar epithelium, and in the ox, with fusiform cells also. Between these two kinds of epithelium there are different grades of transition. They are all beautifully packed in close apposition, so that the convexity of each is applied to the concavity of those which surround it. In the human cord the canal is often filled with what would appear to be the debris of epithelium, for nothing is to be seen but a confused heap of *nuclei;* but sometimes in the midst of this heap there remains a small opening or canal, and sometimes two such secondary canals, each being lined by a regular layer of columnar cells. The cilia of the epithelium are coarser and less numerous than those in the larnyx and trachea. The light coloured space surrounding the canal is interspersed with nuclei, or minute cells. Some of them are oval or round, finely granular, and exactly resemble those in the connective tissue of the white columns.

Kölliker formerly denied the existence of a central canal, but is quoted by Lenhossek as having admitted its existence.

"Hannover," observes Clarke, "regards the cells which line the cerebral ventricles as true *nerve-cells*, and Bidder takes the same view of those round the spinal canal; while Stilling considers them as epithelium, but nevertheless, believes that the fibres which they give off form elementary parts of the primitive *nerve*-fibres and *nerve*-cells, with both of which, according to him, they are directly continuous. He professes to have seen the peripheral ends of two epithelial-cells unite with each other after a shorter or longer course, and then enter a *nerve*-cell; or the process of a *nerve*-cell divides into two or three branches, which end in two or three epithelium-cells. By the most careful examination of some hundreds of preparations, I have never been able to perceive that the epithelial processes are connected with any other than the *small* cells or nuclei which I have already described. I have sometimes seen the process of a *large nerve*-cell extend close up to the epithelium, but I have generally succeeded in tracing it round the canal to the *opposite side* of the cord. If the processes of the epithelial cells were directly continuous with, and formed elementary parts of, *nerve*-cells and *nerve*-fibres we might reasonably expect to find the number of the former always in proportion to that of the latter; but the very reverse is the case; for, as we have just seen, in the *filum terminale*, where both *nerve*-cells and *nerve*-fibres have *entirely disappeared*, the *canal* is much *larger*, and the *epithelial-cells* are consequently much more numerous than in any other region; while, as I have already shown, their processes may be traced through the surrounding white substance as far as the surface of the cord."

Dr. Reissner describes the spinal cord of the Lamprey as being colourless, and devoid of fibres having the characteristics of nerve-fibres in other vertebrata. It presents neither anterior nor posterior fissure, but simply a septum proceeding from the connective tissue around the central canal. The central canal itself is also divided by the septum into two halves. The grey matter consists of fibres and cells. The smallest cells belonging to the connective tissue. Three kinds of larger cells are distinguished by M. Reissner, viz.—

a. Large inner cells—which are found towards the middle line of the upper or posterior columns, have the form of flattened nuclei, sending processes upwards and downwards, and some to the surface.

β. The large outer cells—have various forms, mostly elongated, beginning at the external border of the grey matter—they send numerous processes, as many as six from one cell—which form the axis cylinder of the fibres going to the nerve roots, anterior commissure, and longitudinal columns.

γ. Smaller cells—these are scattered among the larger cells – their finer processes go to the posterior roots and to the radiating fibres of the posterior commissure.

Owsjannikow states that in fishes all the fibres of the spinal nerves entering into the spinal marrow are connected with nerve cells. *(Omnes . . . . cum cellulis gangliosis esse conjunctas)*; and that, in every cell, processes meet from the anterior root, from the posterior root, and from the commissures. That the white substance is formed of processes of the cells going upwards towards the brain; that these are united by connective tissue.

Dr. Stieda divides the cells of the grey matter, in the Pike, into large and small, the former have generally about five processes, the latter only two. He has never seen the processes of the cells on one side of the cord communicate with those of the opposite side. The processes of the cells are traceable to the nerve roots and into the longitudinal fibres. The nuclei of the white and grey substance belong to the connective tissue.

III. The Origin and Connection of the Nerve Roots.

That the posterior roots of the spinal nerves are attached to the posterior columns, and the anterior roots to the anterior columns, only—was the statement made by Mr. Clarke in 1851. This statement was repeated by him in 1853, and with the additional statement that the lateral columns are in immediate connection with the spinal accessory. In his last communication to the Royal Society, 1858, Mr. Clarke reiterates the same account in opposition to the denial of Stilling, who maintains that a few fibres traverse the posterior part of the antero-lateral columns, having, Mr. Clarke suggests, probably mistaken vessels for nerve-fibres.

Posterior roots. The bundles which compose these are larger than those of the anterior; but their component fibrils are mostly finer and more delicate. In a longitudinal section of the cervical enlargement of the cord of a Cat (fig. 5), the bundles are described as being seen to be of three kinds. The first kind enter the cord transversely. and pursue a very remarkable course. Each bundle after traversing the longitudinal fibres of the posterior column, in a compact form and at a right angle, continues in the same direction to a considerable, but variable, depth within the grey substance, dilating and again contracting in a fusiform manner; it then bends round nearly at a right angle, and running for a considerable distance in a longitudinal direction *down* the cord, sends forward, at short intervals, into the *anterior* grey substance a number of fibres like those issuing from the roots of plants.

"The fibres projecting into the anterior grey substance have the following distribution. Part of them form loops with each other within the grey substance, particularly near its border; others extend directly into the anterior white column A, C, and bending round both *upwards* and *downwards*, are seen sometimes to re-enter the grey substance and form with each other a series of loops, and sometimes to continue a longitudinal course within the anterior white columns, amongst the fibres of which they become lost. Whether the latter, also, ultimately form broader loops with corresponding fibres of the grey substance, it is impossible to ascertain. But even if those which *ascend* in the anterior columns are continued upwards to the brain, one can scarcely avoid inferring that those which *descend* re-enter the grey substance, either to form loops, or to become continuous with the fibres of the anterior roots, since the whole of the latter, as we shall presently see, proceed directly to the grey substance. Indeed, (adds Mr. Clarke), I have sometimes felt almost persuaded that a great number of the fibres of these posterior roots are directly continuous, in the grey substance, with those of the anterior roots; but I cannot make this statement with absolute certainty; and as the question is one of extreme difficulty, I shall hereafter endeavour to make it a subject of special attention."

The second kind of bundles which form the posterior roots traverse the posterior columns transversely, and with different degrees of obliquity from without inwards, extending nearly as far as the posterior median fissure. They enter and pass through the grey substance at various angles, and in compact bundles which decussate and interlace each other in the most complicated manner. Some of their fibres cross over to the opposite side through the posterior commissure, behind the spinal canal; others extend into the posterior and lateral white columns; and the rest may be traced deeply into the anterior grey substance, where they separate in various directions and are ultimately lost to view.

The bundles which compose the third kind of posterior roots enter the cord obliquely. A few of their fibres proceed near the surface both upwards and downwards, and pass out again with the roots above and below them. The rest cross the posterior white columns obliquely and chiefly *upwards*, a small number only passing downwards. Interlacing with each other, and the other roots already described, they diverge and reach the grey substance at points successively more distant from their entrance in proportion to the obliquity of their course. The remainder, or most divergent, take a longitudinal course with the fibres of the white columns, among which they are lost. It is impossible to say whether any of these longitudinal fibres are continued as far as the brain, or whether they ultimately reach the grey substance of the cord. It is also extremely difficult to trace the other fibres of these roots after they have reached the grey substance.

In the preceding account of the distribution of the posterior nerve roots it will be seen that Mr. Clarke anticipated the statements of Brown-Séquard on the same point. (Gazette Medicale, 1855).

Of the Anterior Roots. (fig. 6. *a*, *a*, *a*.) The anterior roots of the spinal nerves, as Clarke formerly described them, traverse the anterior part of the antero-lateral columns in distinct and nearly straight bundles. They form no interlacement with each other, like the posterior roots, until they reach the grey substance. Here their fibres diverge in every direction, like the expanded hairs of a brush. Some, near the margin, are easily seen to form loops with those of contiguous bundles; others run outwards to the lateral columns, and inwards to the anterior columns after decussating in the anterior commissure with corresponding fibres from the opposite side. A large number diverge equally *downwards* and upwards, for some distance in the grey substance, while the remainder pass more deeply backwards and are lost. In no single instance has the author seen any portion of these roots take a longitudinal course on directly entering the anterior white columns.

"But besides the transverse bundles which form the anterior roots, a continuous system of exceedingly fine transverse fibres may be seen to issue from the anterior grey substance. They pass through, nearly *all* at right angles to, the anterior white columns, and disappear as they proceed towards the surface of the chord; but as many of them may be observed to turn round and take a longitudinal direction, it is probable that at the points where they disappear they all follow the same course. Within the grey substance they wind about and are gradually lost, mingling with the fibres of the anterior roots, and with those proceeding from the fine bundles of the posterior roots, which, perhaps, are continuous with them.

"It may then, Mr. Clarke adds, be fairly laid down as a well established fact, that nearly all, if not the whole of, the fibres composing the roots of the spinal nerves, after passing through the anterior and posterior white columns of the chord, proceed at once to its grey substance; and that if any of them ascend *directly* to the brain, it must be *those only* of the posterior roots which run longitudinally in the posterior columns."

The connection of the nerve roots with the cells is established by repeated observations of the majority of observers, although it is not equally certain that all the nerve roots are derived from cells; many fibres of the anterior roots, for instance, being continuations of fibres from posterior roots.

*"It appears that there are probably, as regards origin, the three following classes of nerve roots, viz:—

1st. (*a*) Anterior roots which arise from or terminate in anterior cells.

(*b*) Posterior roots which arise from or terminate in posterior cells.

2nd. Anterior and Posterior roots which meet in cells in the central part of the chord.

3rd. Anterior and Posterior roots which are directly continuous, *i.e.* unconnected with any cells in the chord.

"The first class consists of nerve roots which are united, if at all, through medium of deeper lying cell-groups, those of the last two classes being more directly continuous. I am, however, very far from intending to imply any supposed difference of function between these classes, for I am very strongly convinced that the *function* of cell and fibre is every where the same; and one of the principal objects I have had in view in the above classification has been to

* Dean, p. 10.

show how closely anterior and posterior roots are connected, and how nearly they come to having a common origin."

Van der Kolk gives drawings of the connections of the fibres of nerve roots with the multipolar cells, which, he says, he has repeatedly succeeded in tracing, although owing to the fibres not pursuing a perfectly straight course, they are often cut through in making sections of the cord. "There can be no doubt," he remarks, "that the roots of the motor nerves arise from the spinal cord, and more particularly from the ganglionic cells of the anterior horns." The investigation of the connection of posterior roots with the cells, Van der Kolk has found more difficult; he has traced them into the horn proceeding towards the cells, but their minuteness has prevented his seeing whether they absolutely pass into the cell. A portion of the posterior roots, viz: those for sensation, are however subsequently described by Van der Kolk as passing, immediately after their entrance into the spinal cord, upwards along the posterior columns in order to repair to the brain, or seat of perception. They do not penetrate the grey matter, while the rest of the posterior roots, or those for reflex action, are said by him to go to ganglionic cells of the posterior horns. These distinctions however are theoretical, not anatomical.

Stilling lays it down as the general rule that the nerve-roots pursue an apparently unbroken course of nerve fibrils from the cord, but not always preserving the same plane. Spaces entirely free from fibres between two neighbouring nerve-roots are rarely met with.

Dr. Brown-Sèquard (of whose philosophical researches a lucid exposition was given in a previous number of this journal) also expressly states that he has found the "nerve-fibres of the spinal nerves, after they have entered the grey matter, attaching themselves to the nerve-cells."

Measurements.

Cells in grey matter—				
Width	$\frac{1}{290}$	to	$\frac{1}{2166}$	In.
Length	$\frac{1}{213}$	to	$\frac{1}{500}$	
Nuclei of cells . .	$\frac{1}{871}$	to	$\frac{1}{2275}$	
Processes of cells . .	$\frac{1}{222}$	to	$\frac{1}{5500}$	
Nerve-fibres in longit. cols.	$\frac{1}{871}$	to	$\frac{1}{9100}$	
in roots .	$\frac{1}{2900}$	to	$\frac{1}{9000}$	
Gelatinous subst.	$\frac{1}{5000}$	to	$\frac{1}{20000}$	
Commissural	$\frac{1}{8000}$	to	$\frac{1}{30000}$	
Blood-vessels . .	$\frac{1}{435}$	to	$\frac{1}{20000}$	

The above measurements represent the average dimensions of the several structures, but do not affect to indicate their minimum or maximum.

XXXVII.—On Distorted Human Skulls. By Professor Wyville Thomson.

It seems to have hitherto been generally admitted that the bones of men and of the lower animals found in a fossil or subfossil state retain precisely or with an inappreciable amount of contraction, the form which they possessed during life, and that therefore their measurements form as valid a basis for argument or for speculation, as if we had had an opportunity of deriving them from the recent bones. Several singular cases have been observed during the last few years, showing that bones may undergo a very decided change in form, after burial, without being wholly disintegrated. These distortions are comparatively slight, rarely, if ever, altering the bone sufficiently to obscure its distinctive characters: they only occur as a rule in thin flat bones, they appear never to affect the teeth; they are therefore of little importance in the case of the lower animals.

One congeries of bones, the human skull, seems to be specially liable to such posthumous alterations. This liability depends doubtless upon the great size of the brain-cavity in proportion to the thickness of its walls, and to the extreme closeness and frequent partial anchylosis of the sutures, resisting the separation of the bones under slow pressure, in cases where slight softening has rendered the skull in mass to a certain extent plastic. Now that the proportions and measurements of skulls found in old sepulchres, and in connection with ancient habitations are believed to throw so much light upon the distribution of human races, it becomes of importance to ascertain generally the frequency of such distortions, their extent and description, and the circumstances under which they usually or unusually occur.

Opportunities of observation seem to be frequent, and the phenomena are usually well marked. Since I first thought of the matter towards the close of last summer, and with but little time to devote to such questions, I have seen, I should think, more than thirty skulls more or less distorted; and I have little doubt that there already exist, scattered in antiquarian collections, materials which might add greatly to our stock of information. All the distorted skulls which I have had an opportunity of examining, have been twisted nearly in the same way, though in a greater or less degree. This uniformity of malformation is so evident, that in cases where a number of such skulls have been found together, it has led to the idea that the form was a hereditary malformation, or that the skulls belonged to a family of idiots. Messrs. Davis and Thurnam ("Crania Britannica," plates 15, 16 and 27), figure skulls from cists at Juniper Green, near Edinburgh, at Lesmurdie, Banffshire, and in Orkney, all of which are slightly distorted. In reference to these skulls, Mr. Davis suggests the question, "whether a slight distorting process may not have influenced the cranial conformation of the Britons, at least of the Northern tribes." I had an opportunity last summer, through the kindness of Mr. George Petrie of Kirkwall, of examining one of the Orkney twisted skulls. Mr. Petrie, who has paid great attention to Archæology, was perfectly acquainted with the phenomenon. He kindly furnished me with a photograph of a well-marked example, and informed me that he had met with many skulls in the cists and barrows of Orkney, showing the same form of obliquity. The present short notice is meant merely to direct more general attention to this curious subject, and to indicate certain conclusions which appear to be applicable at all events to one great group of cases. Whatever explanation we may accept, so uniform a result clearly points to an equally uniform cause. As already indicated, my own observations have led me to conclude with Professor Owen, Dr. Johnson of Shrewsbury, and others who have had an opportunity of examining good specimens, such as the Wroxeter twisted skulls, that the distortions are due to what has been termed by Professor Owen, "tomb pressure," a cause of posthumous change, which was, I believe, first suggested in a definite form by Dr. Thurnam, and whose importance in certain cases is fully admitted by Mr. Davis in the work already cited. Before entering more fully into this question, I shall briefly describe three skulls, selected because they have been procured from distant localities in England, Scotland, and Ireland, and are to be referred in all probability to widely different periods and tribes; and because the distortion in all three cases, though highly characteristic, is slight, and slight distortions only can give rise to any serious misconception as to their cause.

During the recent explorations at Wroxeter, a number of skeletons were disinterred in a piece of ground called the Orchard, within the walls of the Roman city of Uriconium. The skeletons had evidently been buried. They were however simply imbedded, without any appearance of protection, in soil richly impregnated with vegetable matter. Although there is no tradition of the place where they were found ever having been used as a graveyard, I am by no means satisfied with the evidence which refers these skeletons to the Roman period. The dead were rarely, if ever, interred within the walls of Roman towns, and the true cemetery, containing abundance of cinerary urns, with burnt bones, has been discovered in its usual site, outside the walls of Uriconium. Among a rude people, a certain reverence always attaches to ruins, and it is by no means impossible that this site was chosen for the burial of their dead, after the destruction of the Roman city, by some British tribe. Of nineteen skulls found in the Orchard, twelve were more or less distorted, and the character of the distortion was so uniform that it was the general impression that the remains were those of a race afflicted with some peculiar congenital malformation, or of an aboriginal tribe, slaves possibly to the Romans, and whose fashion it was to squeeze the heads of their infants, after the manner of the Caribs and Flatheads, only to the production of an infinitely more grotesque deformity.

Fig. 1. is a view of the base of one of the most characteristic of these deformed skulls. The bones of the face, with the right temporal, and a part of the right side of the occipital bone are wanting. The form of the posterior portion of the cranium is nearly normal, perhaps it may be slightly compressed laterally. All the twisting is in front of a line joining the zygomatic processes of the temporal bones. The right external angular process of the frontal bone, and the right orbit are forced downwards and inwards, carrying the orbit on the opposite side, upwards and outwards, and displacing the eyes nearly an inch on either side. The congeries of bones is bent in mass, the sutures remaining perfectly close. Along a line passing from the upper and outer angle of the left orbit, through the upper portion of the temporal fossa, across the coronal suture, and for about an inch and a half into the sphenoidal angle of the left parietal, the bones are somewhat abruptly bent. Lines of minute cracks with perfectly sharp edges traverse this line of flexure, the cracks are widest and most evident where the bending is most abrupt. The Orchard skulls generally are rather long, with a well marked occipital protuberance. Were it not for the doubt caused by the peculiar circumstances of their interment, I should be inclined to refer them to the Celtic type.

For an opportunity of examining and figuring the next example (Fig. 2.) I am indebted to the kindness of Mr. Grattan of Belfast. It is one of a series disinterred by Mr. Grattan in May, 1853, from a sepulchral mound at Mount Wilson in King's County, and described by him in the 1st Vol. of the Ulster Journal of Archaeology.

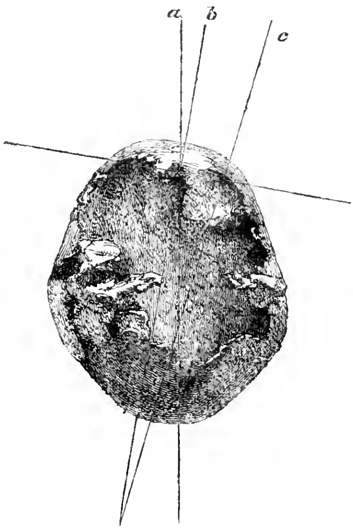

FIG. 1.

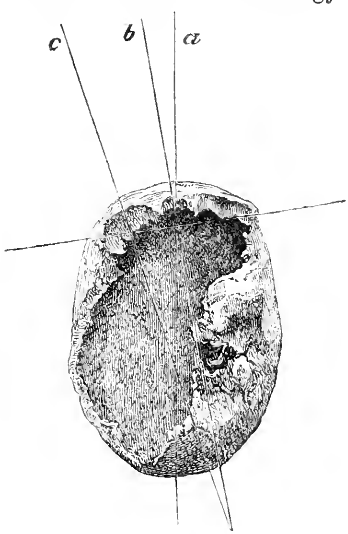

FIG. 2.

These remains are undoubtedly extremely ancient. The skulls examined, about fifteen in number, form an interesting group, somewhat intermediate in form between the true Celtic and the round types. The skull figured is that of a child about eight years of age. The bones are thin and delicate, and many of the sutures are slightly separated. As in the former case, the posterior portion of this skull is nearly normal, but the frontal region is greatly distorted. The right external angular process of the frontal, and the right orbit are forced downwards and inwards, and the left upwards and outwards. The whole frontal bone is twisted round to almost exactly the same degree, only in this case to the right, and in the other to the left. The twist commences in both from the same line of comparative weakness in the cranial arch, a line nearly coincident with, but not involving the integrity of, the coronal suture. As shown in the woodcut, the physiognomy of the change in form in these two skulls is almost precisely the same.

For Fig. 3* I am indebted to a photograph taken by Mr. Petrie

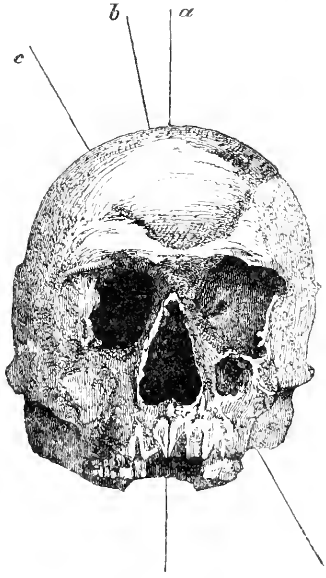

FIG. 3.

* Explanation of the woodcuts. Fig. 1. Skull from the "Orchard," Uriconium. Fig. 2. Skull from a sepulchral mound at Mount Wilson, King's County, Ireland. Fig. 3. Skull from a cist, Pomona, Orkney. *a.* A line joining a point in the centre of the glabella with the external occipital ridge, and forming the present axis of the base of the skull. *b.* Axis of distortion of the frontal region, found by drawing a line perpendicular to a straight line cutting symmetrically the two orbital arches. *c.* Axis of vertical tomb-pressure.

of a skull from a cist in Orkney. The distortion is not so strongly marked in this as in the two former cases, and the character of the distortion is slightly different. In most cases of skull twisting the bones of the face have escaped distortion, by separating from the bones of the head—in this they have remained attached and have become involved in the change of form. In the two former cases, the crania posterior to the coronal sutures remained nearly normal, in this case the whole of one side of the skull has been forced slightly inwards, forcing out and bulging the opposite side to a corresponding degree. From the difference in position, the twist in the frontal bone is not so evident, but the axis of distortion of that bone, when projected, follows almost exactly the same course as in the two former occasions.

From these three, and from many other examples of skulls, whose distortions present essentially and closely the same features, outnumbering by ten to one the cases in which there is the slightest difficulty in referring the distortion to this common type, I conclude that a peculiar and definite form of distortion of the human skull, varying in degree, but constant in essential characters and physiognomic effect, is extremely common in connection with ancient burial, and that it is totally independent of period, and of race, and nearly so of the original form of the head. The first question which suggests itself is whether this distortion was caused by a system of artificial pressure and bandaging during life, or by posthumous changes. That the distortion was posthumous I believe we have ample proof. In the three cases described the change is comparatively slight. The distortion is frequently carried further, though still in the same direction, till the deformity produced is evidently inconsistent with life; before this occurs, however, the sutures most usually give way, and the skull falls to pieces. When this has been the case, it has often been found that still further changes have taken place in the form of the individual bones, and that they will not fit at the sutures, when put in position. This circumstance has already been adduced by Mr. Davis as an argument in favour of posthumous changes in the form of bones. To my mind, however, we have the most absolute proof in the systems of cracks traversing the bends. These cracks have perfectly sharp edges, so that they could not possibly have been produced by slow pressure during life. They are almost microscopic where the curve is slight, increasing in width and depth with the abruptness of the bend, and in some cases the bone has given way along their course, breaking short off. They are evidently the result of unequally supported pressure, on dead bone, reduced to an imperfectly plastic condition. The change in form was then posthumous, due to tomb-pressure, and the range of inquiry is narrowed to the two questions: What circumstances reduce the thin bones of the skull to that peculiar plastic condition in which they are softened without being disintegrated, and bent without giving way at the sutures? And what cause has given the subsequently applied pressure, this uniformly oblique direction, producing under the most diverse circumstances the same regular irregularity?

The first question need not detain us long. It is well known that thin bones when long macerated become quite soft, and can of course be bent. Still, as the posthumous distortion of bones is undoubtedly an exceptional process, it may be well to glance at the physical and chemical circumstances which seem favourable to its occurrence. To give a distorted skull, the bones must clearly be reduced to a certain condition of plasticity, and yet they must retain enough of their original character to harden and set when dried. To produce this result a certain amount of the organic matter must still remain in the bone, and the bone may be altered in one or in both of two ways; either the whole bone may be partially decomposed, a part of the mineral and a part of the animal matter being replaced by water, and the bone thus softened, a process which will render the bône more and more friable until it is thoroughly disintegrated, or, under exceptional circumstances, a large part, or the whole, of the mineral matter may be dissolved out, and the animal matter at the same time preserved, the bones thus become light and flexible and yet they retain their integrity, The first of these is the ordinary case of the rotting of bones in a damp churchyard. I shall give one extreme case of the second, to show, not only that the process occurs, but that it may be carried to an almost indefinite extent. The late Rev. Prof. Fleming of Edinburgh had in his possession a head of Bos longifrons (*Owen*) taken from a bog in the south of Scotland, only weighing a few ounces, and, when damped, as flexible as a piece of leather. In this case the mineral matter had been almost entirely removed by some acid produced probably by the fermentation and heating of a portion of the moss, while the animal matter remained tanned and preserved by the antiseptic principles in solution in the bog water. The condition of the distorted skulls may probably be frequently produced by a compromise between these two processes. The bones are imbedded in mould, frequently peat or virgin soil, containing a large proportion of vegetable matter, and probably enough of tannin to retard the decomposition of the chondrine—while the fluids percolating through the soil, highly charged with carbonic acid, the product of the decomposition of the vegetable matter, and containing various salts in solution, must gradually decompose and remove the inorganic constituents, thus increasing the flexibility of the bone. My friend Dr. Henry Johnson of Shrewsbury, who has carefully analysed the bone of the Orchard skulls, puts great faith in the peculiar properties of humic acid.* I find the information on this point somewhat obscure. It may be sufficient at present to indicate the general results, without attempting to trace the actions of the several re-agents.

Notwithstanding their undoubtedly great age, the Orchard skulls

* Dr. Johnson, in a paper lately read before the Royal Society, and of which a notice will be found in the Royal Society Proceedings, for 1862, states that he believes that free nitric acid also exists in the soil of the Wroxeter cemetery.

do not differ much in chemical composition from recent bone. The inorganic matter (73.243)* is apparently greatly in excess, but its proportion is increased by a considerable quantity of fine silicious sand, which has sifted into the cancelli. Allowing for this infiltrate, we may regard the amount of organic matter (26.757) as little below the average. It is most likely that all the constituents of a given portion of bone have been slowly and pretty equally reduced.

The relative amount of organic matter in these bones from the Orchard; in a bone of the short-horned ox, in the ordinary state of preservation from the marl at the bottom of an Irish bog (Postpleistocene) (37.221); in a bone of the same species, domesticated by the Romans (A.D. 300) at Uriconium (20.172); in the bone of an Irish elk (Postpleistocene) (37.2)—seems clearly to show the extremely limited value of a theory such as that of M. Couèrbe (quoted in the *Lancet*, Feb. 22nd, 1862), that bones lose 3 per cent. of organic matter in a century. Possibly such a generalization may apply to bones slowly decaying in dry air in a stone coffin, but in the case of buried bones the proportion of their organic to their inorganic constituents, at the end of a hundred or at the end of ten thousand years, would depend entirely upon the circumstances of their burial.

In this discussion I have purposely omitted the possible case of bones being first distorted and then fossilized. This double change occurs in some mammalian remains from the French tertiaries, but no cases have as yet been met with which bring it within the scope of the present inquiry.

The question as to the cause of the constancy in the style of deformity is one of rather greater difficulty. As I have stated above, the skulls presenting this peculiar distortion have all, so far as I am aware, been found surrounded, supported, and filled with vegetable mould. Some of them—for example, those from the Orchard at Uriconium—had undoubtedly been buried at once in the soil without any coffin or external defence, and it is very probable that all may have been interred either in this most simple way or in rude stone chambers, which were either filled up with earth at the time of burial, or into which the soil shortly afterwards drifted. We may then conclude that in all, before the body was thoroughly decomposed, the head was supported in the position which it had assumed at the time of burial.

A glance at the position of the heads on the slate slabs of a dissecting-room will show at once, not only that it is a matter of some delicacy to poise and support the head vertically on the apex of the occipital protuberance, on a plane surface, a delicacy which our ancestors were little likely to attend to in their ruder forms of burial, but that the heads tend to fall over to either side, and to remain

* For careful and valuable analyses of these and other bones, fossil and subfossil, I am indebted to my friend Dr. McCrea, chemical assistant in Queen's College, Belfast. As Dr. McCrea means to continue his researches, I shall leave the details of his results to be given by himself in a future paper.

inclined at something like a definite angle varying from 25^0 to 30^0. The articulations of the neck, from their structure, only yield to a certain extent, thus defining the angle of inclination, which may be modified, however, within certain narrow limits by the state of the soft parts of the individual, and by the form of the occipital bone. It may possibly reach its maximum in the Celtic head, in which the occipital protuberance is usually conical and strongly marked. The vertical point of a skull resting carelessly in this natural position would be removed from the centre of the frontal bone to a point above and somewhat within the outer angle of the orbit, and midway between the superciliary ridge and the coronal suture.

Pressure is principally applied vertically to bones buried in loose soil, and the tendency is for bones and soil together to be compressed and to set downwards. The common form of distortion illustrated by the three above examples is exactly what would be produced were vertical pressure applied to the spheroidal skull, rendered somewhat flexible, and its walls supported by a yielding mass within, were the skull slightly weak along a line nearly coinciding with the coronal suture, and were the axis of vertical pressure to be represented by a line joining the lateral point indicated, on the frontal bone, right or left, with a point a little above the outer end of the superior curved line of the occipital, on the opposite side.

Such are the circumstances which seem to me to account sufficiently satisfactorily for this remarkable form of distortion. One or two further considerations suggest themselves. Another form of distortion, much more calculated to embarrass the ethnologist, and much less easily detected, probably exists more generally than we at present imagine. Frequently in ancient graves we have evidence that the head had been carefully propped in a vertical position. Heads so placed, and surrounded with soil, would be in exactly the same circumstances as to the effect of pressure as in the former case, only the axis of vertical pressure would pass through the centre of the frontal bone. The effect of pressure in this direction would be to flatten the frontal and the occipital bones, to bulge the parietals regularly out, and to shorten the skull. The head might be very considerably shortened by extremely slow and well-supported vertical pressure, especially after the separation of the maxillary bones and the rupture of the basi-occipital by the cervical vertebræ, frequently an early effect of pressure; without materially affecting the symmetry of the cranium. A force acting in this direction, however, would take the squamous sutures at great disadvantage, and might probably be much more effective than oblique pressure in breaking up the head.

Distorted skulls are frequent in connection with ancient sepulture; they are certainly not common in modern churchyards. The reason is obvious. Certain conditions are favourable to steady regular distortion. The head ought to be at once surrounded and supported by soil, and fine soil should sift into the cavity as the soft parts are decomposed. The soil should be spongy and moist, and the moisture should contain some antiseptic vegetable principle in solution, to prevent the too rapid decay of the animal matter. I do not say that distortions might not occur under other circumstances, but all these evidently favourable conditions exist specially in the peaty virgin soil which forms most barrows, and which fills most cists. The plan of modern burial is very unfavourable to any such chronic changes in form. The head receives no support in the coffin during the progress of decay. The moisture soaking through the rank earth of a grave-yard promotes instead of checking decomposition. There is no drainage or absorption, and bones and brain sink into one softening putrifying mass; and, finally, the head is relieved from all vertical pressure by the coffin lid, until either the bones have become thoroughly disintegrated, or until they are so dry and carious as to break rather than to yield. Of course, the undeformed skulls in vaults and catacombs do not enter into the question, as they have been subjected to no vertical pressure.

I am well aware that this short notice is anything but exhaustive. I believe, however, that the subject is worthy of some investigation, and I mean to take every opportunity of extending observation and of increasing our meagre stock of facts. It is my present conviction that many, most probably all, of the old skulls which have been found in Europe, and whose distortions have been referred to artificial compression during life, will be found to owe their deformity to some variety of tomb-pressure.

P.S.—The above communication was in the hands of the publishers before the appearance of the last number of the "Review," but too late for publication. I, therefore, had not the advantage of Mr. Davis' ingenious paper, a paper which derives additional value from the author's great experience.

Mr. Davis believes that he can thoroughly eliminate the results of posthumous pressure; it is remarkable, however, that the *parieto-occipital flatness* referred by him to the use of cradle boards, should correspond so perfectly with a form of distortion which I had not had an opportunity of studying, but whose frequent occurrence I had anticipated from a totally different cause.

In discussing the subject of posthumous distortion, the question has frequently arisen—Why is the distortion usually so slight? Why, when the depressing force has been sufficient to alter the form of a series of bones, individually so strong, and so firmly united together, has it not gone on to its complete disruption? It must always be remembered that, in most cases, the head has been completely surrounded and filled, supported from within and from without by soil; that, therefore, no compressing force was applied to the skull alone, but that the compression or subsidence acted equally upon the whole mass, skull and soil. Sand, or soil consisting entirely of inorganic matter, is capable of but little compression. Vegetable soil, on the other hand, and especially peaty or virgin soil, may be considerably compressed, but the process is a slow one, depending upon the gradual decomposition of a part of the vegetable matter, and has a very definite limit.

A grave is naturally frequently sunk till the digger reaches a harder layer of soil, which forms a *point d'appui* for the back of the skull, or, in a cist, the occiput rests upon a stone. Resistance is thus offered to the forcing of the whole head downwards, and the compression of the skull is limited by the amount to which the bed of loose soil thrown or drifted in, immediately round it, is capable of subsidence.

I have lately been assured, however, that some of the Orkney skulls in which this characteristic obliquity is clearly marked, have been found in cists which have not been filled up with soil or sand. Such instances, if authenticated, would suggest the solution, that in the case of a body slowly decomposing in a damp situation, the bones of the head may become so thoroughly softened during the putrefaction of the soft parts as to subside slightly. The subsidence would of course be vertical, and its direction in reference to the form of the skull would depend as before upon the position of the head at burial. The process would be limited by the total decomposition and removal of the soft parts, the skull being left comparatively dry.

XXXVIII.—On the Germination of Reticularia umbrina, Fr. By Frederick Currey, M.A., F.R.S. Sec. L.S.

Reticularia umbrina is a fungus too well-known in this country to require any introductory description or comment. It belongs to the Myxogastres, a family which has lately attracted considerable interest on account of the attempt of Dr. De Bary to transfer the plants belonging to it to the animal kingdom. One of the most striking peculiarities observed by that author was the peculiar mode of germination of the spores of many of the species. Instead of protruding in the first instance colourless filaments, as is the case with almost all fungi in which germination has been observed, De Bary noticed that in several of the Myxogastres, the contents of each spore escaped in the form of a single zoospore. The plants mentioned by De Bary as those in which he had observed these zoospores are the following, *Æthalium septicum*, *Physarum albipes*, *Stemonitis fusca* and *obtusata*, *Arcyria punicea*, *Trichia rubiformis*, *pyriformis*, and *varia*, *Lycogala epidendron*, and *Reticularia umbrina*. There seems, however, some little doubt about the latter species, for in his introductory notice in the Botanische Zeitung (1858), the plant was called *Reticularia maxima*, and moreover the description of the spores at p. 153 of the paper in Siebold and Kölliker's Zeitschrift does not accord with the spores of *Reticularia umbrina*, as I have observed them in this country. The writer there says that in the spores of this species, one half (or nearly so) of the membrane is much more delicate than the remaining portion, the line of demarcation between the two portions being sharply defined. In all the spores of *Reticularia umbrina* which I have examined, I find the membrane of one uniform thickness.

At the time when De Bary's observations were made, the existence of zoospores in fungi had not been ascertained, but they have since been found to occur in the common white rust of the Cruciferæ (*Cystopus candidus* Lev.), and in *Peronospora*.

Of course the discovery of zoospores in other fungi diminishes the importance of the fact of their existence in the Myxogastres, but it is still a matter of considerable interest to ascertain whether the phenomenon is general, for out of about 250 species of which the tribe consists, the zoospores have as yet not been observed in more than a dozen, a number hardly sufficiently large to justify the general inference of uniformity in germination which De Bary seems inclined to draw.

I have lately had the opportunity of examining fresh specimens of *Reticularia umbrina*, and of experimenting upon their germination. The spores are of a brown colour and globular shape, they are very small, their diameter being only 0.0003 inch. The outer membrane is echinulate, but the prominences are exceedingly minute, and can only be clearly made out under a high power of the microscope. I placed some spores in a drop of water on a glass slide over night, protecting the latter from evaporation by a bell-glass. On the following morning the contents of many of the spores had escaped in the form of colourless globular vesicles without motion, but when exposed to the sun the shape of the vesicles changed, and they assumed the form of the zoospores figured by De Bary in his Pl. vii. fig. 3 *d d'*, and Pl. viii. fig. 7 *d*, as occurring in *Æthalium septicum* and *Arcyria punicea*.

Their size varied but little, the average length being about 0.0005 inch. After becoming elongated, they exhibited an active wriggling motion, but no motion of rotation, such as is mentioned by De Bary. Their movements were confined to a very limited space; they did not travel about over the field of the microscope like the zoospores of Algæ. I am doubtful whether they possessed one or two cilia; it is possible the number varies.

Sunlight and warmth appear to have a strong effect in hastening the germination, for a few days after the above experiment I took some spores from another specimen of *Reticularia umbrina*, and placed them at once in full sunshine protected as before. In very little more than three hours the zoospores were produced in the greatest profusion. Their number was much greater than on the former occasion; by far the greater part of them agreed exactly in form and motion with those which I had previously observed. A few however were of irregular amæboid shape, similar to those shown in De Bary's Plate vii. fig. 7 and 8. I did not ascertain whether these latter ever resumed their ordinary outline. Although most of the zoospores had become quiescent, a few were still active after the lapse of 48 hours: beyond which time I was unable to carry on my observations. Many, if not most, of the zoospores exhibited a vacuole at the thicker end, but owing to their constant motion it was impossible to ascertain whether this vacuole was contractile or not.

XXXIX.—Reply to the Remarks on the Translation of the First Chapter of Aristotle's History of Animals. By the Rev. W. Houghton, M.A., F.L.S.

The critical observations that appeared in the last number of this Journal on the translation of the first chapter of the History of Animals are an admirable commentary on the truth of my remark, (No. VI. p. 140) that "it is unreasonable to suppose that even a small portion of the History of Animals can be fully understood and accurately interpreted, until all that Aristotle has written, which bears on the subject, has been thoughtfully digested." They are so in a two-fold manner; in the first place because the "Remarks" very justly and deservedly censure one or two undoubted errors in my translation, and in the second, because they contain not a few themselves.

Without then attempting to offer any excuse for "nerve" being given as the rendering of *νεῦρον*,—for it is an error I frankly own,—and acknowledging also the vague and un-Aristotelian translation of *παρὰ τὰς τῶν παθημάτων ἐναντιώσεις* by "according to their capabilities of distinction," I proceed to make a few comments on the other criticisms of the Reviewer.

The rendering of λιμναῖα by "salt-water marshes" is condemned as an error; "there is not," says the writer, "a word about salt-water in the original; the proper rendering is 'lakes'; if the translator had turned to vi. 13, he would have found that if salt-water marshes be correct then the Perch, the Carp and the Silurus are marine fishes," (p. 331). Now, if such an argument be allowed, it follows by parity of reasoning, that the oysters which were kept in *λίμναι* and termed *λιμνόστρεα* (iv. 4. § 3; v. 13. § 9,) are freshwater animals.* The fact of the matter is that *λίμνη* may mean either, "a salt-water," or "a fresh-water marsh or pond;" the former is pro-

* Since this paper was written I have had access to Spratt and Forbes' valuable work on Lycia, and accordingly insert the following extracts, which bear on some of the Greek names of animals under discussion.

"The *λιμνόστρεα*, fixed and spiny and of the oyster kind, was the *Spondylus* common enough in the Greek seas," (*Travels*, ii. p. 112). The Reviewer is welcome to either opinion.

bably the original signification of the term, as from λιμήν, like the Latin *æstuarium*: at any rate there is no inaccuracy in the rendering, even though Aristotle be understood to be speaking of "ponds" or "lakes," as the Reviewer ought to have known.

The next complaint is, that "the Greek word ἰλυσπαστικά is strangely enough translated 'wriggling'; if we consult the treatise *de Incessu*," it is added, "we find it signifies to crawl like an earthworm, and expresses the mode of progression of gasteropods, caterpillars and worms." Not being acquainted with the term, I was content to take the meaning given in Liddell and Scott's Lexicon. There should not be any thing to excite surprise in the mind of an ordinary individual, in the fact that I did not know that the Greek word occurs in the Treatise *de Incessu*, seeing that I made no pretence to any profound acquaintance with all Aristotle's physical works.

It is worthy of note, that when the Reviewer mentions other treatises besides the *Historia Animalium*, he omits to give the references.* However, I have gone carefully through the *de Incessu*, and find the Greek word in question mentioned once, viz., in cap. ix. Vol. i. p. 709, Ed. Bekker. Aristotle is speaking of the mode of progression in footless animals; I give the passage itself in full,—*τὰ δ' ἄποδα τὰ μὲν κυμαίνοντα προέρχεται (τοῦτο δὲ διττῶς συμβαίνει· τὰ μὲν γὰρ ἐπὶ τῆς γῆς, καθάπερ οἱ ὄφεις, τὰς καμπὰς ποιεῖται, τὰ δ' εἰς τὸ ἄνω, ὥσπερ αἱ κάμπαι), ἡ δέ κύμανσις καμπή ἐστιν· τὰ δ' ἰλυσπάσει χρώμενα, καθάπερ τὰ καλούμενα γῆς ἔντερα καὶ βδέλλαι. ταῦτα γὰρ τῷ μὲν ἡγουμένῳ προέρχεται τὸ δὲ λοιπὸν σῶμα πᾶν πρὸς τοῦτο συνάγουσι καὶ τοῦτον τὸν τρόπον εἰς τόπον ἐκ τόπου μεταβάλλουσι.* "Now of footless animals some proceed by undulations of the body, which may be done in two ways; for some make their inflexions on the ground like serpents, while others do so in an upward direction like (some) caterpillars; but the undulation here spoken of is an inflexion; others use an *ilyspastic* mode of progression, *like what are called the entrails of the earth and leeches*,—for these animals advance with the anterior part of the body, and draw together all the rest of the body to this part, and in this manner go from place to place." Here then we see that the *ilyspastic* method of progression is that which is adopted by leeches, and what are called "the entrails of the earth;" what these latter may denote I have been unable to ascertain; certain, however, it is that they are distinct from earthworms; Aristotle couples them with leeches, and says, they adopt a similar mode of progression. Whence then, I ask with reasonable surprise, does the Reviewer get his earthworms, gasteropods, caterpillars and worms? The *ilyspastic* mode of progression is clearly that which is so familiarly known as being characteristic of the *Hirudinidæ*. If my error of rendering

* The interesting passage in the *de Anima* (ref. ?) respecting Empedocles and analogous parts, I have been unable to discover in that Treatise.

ἰλυσπαστικά by "wriggling" is surprising, what must be the Reviewer's correction under the circumstances of the case?

The Greek word is etymologically derived, I have not the slightest doubt, from εἰλύω, (akin to εἴλω) "to fold up or enwrap," and σπάομαι, "to draw one-self up"; the combined term well expresses the mode of progression of leeches and "geometric or looping" caterpillars. I cannot agree with Mr. Cresswell, who renders the term by "creeping in the mud" (as from ἰλύς), because this would come rather under the category of "where" than "in what manner," and is far too indefinite to express the peculiar mode of progression of the leech family.*

Another matter of surprise is occasioned by the supposition, "that the translator should find any difficulty respecting the two well known words γένος and εἶδος of such frequent employment in the writings of Aristotle, and so familiar to both naturalists and metaphysicians." I can assure the Reviewer that I had no difficulty whatever in understanding the precise meaning of both these terms. As to γένος it is certain that Aristotle uses it to denote either 'a class,' or an 'order,' or a 'genus;' but where the ancient Philosopher has only two distinct terms, and modern Zoologists so many to express the various divisions in the animal kingdom, it is not so simple a matter as is supposed to render the Greek term correctly in every instance; Mr. Cresswell's recent translation, excellent as I believe it to be, will afford illustrations of the truth of this remark. As to εἶδος, I am aware, that when Aristotle uses this term in what we should call a scientific sense, it differs in no respect from the 'species' of the modern Zoologist, but he does not always so employ it. Thus, (i. 6. § 3) he speaks of many forms (εἴδη) of viviparous quadrupeds, which are without "recognised generic names," as Dr. Whewell† well translates ἀνώνυμα. It is clear that εἴδη in this passage is not to be restricted to 'species,' because Aristotle speaks of these εἴδη (§ 1.) as having specific differences, and seems to regret that they are, with the exception of the λόφουρα (*Equidæ*), without names, by means of which the groups might be respectively characterised.‡

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* See *Etym. Mag.* s. v. ed. Gaisf. ἀπὸ τοῦ εἰλεῖσθαι καὶ σπᾶσθαι. The form ἰλυσπᾶσθαι (ῖ for εἰ) led Lexicographers to doubt the etymology. *See* Stephani *Thes.* and Hesych. Lex. s. v. Josephus (*Antiq.* i. 4.) uses the term as expressive of a serpent's mode of progression.

† *Hist. of the Induct. Sciences*, iii. p. 292. Ed. 1857.

‡ "I ought also to remark that, although Aristotle has exemplified groups of animals which agree with many of the modern classes, orders and genera, their relative value is not so defined; and his, in most respects, natural assemblages would have commanded greater attention and been earlier and more generally recognised as the basis of later systems, had its immortal author more technically expressed an appreciation of the law of the subordination of characters; but Aristotle applies to each of his groups the same denomination, viz. γένος, genus; distinguishing, however, in some cases the greater from the less."—OWEN, *on the Classification, &c. of the Mammalia*, p. 3.

I am next informed that I have completely misunderstood the whole of the passage respecting analogous parts, an evidence whereof, it is assumed, is to be found in my rendering of χεὶρ πρὸς χηλήν by "a hand with a claw;" "it should be," we are told, "a hand with the forceps of a crab, both analogous as to function" (p. 332). What authority has the Reviewer for thus restricting the analogy? χηλή denotes the claw of various animals, and though it may be that Aristotle's mind more particularly adverted to a crab's claw, yet the analogy holds *equally* good in the case of some other animals, as of a scorpion for instance, and, in short, is applicable to any animal which uses its χηλαί as a man his hands, πρὸς τὸ λαβεῖν καὶ κατασχεῖν ἀντὶ χειρῶν.* I confess that I had in view when I made the translation the forceps of a crab as the χηλή in question; I have often watched the droll manner in which crabs use their claws, and been struck with the analogy here mentioned by Aristotle. From the remark of the Reviewer it would appear that in his opinion no other animal but a crab has claws which may be considered as analogous to hands. If Aristotle was acquainted with any kind of parrot† he could not fail to have been struck with the analogy between a χείρ and the χηλή of a bird. In the *de Partibus* (iv. 12. p. 692), Aristotle compares the proboscis (μυκτήρ) of the Elephant with a hand. See also *Hist. An.* ii. 1, § 2. Again, in the *de Partibus* (iv. 8. p. 685), the arms of some of the *Cephalopoda* that are furnished with sucking discs (κοτυληδόνες), are regarded by Aristotle as analogous to hands; and there is a passage in the *Hist. Anim.* (ii. 1. § 2) which it is a pity the Reviewer had not seen, where Aristotle compares the divided fore-feet of quadrupeds to hands. Ἔχει δὲ τὰ τετράποδα ζῶα καὶ ζωοτόκα ἀντὶ τῶν βραχιόνων σκέλη πρόσθια, πάντα μὲν τὰ τετράποδα, μάλιστα δ' ἀνάλογα ταῖς χερσὶ τὰ πολυσχιδῆ αὐτῶν· χρῆται γὰρ πρὸς πολλὰ ὡς χερσί. From this it is quite clear that the analogy between χείρ and χηλή must not be restricted to such as exists between a hand and the forceps of a crab; perhaps the crab's claw is the best type to be taken in illustration of the simile, but the analogy is evidently one of "more or less;" the manner in which the rapacious birds use their claws must also not be entirely left out of the ques-

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* *De Part. Anim.* iv. 8. i. p. 683. Ed. Bekker.

† There is reason, however, to believe, that Aristotle was not personally acquainted with any kind of Parrot. From the manner in which he speaks of "the Indian Bird" (*Hist. Anim.* viii. 14. § 6), it would appear that his knowledge was derived from hearsay. With the later Greeks and Romans, it is well known, parrots were great favourites. The kinds with which they were acquainted belonged chiefly to the genus *Palæornis*, Vig., of which the *P. Alexandri* and *P. torquatus* were perhaps the best known species. See Mr. Vigor's interesting paper "On a group of Psittacidæ known to the Ancients" in Sowerby's *Zool. Journal*, ii. p. 37. Strack, Külb and Cresswell identify Aristotle's 'Indian Bird' with the Grey Parrot (*Psittacus erythacus*), a species strictly confined to Western Africa!

tion, though I do not remember that Aristotle draws this comparison in their case; though their χηλαί are in every sense to them ἀντὶ χειρῶν πρὸς τὸ λαβεῖν καὶ κατασχεῖν.

I must not omit to notice another rendering which, though not mentioned in the 'Remarks,' was condemned by a writer in the *Saturday Review*, when Mr. Cresswell's recent translation was criticised; the rendering in question was that of Aristotle's ὀστοῦν πρὸς ἄκανθαν by "a bone when compared with a spine." "There is no analogy," it was said, "between a bone and a spine." I confess that my idea of 'spine' was that of a 'spinous bone' of a fish, and that the Greek ἄκανθα had this meaning rather than that of "a back bone," or "spinal column." I was in error, however, and so was the writer in the *Saturday Review*, as I shall demonstrate. The Greek ἄκανθα does properly denote the backbone of a fish (or a serpent), and not an isolated spinous bone. I have referred to various passages in Greek authors where the word occurs, and find the above statement is correct; but we must confine our attention to Aristotle, who says (iii. 7. § 6), τὰ δ' ᾠοτοκοῦντα ἄκανθαν ἔχει, ἥ ἐστιν ὥσπερ τοῖς τετράποσιν ἡ ῥαχις,—"oviparous fish have a *spinal column* like the backbone of quadrupeds," *i.e.* they have an *osseous* vertebral column (*Teleostia*), and not a *cartilaginous* one like the viviparous fish (*Selachia*); the small disconnected bones of fish (κατὰ τὴν σάρκα κεχωρισμένα) are called ἀκάνθια; now, in order to express the analogy, we must understand ὀστοῦν to denote not a disconnected bone, (indeed Aristotle says the bones depend on one bone and are connected, there is no such thing as a separate bone (iii. 7. § 1,) but the connected series of vertebræ which form the spinal column, or *backbone*. Aristotle draws the analogy from living animals, and the comparison lies between the whole vertebral column, and not any separate bone, and ὀστοῦν must be understood in this sense, in order to render the analogy intelligible and the translation accurate.*

As to the difficulty attending the satisfactory solution of what the ἀκαλήφη denotes, I have to observe that I am only one amongst many who have been unable to arrive at the conclusion that some *Actinia* is *always* denoted, and never a *Medusa*. Over the same "stumbling-block" even Cuvier tripped. As to the quotation from Archestratus, it merely proves that the Acalephæ he was speaking of were Actiniæ, which nobody ever denied; but it does not prove that the Acalephæ of Aristotle and other Greek and Latin writers can *never* denote any of the Medusæ. The uniform manner in which ancient authors speak of the stinging properties of the animal, and the very etymology of the term, may well incline us to believe that in some instances the Medusæ must be intended, for stinging properties, as far as relates

* See also *Poster. Analyt.* ii. 14, where Aristotle mentions the analogy between ὀστοῦν, ἄκανθα and the σήπιον, "bone of the cuttle-fish."

to their being handled, are scarcely appreciable in the case of the Actiniæ, unless it be to a few tender-skinned ladies.*

The following piece of criticism is interesting on account of its curiosity.

"The Holothuria has also been misunderstood by the translator. It is a Medusoid animal, and has no relation to the animals which have obtained that name in modern times. . . . . The free Holothuria and the adherent sponge agree in this, that they are incapable of locomotion. *If this is not strictly true of the Medusa, it holds good of some other animals!*" In other words, the Holothurion *is* a Medusoid animal, but it *is not*, because this latter creature is capable of locomotion; therefore it must be something else!

There was nothing extraordinary in my suggesting that the ὁλοθούριον might signify either the Echinoderm of that name, or the *Alcyonium digitatum*. I am more inclined to the latter opinion, because the possible etymology of the term (from ὅλος, "whole," and θύριον, "a little door,") may be of some small value in helping us to refer it to the *Alcyonium*, with its numerous little polygonal depressions.†

The Reviewer then proceeds to notice "two other mistakes:" he gives us, however, only one (?) "The gnat and the *oistros* are not different animals, but different states of the same animal." Why, then, does Aristotle name both the gnat (ἐμπίς) and the οἶστρος together as dipterous insects which have a sting in their head? (i. v. § 5.)

Scarcely less satisfactory is the Reviewer's attempt to explain Aristotle's opinion with regard to the animal nature of the sponge;

* "The ancient Greeks included under the name of *Acalephæ* both the Medusa and the Actinea; and, indeed, they closely approach in organization. When, however, we are told by Aristotle, after he has distinctly described the common rock-inhabiting *Actineæ*, that there is a kind which detaches itself at night from the rocks, we must not suppose (as has been hitherto conjectured) that he confounded the two animals—the floating *Medusa* and the fixed *Actinea*—and had mistaken the former for a state of the latter. In the Greek seas, and especially on the coast of Lycia, there are true *Actineæ*, which are equally at home fixed to the rock and swimming about the sea, even far from land." (*Trav. in Lycia*, ii. p. 120.) The authors have figured some species of floating *Actinea*, of which also an interesting account is given (p. 121).

† "The Holothuriæ are exceedingly sluggish creatures, but scarcely so much so as to permit our considering them to be identical with the creatures called *Holothuriæ* by the ancients, which are said by Aristotle to be motionless and of a nature between the animal and the plant, and to differ from sponges only in their being detached. May he not have had in view the large, round, sponge-like *Spongodium*, living free on the sea-bed, and abundant in the Greek seas? This is the more likely, since (in the fourth book and eighth chapter of the 'History of Animals,') he mentions the *Holothuriæ* of modern naturalists distinctly, when he states that experienced fishermen assert they have speared, when fishing, black, round, cylindrical animals like pieces of wood; a description which cannot be mistaken, since it exactly applies to the common Greek sea-cucumbers."—*Lycia*, pp. 117, 118.

indeed, utterly untenable is his theory that the *Aplysias* is the *Alcyonium digitatum* or some allied species, as I shall show by-and-by.

"With respect to the sponges properly so called," the Reviewer remarks, "we think Aristotle's opinion is that they *are* truly plants, *παντελῶς ἔοικε τοῖς φυτοῖς*."* Now, first of all, I submit that *ἔοικε* denotes "resemblance," and not "identity;" and in the second place, that it is quite evident, from a comparison of the different passages where Aristotle speaks of the sponge, that he could not say to which kingdom it belonged, because he thought there were living things which did not belong exclusively to either the animal or the vegetable kingdom, but which partook as it were of the nature of both,—*ἡ γὰρ φύσις μεταβαίνει συνεχῶς ἀπὸ τῶν ἀψύχων εἰς τὰ ζῷα διὰ τῶν ζώντων μὲν οὐκ ὄντων δὲ ζῴων, οὕτως ὥστε δοκεῖν πάμπαν μικρὸν διαφέρειν θατέρου θάτερον τῷ σύνεγγυς ἀλλήλοις.* "Nature passes in unbroken series from inanimate to animate objects, through living things indeed which, however, are not animals, in such a manner that the one appears to differ in no respect from the other by reason of their continuity."† Again, in the *Hist. Anim.* viii. i. § 3. "The transition from plants to animals proceeds in an unbroken line, as was stated before, so that one might doubt whether some marine things are animals or plants."‡

As to the *Aplysias* which in the "Remarks" is so readily referred to the *Alcyonium digitatum*, there cannot be a doubt that it is some kind of veritable sponge. Aristotle (ii. 14, § 2—6), is speaking of various kinds of sponges, and thus describes the *Aplysias*. "There is another kind which people call *Aplysias*, because it cannot be washed; it has large pores, but in other respects the substance is compact; when cut in two it is more compact and sticky than the sponge; the whole resembling lung; this kind is confessed on all sides to have sensation and to be long lived. They are readily discerned in the sea near the sponges, from these being white as the mud settles upon them, while the *Aplysiai* are always black." It seems clear that the *Aplysias* is a sponge from the following considerations. (1.) Because the comparison is made between it and sponges, and it is described as having large external pores with a

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* Aristotle (*De Part.* iv. 11. ed. Bek) uses a still stronger expression than the above; *οὗτοι γὰρ πάμπαν ἔχουσι φυτοῦ δύναμιν.* But even this cannot be interpreted, when taken in connection with his other remarks, to mean, that sponges *are* plants.

† *De Partibus*, iv. 5. p. 681. ed. Bek.

‡ "The sponge-fisheries were probably conducted among the ancient Greeks as they are now. Hence, information being obtainable with facility, we find a full account of the sponge in the writings of Aristotle. He appears to have been deeply interested in his history, *on account of the link it seemed to present between the animal and vegetable natures. Therefore the question whether sponges possessed sensation is discussed by him more than once, and left undecided.*"—*Lycia*, ii. p. 126.

dense internal structure. (2.) Because being mentioned with sponges the meaning of the term ἀπλύσιας, "that which cannot be washed," is a strong argument that some sponge, useless perhaps in a commercial point of view, is indicated. It is absurd to suppose that the *black* Aplysias can be represented by the *white* or *cream coloured Alcyonium digitatum*, or that the Greek name should ever have been given to any species of *Alcyonium;* neither can the *large* pores attributed to the *Aplysias* be supposed to indicate the *small* depressions of the asteroid polype, thus so erroneously sought to be identified with it.*

I have only one more remark to notice. "When it is remembered," we are told, "that the Alcyonium is endowed with motion and sensation, Aristotle's discussion respecting the nature of the sponge becomes intelligible." I do not see the force of this argument, because the "motion" attributed to the *Alcyonium* must refer, of course, to the movement of the Polypes within the cells, and not to the entire mass, which is no more endowed with locomotion than the sponge; unless Aristotle had observed the Alcyonium in a vessel of sea water or shallow rock pool, he could not have witnessed the movements of the polypes here spoken of; and if he had seen the curious spectacle he would have had no doubt of the animal nature of the substance, and would probably have made some mention of the interesting sight afforded.

Aristotle's treatises on Natural History are to be understood only after long and pains-taking research; my object in publishing a paper on the subject was, as I stated, to stir up in the minds of Naturalists a desire to possess an English translation, (which, thanks to Mr. Bohn and Mr. Cresswell, we now possess), the translation and notes were expressly admitted to be *provisional*, and they, with the "Remarks" in the last "Review," are a striking illustration of the real difficulties a translator must experience who cautiously and honestly sets about the work.†

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* "Aristotle distinguishes sponges under two heads, those that might be cleaned and those which could not. Of the last, he states that their substance was compact, but perforated by large canals. They were more viscous than other sponges, and when dried remained black. *The description exactly applies to the common coast line sponges of the Aegean, useless for economic purposes.*"—*Lycia*, ii. p. 127.

† I may state that the whole of this paper was written before I had seen either Strack's or Külb's German translation, or the "Travels in Lycia" by Spratt and Forbes.

Botanical Bibliography.

XL.—PHANEROGAMIA.

ALEFELD, Dr.—Ueber Vicieen. Bonpl. 1861. pp. 66, 99, 116, 139.

With a proposed distribution of the group into tribes and sub-tribes and a Synopsis of the Species, with descriptions in German. Observations upon the germination of the *Vicieae* precede the descriptive portion of the paper.

——— Ueber die beiden *Orobus venosus* (Mühlenb. und Al. Braun.) Bonpl. 1861, p. 211.

——— Ueber *Pisum frigidum*, Alf. Bonpl. 1861. 236.

Now *P. formosum*, the author having identified his plant with *Orobus formosus* of Steven.

——— Ueber *Juglans*, L. Bonpl. 1861. p. 434.

The American species (*J. nigra*, *J. cinerea*, &c.) constitute a distinct genus—*Wallia*, based upon slight differences in the pericarp.

——— Ueber *Cicer Soongoricum*, Steph. p. 348.

——— Die Embryolage einiger Papilionaceen. Bot. Zeit. 1861. p. 129.

——— Ueber *Hibiscus Lampas*, Cav. Bot. Zeit. 1861. p. 297.

Hibiscus Lampas, and two allied species, are raised to generic rank under the name *Azanza*. The author considers his new genus nearer to *Thespesia* and *Gossypium* than to *Hibiscus*.

——— Ueber die Stellung der Gattung *Gossypium* und mehrer andrer. Bot. Zeit. 1861. p. 299.

Gossypium, *Fugosia*, *Thespesia*, *Sturtia*, and *Azanza* constitute a Tribe (*Gossypiidae*) referred to Bombaceae.

AMO, M. DEL.—Sobre la distribucion geográfica de las familias de las plantás cruciferas, leguminosas, rosáceas, salsoláceas, amentáceas, coniferas y gramineas de la Peninsula Ibérica. Mem. Ac. Cien. Madrid. V. 223.

ASCHERSON, P.—Die Zweifelhaften Gefässpflanzen des Vereinsgebiets. Verh. Bot. Ver. Brandenb. Hft. ii. p. 124.

——— Die Wichtigeren im Jahre 1860 entdeckten und bekannt gewordenen Fundorte in der Flora des Vereinsgebiets. Verh. Bot. Ver. Brandenb. Hft. ii. p. 159.

——— Einige Ortsnamen im Grossherzogthum Posen die von Pflanzennamen abgeleitet sind. Bonpl. 1861. p. 35.

ASHFIELD, C. J.—On the Botany of the Borders of Suffolk and Norfolk, near the source of the river Waveney. Phytol. 1861. 321.

BAKER, J. G.—Curator's Report for 1860 on Botanical Exchange Club. Thirsk, 8vo. pp. 20.

With remarks upon various critical British Species, and desiderata of the Club for 1861.

Babington, Chas. C.—Discovery of *Isoetes Hystrix* in Guernsey, announced in a Letter addressed to the Secretary of the Linnean Society. Linn. Soc. Proc. V. p. 188.

Grows in "damp spots on L'Ancresse Common."

——— On the Discovery of *Carex ericetorum*, Poll. as a native of Britain. Linn. Journ. vi. 30.

Gathered by Mr. Ball on the Gogmagog Hills, Cambridge.

Baenitz C.—Flora der östlichen Niederlausitz. Mit besonderer Berücksichtigung der Umgebungen von Neuzelle, Guben, Sommerfeld und Soran, zum Gebrauche auf Excursionen. Görlitz, 1861, 12mo. pp. 162.

Baillon, H.—Recherches organogéniques sur la Fleur femelle des Conifères. Ann. S. N. Ser. iv. xiv. p. 186. (Vide Vol. I. N.H.R. p. 92.)

——— Organogenic Researches on the Female Flower of the Coniferae (trans.) Ed. Phil. Journ. N.S. xiii. p. 184, with 1 plate.

——— Genera Euphorbiacea tria nova. Rec. d'Obs. Bot. i. p. 50.

Payeria, *Hasskarlia*, and *Sagotia* are the genera described.

——— Species Euphorbiacearum. A. Euphorbiacées Africaines, pp. 58, 139, 251.

Bureava and *Mareya* are the new genera described. Some remarks are added upon the African species of *Croton*.

——— Sur le Nectar sécrété par les glandes septales d'une Broméliacée. p. 87.

With treatment, by re-agents, of the nectar. No analysis is given.

——— Mémoire sur le Développement des Fleurs à Couronne. p. 90.

The genera treated of are *Peliosanthes*, *Narcissus*, and *Pancratium*. In opposition to the view of M. Gay, the author states that the corona at its first appearance is totally independent of the androecium, and that it is an expansion of the receptacle.

——— Énumération des Euphorbiacées cultivées dans les jardins botaniques de Paris. pp. 104, 340.

——— Organogénie florale de *Xanthium*. p. 117.

——— Description d'une Flacourtianée nouvelle. p. 120.

Eriudaphus Closianus—the *Sapium Drummondi* of gardens.

——— Considérations sur la Parthénogénèse dans le règne végétal. p. 124.

With observations on the fecundation, &c. of *Mercurialis*, *Bryonia*, and *Coelebogyne*, which the author does not consider to offer true Parthenogenesis.

——— Observations organogéniques pour servir à l'histoire des Polygalées. p. 174.

Referring to the Organogeny of *Monnina* and *Muraltia*.

——— Experiences sur des Boutures des Fleurs. p. 181.

Referring to the buds borne upon the inferior ovary of *Cacta-*

ceae, the author suggests whether horticulture might not imitate what in the case of this group occurs spontaneously. Dr. Baillon obtained young plants from the axils of the "ovarian" leaves from cross sections of the ovary of a Jussiaea placed under glass.

BAILLON, H.—Generum novorum quatuor descriptio. p. 184.

The genera are *Tandonia*, *Gavarretia*, *Wurtzia*, and *Regnaldia*; —all Euphorbiaceous.

——— Recherches sur l'organisation et le Développement des Éricoidées. p. 189.

Including *Monotropeae*, *Pyrolaceae*, *Ericineae*, *Cyrilleae*, *Epacrideae*, *Humiriaceae*, and *Sarraceniaceae*.

——— Note sur une nouvelle espèce du genre *Sorocea*. p. 212.

S. Klotzschiana, Spruce's No. 3794.

——— Mémoire sur le développement du Fruit des Morées. p. 214.

——— Sur une Bruyère a Gynécée monstrueux et sur le Placenta normal de quelques Éricinées. p. 287.

——— Note sur un Paradoxe de régularité dans les fleurs de la Limoselle. 305.

The occurrence of regular tetramerous flowers in *Limosella aquatica*, the posterior sepal being aborted and the two posterior lobes of the corolla connate.

——— Mémoire sur la Symetrie et l'organogénie florale des Marantées. p. 306.

With an account of the floral organogeny of *Thalia dealbata*; the development of the flower in *Calathea*, *Stromanthe* and *Maranta* is described as agreeing with it in essential points. The author regards the Marantaceae as having a regular double perianth, and three stamens in one verticil, each opposed to a segment of the corolla. Of these stamens, usually two, sometimes one, or exceptionally all three, split above, in the part corresponding to the anther, one division only becoming fertile and pollen-bearing. The arilliform thickening of the ovules of Marantaceae is due to a swelling of the primine.

——— Expériences relatives à l'absorption des Liquides par les Feuilles. p. 328.

With statements of the quantity of water absorbed by the leaves, plunged into vessels containing it while still attached to the tree.

——— Observations sur les Ovules des Anémones et de quelques autre Renonculacées. p. 334.

1. On the occurrence of ovules, abortive at an early stage in the development of the pistil, in *Anemone* and *Adonis*. 2. M. Baillon believes the Hellebores to have ovules with but a single coat, in opposition to M. Barnéoud's opinion that in all Ranunculaceae there are two. 3. The relative position of the micropyle, affording a character distinguishing Ranunculaceae from Dilleniaceae. 4. Memorandum on the two minute lateral glands at the base of the connective in *Anemone* and some Berberideae

suggesting that they may represent leaflets of a (compound) staminal leaf.

BAILLON, H.—Note sur un Lys et un Oeillet Monstrueux. p. 338.

In each case the floral axis had elongated bearing numerous leaflets, the sexual organs being abortive.

—— Organogénie florale des Roxburghiées. p. 245.

With brief observations on the affinities of the group.

—— Observations sur *l'Euphorbia paucifolia*, Kl. p. 291.

No. 1208 of Preiss's New Holland Collection, regarded as a new generic type.

—— Études sur l'Anatomie, la Physiologie et le Développement des Tiges et des Racines. p. 298

1. *Lemna minor*, showing its entirely cellular structure.

2. *Asparagus officinalis*, detail of the anatomy of the stem and root.

——Recherches sur l'organisation, le developpement et l'anatomie des Caprifoliacées. p. 353.

The genera are grouped under 6 types, viz.—With regular flowers: 1. *Leycesterieae*, stamens 5: cells of ovary pluri-ovulate. 2. *Sambucineae*, stamens 5: cells of ovary 1-ovulate. 3. *Symphoricarpeae*, stamens 5: cells of ovary 4, 2 1-ovulate, 2 pluri-ovulate. With irregular flowers: 1. *Lonicereae*, stamens 5: cells of ovary pluri-ovulate. 2. *Triosteae*, stamens 5: cells of ovary 1-ovulate. 3. *Linnæeæ*, stamens 4: ovary cells 3, 2 pluri- and 1 1-ovulate.

The wood structure of the Honeysuckle is described.

—— Organogénie florale du Sésame. Rec. d'Obs. Bot. ii. 1.

This is described in detail.

—— Monographie des *Phyllanthus* (continued), ii. 13.

—— Observations sur *l'Antholoma*, Labill. p. 21.

The structure of the flower is described. The author agrees with Planchon in referring the genus to Elæocarpeae. Analyses are figured.

—— Species Euphorbiacearum.—A. *Euphorbiacées Africaines.* 2me partie (suite), p. 27. An enumeration, with descriptions of novelties.

—— Sur l'émission des tubes polliniques des *Helianthemum*, p. 56. Pointing out the development of pollen-tubes, from grains of pollen remaining on the surface of the anthers after dehiscence. These tubes are directed toward the stigma, and bridging over the intervening space, curve and find their way into the stigmatic papillae.

—— Sur une nouvelle espèce du genre *Menarda*, p. 60.

BALFOUR, J. H.—Observations on Temperature in connection with Vegetation, having special reference to the Frost of December, 1860. With a Report on the effects of the late Frost on the Plants in the Royal Botanic Garden of Edinburgh, by J. McNab. Trans. Ed. Bot. Soc. vii. 58.

BALFOUR, J. H.—The Calabar Ordeal Bean. R. S. E. T. xxii. p. 305. With 2 plates.

The plant affording this ordeal poison is described as a new genus (*Physostigma*) of the Tribe *Phaseoleae.* It is allied to *Phaseolus;* the legumes resemble those of *Mucuna,* the hilum and calyx those of *Canavalia.* The obtuse stigma is covered by a "ventricular sac or hood which extends along the upper part of the convexity of the style."

——— Description of Asafœtida Plants, (*Narthex Asafœtida,* Falc.) which have recently borne flowers and fruit in the Royal Botanical Garden of Edinburgh. With 2 plates. p. 361.

BEDDOME, R. H.—Contributions to the Botany of Southern India. Madras Journ. N. Ser. vi. 70.

The new genera described are *Tetraglossa* (Euphorbiaceae near *Trewia*) and *Laneasagum* (*Antidesmeae*).

BENTHAM, GEORGE.—Flora Hongkongensis: a Description of the Flowering Plants and Ferns of the Island of Hong Kong. 8vo. pp. 481. (Introd. li.) London, 1861.

The preface contains a brief account of the Island, its physical aspect and climate, the materials upon which the work is based, and observations on the geographical relations of the Hongkong Flora. The total number of species described is 1056 (including some which have probably been introduced), referred to 591 Genera, and 125 Nat. Orders. The native species are distributed under seven geographical types or floras, of which the Tropical Asiatic includes the largest proportion (398). 159 species have not, as yet, been found out of the island; most of these, however, are to be expected in Southern China. The Hongkong Flora is compared with those of Aden and Ischia, which are both similarly situated as to proximity to the mainland and of about equal size, but widely different in soil and climate.

Hongkong affords of native species	1003, belonging to	125 N. orders.
Aden	„	95	„	42	„
Ischia	„	792	„	82	„

The Introduction consists of outlines of Botany framed with special reference to local Floras, and an analytical key to the Orders and anomalous Genera of the Hongkong Flora. Under the respective heads of the several orders, genera, and species described is given in brief their general geographical distribution.

A new genus of Hamamelideae is described under the name *Tetrathyrium.*

——— On *Fissicalyx* and *Prioria*; two recently published Genera of Leguminosae. Linn. Trans. xxiii. 389. With 2 plates.

In *Fissicalyx* (Dalbergieae) a Venezuelan tree, the broad wings of the fruit do not arise from the sutures, as in Dalbergieae generally, but from the centre of the valves. The embryo

is perfectly straight. *Prioria* (near *Copaifera*) is described by Grisebach, in 'Flora of British West Indies.' The fruit, unknown to him, is figured by Mr. Bentham.

Bentham, George.—Notes on *Menispermaceae.* Linn. Proc. Suppl. Vol. v. (Bot.) p. 45.

The apparent opposition of the stamens to the petals in the trimerous, dimerous, and tetramerous species of the Order (as also in *Berberideae*) is due to the circumstance that the petals and stamens are each usually in two whorls,—the outer stamens being opposite to the outer petals, the inner stamens to the inner petals. A synopsis of the sufficiently known genera of American, tropical, cocculoid Menispermaceae is given, followed by general observations upon each genus.

——— Notes on *Tiliaceae.* p. 52.

Mr. Bentham, with Dr. Hooker, adopt 37 genera, which are disposed under 6 tribes, grouped into 2 suborders,—*Holopetalae*, characterized by the petals, which are always of petaloid nature, being always present (except in one or two *Grewias*), narrowed at the base and deciduous; and *Heteropetalae*, marked by petals when present being more or less sepaloid, attached by a broad base and usually persistent.

A synopsis of the Tribes is given, followed by critical observations upon the Genera. New species of *Luhea* and *Mollia* are described from Spruce. The species of *Sloanea* are diagnosed, some new species of Spruce's being described at length. Of the genus *Echinocarpus*, Bl. five new species are described from N. E. India, and one from Australia.

——— Notes on *Bixaceae* and *Samydaceae.* p. 75.

The authors of the new 'Genera Plantarum' propose to unite Decandolle's Orders *Bixaceae* and *Flacourtiaceæ*, *Samydeae* and *Homalineae* into two Orders, viz., *Bixaceae* with hypogynous, and *Samydaceae* with perigynous stamens. *Banera* is referred to the latter Order. A synopsis of the Tribes of each Order is given with an enumeration of their included genera, upon many of which critical observations are added, with descriptions of new and imperfectly known species.

Bertoloni, A.—Miscellanea Botanica. Fasc. xxi. 1861, pp. 18. With 5 plates.

——— Come si comporta il midollo delle piante dicotiledonali dopo il suo compiuto sviluppo. Bologna, 1861. (Mem. Ac. Sc. Istituto. xi.) pp. 16.

Bell, R.—List of Plants collected on the South and East shores of Lake Superior, and on the North shore of Lake Huron in 1860. Ann. Bot. Soc. Canada. i. 67.

Bentley, Robt.—A Manual of Botany: including the Structure, Function, Classification, Properties, and Uses of Plants. London, 1861

Berg, O.—Cortex Quillajae. Bot. Zeit. 1861. p. 140.
The structure of the bark is described at length.
——— Mexicanische Sarsaparille aus Manzanilla. With 1 plate. Flora, 1861. p. 373.
With the microscopic character of the rhizome.
——— Mantissa ii. ad. Revisionem Myrtacearum Americae. Linnaea xxx. p. 647.
Temu, n. g., near *Blepharocalyx* and *Myrtus*, is described.
Bicchi, C.—Descrizione di una nuova specie del genere *Tulipa*. I. Giard. Augt. 1861, 50. *T. Beccariana* of the section *Tulipanum*.
Bizio (D. G.) Sopra l'olio della camomilla (M. Chamomilla). Sitz. d. Kais. Akad. Wiss. xliii. 2. p. 292.
Black, A. A.—Catalogue of Japan Plants. An Appendix to Hodgson's Japan.
Including "the great bulk of the plants described or noted as having been found in Japan since the publication of Thunberg's 'Flora Japonica.'"
It is based upon the enumerations of Siebold and Zuccarini, and Asa Gray, including also the Japanese plants of Blume, Morren and Decaisne, and Kunze, with the addition of species collected by Wilford, Alcock, and Hodgson. About 1600 species of phaenogamous plants and ferns are catalogued. There are 18 genera of Ranunculaceae, 8 of Ternstromiaceae, 14 spp. Maple, 25 genera Rosaceae, 15 spp. *Hydrangea*, 4 spp. Hamamelideae, 11 gen. Lauraceae, 23 Oaks, 16 gen. (of 47 spp.) Coniferae, 5 spp. Palmae, 45 Carices, 8 Bamboos, 11 spp. *Viburnum*, including *V. opulus*.
Blackie, G. S.—On the *Cornus florida* of the United States. Ann. Bot. Soc. Canada. Vol. i. p. 22, also in Canad. Nat. and Geol. vi. 1.
Blaese, G.—Die natürlichen Familien der wildwachsenden Phänerogamen Kur-, Liv- und Esthlands. Mitau. 1861. 12mo. pp. 75.
Blytt, M. N.—Norges Flora. Forste Deel. Christiania, 1861. 8vo. pp. 386.
Vascular Cryptogams to *Sparganium*.
Bocquillon, H. T.—Observations sur le genre *Oftia*, Adans. Baillon, Rec. d'Obs. Bot. ii. 4.
——— Revue du Groupe des Verbénacées. Baill. Rec. d'Obs. Bot. ii. 81.
The author discusses the intergeneric relations of the Verbenaceae, the organogeny of several genera, the general character of the inflorescence, floral and fruit structure and symmetry, the vegetative organs and natural affinities of the group.
Böckeler.—Ueber eine zweite Species der Gattung *Courtoisia*, Nees, nebst einigen Bemerkungen über die Gattung und die ihr nahestehenden Genera. Flora, 1861, p. 331.
Boisduval et Duhamel, MM.—Une Herborisation à Notre-Dame-de-la-Trappe (Orne) faite en Aout 1861. Bull. Soc. Bot. viii. 534.

Bolle, C.—Ueber Formen von *Vicia Cracca*, L. Verh. Bot. Ver. Brandenb. ii. p. 76.

——— Der Weinstock in der Mark verwildert gefunden. Verh. Bot. Ver. Brandenb. Hft. ii. p. 153.—Ueber *Triticum caesium*, p. 156.

——— Die Scrofularien der Canarischen Inseln, ein Beitrag zur Florenkenntniss dieses Archipels. Act. Soc. Zool. Bot. Vienne, 1861. 1. Wien Verhandl. xi. 193.

Eight Canarian species of *Scrophularia* are described.

——— Addenda ad Floram Atlantidis, praecipue insularum Canariensium Gorgadumque. Bonpl. 1861, p. 50.

Bonnet, M.—Sur un caractère variable des espèces du genre *Iberis*. Bull. Soc. Bot. 1861, p. 158.

Referring to the divergence of the lobes terminating the wings of the fruit above, which, in some species, varies in the same corymb.

Bornet, Éd.—Note sur le *Phycagrostis major*. Bull. Soc. Bot. viii. 456.

With a minute description of the male and female flowers, and the development of the embryo.

Borszczow, El. — Die Pharmaceutisch-wichtigen Ferulaceen der Aralo-caspischen Wüste, nebst allgemeinen Untersuchungen über die Abstammung der im Handel vorkommenden Gummiharze, —Asa-Foetida, Ammoniacum und Galbanum. Mem. Ac. Sc. Petersbg. vii. ser. iii. No. 8. With 8 plates.

Brady, H. B.—On the Seed of *Dictyoloma peruviana*, DC. Trans. Micr. Soc. 1861, p. 65. With 1 plate.

Referring to the microscopic structure of the seed-wing. The radiating fibres, connected at their outer margin, of which each of the concentric wings consists, Mr. Brady believes to be the thickened lateral walls of the elongated cells, persisting after the rupture of the front and back.

Braun, A.—Zurückführung der Gattung *Leersia*, Sw. zur Gattung *Oryza*, L. With fig. Verh. Bot. Ver. Brandenb. Hft. ii. p. 195.

——— Ueber die Wirkung der Spätfröste auf die Blätter von *Æsculus Hippocastanum*. Berlin. 1861. Aus Monatsber. K. Ak. d. W. p. 691.

——— Mémoire sur les Graines charnues des Amaryllidées; la Viviparité et les Transformations de l'Ovule Végétale. Ann. S. N. Ser. iv. xiv. p. 5. With 1 plate. (Trans.)

The original memoir appeared as an appendix to the author's Essay on Polyembryony, &c. in the Transactions of the Berlin Academy (1859). I. In respect to the fleshy seeds of Amaryllideae, Prof. Braun distinguishes, with M. Prillieux, two essentially different kinds, which he calls, respectively, bulbous and tubercular seeds. The bulbous seeds result from an anatropous ovule having two integuments, of which the outer is formed of a

thick fleshy mass traversed by vascular bundles. The embryo is not developed in these prior to the fall of the seed from the fruit. The tubercular seeds are produced by a more or less campylotropous ovule destitute of integuments, of which the endosperm forms a fleshy mass without vessels. The embryo develops at an early period, and before the fall of the seed. A detailed account is given of the ovules and seeds of *Hymenocallis*, *Amaryllis Belladonna*, and species of *Crinum*. II. The various conditions included under the general term Viviparity are enumerated, and the question of the morphological signification of the ovule and its parts discussed. *Apropos* of the latter subject, the author states the only example known to him of the formation of a foliaceous bud replacing the nucleus in the interior of an ovule. In this case, observed by Schimper, the ovules (of *Nigella Damascena*), although enlarged and elongated, retained their anatropous form and two integuments, of which the inner projected beyond the outer one, which was more or less open. The inner coat presented a micropyle, sometimes very minute, sometimes widened. In the former case, the leafy bud broke through the side of the coat; in the latter, it projected from the micropyle. Upon one of the small leaflets borne by these ovular buds, M. Schimper found a rudimentary ovule, consisting of a conical nucleus and basal annulus, from which it projected.

Braun, A.—Ueber eine Sonderbare Wirkung der diesjährigen Spätfröste auf die Blätter der gemeinen Rosskastanie (*Æsculus hippocastanum*) und einiger anderer Bäume. Berlin Monatsb. 1861, 691.

Brongniart, Ad.—Note sur le Sommeil des Feuilles dans une Plante des Graminées, le *Strephium Guianense*. Bull. Soc. Botan. vii. p. 470.

During 'sleep' the distichous leaves overlap each other closely, the upper surface of the limb of each being applied against the sheath and lower face of the leaf immediately above. The sleep movement commences long before nightfall, between 4 and 6 p.m. in the long days of summer.

Brongniart, Ad. et A. Gris.—Observations sur l'Ovule et la Graine du *Posidonia Caulini*. Bull. Soc. Botan. vii. p. 472.

In reference to the debated structure of the seeds, the authors find the 'canal' of elongated cells traversing the interior longitudinally to constitute the single vascular bundle of the tigellus of the embryo. The true micropyle is hardly discoverable in the seed, owing to the integuments being usually destroyed. The brown spot which may have been taken for such is the point of origin of the radicle, thus corresponding, however, with the micropylar extremity.

Brongniart, Ad.—Observations sur un genre remarquable de Violacées de la Nouvelle-Calédonie. Bull. Soc. Bot. 1861, p. 77.

Agatea of Asa Gray (for which name M. Brongniart proposes

to substitute *Agation*, owing to its pronunciation, which he considers, as pronounced on the Continent, identical with that of *Agathaea*, Cass.) A specimen sent from New Caledonia requires modification of the generic character. A description is given of the ripe fruit.

BRONGNIART, AD. et A. GRIS.—Note sur un genre nouveau d'Ombellifères de la Nouvelle-Calédonie. Bull. Soc. Bot. 1861. p. 121.

Myodocarpus, of which two species are described. Both are arborescent or shrubby, one species with simple leaves. Vittae are absent, but numerous spherical glandular reservoirs are immersed in the pericarp.

—— Description de quelques Éléocarpées de la Nouvelle-Calédonie. Bull. Soc. Bot. viii. 198.

With descriptions of six New Caledonian species of *Elæocarpus* and of the new genus *Dubouzetia*, Panch. Characterized by entire petals, 5-locular ovary, and capsular 5-celled fruit, with septicidal dehiscence.

—— Note sur le genre *Joinvillea* de Gaudichaud, et sur la famille des Flagellariées. Bull. Soc. Bot. viii. p. 264.

The authors recognise in a plant of the Sandwich Islands, the *Joinvillea elegans* of Gaudichaud; the structure of which is described in detail. This genus, with *Flagellaria*, constitutes the family Flagellarieae, characterized by solitary, suspended, orthotropous ovules and embryonary structure analogous to that of Restiaceae and its allies. The above characters remove it from Juncaceae, to which order *Flagellaria* was doubtfully appended by R. Brown.

—— Sur un nouveau genre de Nyctaginées de la Nouvelle-Calédonie. Bull. Soc. Bot. viii. 374.

Vieillardia, an arborescent plant, remarkable in the order from its straight embryo and the almost complete absence of albumen.

—— Sur quelques cas de transformation des étamines en carpelles. Bull. Soc. Bot. viii 453.

In *Sempervivum*, *Cheiranthus* (the stamens transformed into carpellary leaves), and *Polemonium cœruleum*. In the latter plant the petals were represented by free, green foliolae nearly equalling the calyx, between these and the pistil was a circle of carpels replacing the stamens; these were united laterally to each other, enveloping the central ovary and forming five flattened cells, each usually enclosing two rows of ovules. By artificial fertilization M. Brongniart obtained fertile seeds from both the central normal ovary and the surrounding metamorphosed stamens.

BUCHENAU, F.—Morphologische Bemerkungen über einige Acerineen. Bot. Zeit. 1861, 265, 273, 281. With 1 plate.

—— Bemerkungen über die Wachsthumsweise der *Corydalis claviculata*. With figs. Bot. Z. 1861, 321.

Describing the germination and development of the leaves.

CARRIÈRE, M.—Considérations générales sur l'espèce. (Suite.) Rev. Hort. 1861, pp. 46, 76, 98, 118, 138, 157, 178, 198, 218, 298, 337, 355.

CARRUTHERS, W.—On some Species of Oaks from Northern China, collected by W. F. Daniell, M.D. Linn. Journ. vi. 31.

CASPARY, R.—Einige Pelorien. Schrift. K. Gesell. Königsberg, 1860, i. 59. With figs.

Orchis latifolia, Columnea Schiedeana, Digitalis purpurea.

——— *Bulliarda aquatica*, p. 66. With plates.

A detailed account of the morphology, anatomy, distribution, &c. of the species.

——— Ueber Beschädigung holziger Pflanzen durch den Frost. Königsb. Sitzbericht. 1860. 3.

——— Ueber einige Pflanzen-Bastarde. p. 12.

——— Ueber die Stellung der Aeste und Blüthen und die Richtung der Blattstellung an Ast und Stamen bei der gelben Mummel. p. 23.

——— Ueber die Cacteen Nordamerikas. p. 23.

——— Ueber das Vorkommen der *Hydrilla verticillata*, Casp. in Preussen, die Blüthe derselben in Preussen und Pommern, und das Wachsthum ihres Stammes. Verh. 35. Vers. Nat. Königsb. 1860. 293. With 4 plates.

Including observations upon this plant made subsequent to the publication of the author's work on the Hydrilleae. The anatomy, general structure, and development of the species are described in minute detail.

——— Sur le *Bulliarda aquatica*, DC. Ext. Act. Soc. Phys.-écon. Königsberg. 4to. pp. 25. 2 plates.

An account of the structure and development of the plant, its geographical distribution, &c. The question as to whether fertilization of the flower takes place under water the author leaves undetermined.

——— De Abietinearum, Carr. Floris feminei structura morphologica. 4to. pp. 12. Regiomonti Pr. *vide* also Ann. S. Nat. Ser. iv. xiv. 200, and N. H. R. ii. 19.

——— Berichtigung einiger Irrthümer des Herrn Nitschke. Bot. Zeit. 1861. p. 182.

Referring to Herr Nitschke's comparison of the stipulary appendages found on the upper side of the leaf-stalk of *Drosera rotundifolia* with the setae on the petiole of *Aldrovanda* in respect of morphological import.

CASPARY, R.—Aufforderung an H. Dr. Nitschke und noch einige Worte über dessen Arbeit über *Drosera rotundifolia.* Bot. Zeit. 1861. 278

——— Ueber das Verhalten von Pflanzen zu Verwundungen. Königsb. Sitzungsb. Jahrg. ii. 11.

CAUVET, M.—Notice organographique sur quelques plantes de la famille des Cactées. Rec. Mem. de Méd. Ser. iii. v. 67. (Bull. Soc. Bot. viii. 641).

Observations on the structure of the ligneous system, leaves, epiderm, the fruit, &c. of *Opuntia*.

——— Études sur le rôle des racines dans l'absorption et l'excretion. Strasburg, 1861.

M. Cauvet is of opinion that rootlets in perfect health do not excrete poisons absorbed by the plant; it is through the leaves, by their death and fall that poisons are eliminated. With regard to the elective power of the so-called spongioles, he believes that if salts be absorbed in unequal proportions it is owing to their special action on the tissue of the absorbing extremity.

CHAPMAN, A. W.—Flora of the Southern United States. 1860.

Leitneria (Myricaceae, gen. nov.) is described.

CHATIN, AD.—Sur la Structure anatomique des Pétales comparée a celle des Feuilles; une conséquence physiologique des faits observés. Bull. Soc. Botan. viii. p. 22.

The colouring matter of petals is stated to be contained in epidermal cells (*Calendula*, *Dahlia*, &c.); and with regard to its condition, whether liquid or granular, as well as seat, it may be generally affirmed that what is the rule in the case of leaves is exceptional in petals.

——— Excursion botanique dirigée en Savoie et en Suisse. Bull. Soc. Bot. 1861. viii. pp. 127, 210, 302, 333.

A list is given of the species collected.

——— Sur un cas extraordinaire de monstrosité (?) offert par le *Cytinus hypocistis*. Bull. Soc. Bot. viii. 196.

The ovaries, destitute of parietal placentas, were almost entirely occupied by a pendulous, pedicellate, cellular mass, the import of which is left doubtful.

——— Sur les plantes des vieux Chateaux. Bull. Soc. Bot. viii. 359.

Of the plants naturalized on and about old edifices, M. Chatin distinguishes at least two principal groups. The one, and older, represented by *Dianthus Caryophyllus* and *Salvia Sclarea* he terms the group of the Middle-Age period; the other, characterized by *Aegopodium Podagraria* and *Eruca sativa*, the group of the Renaissance period. Under the former he includes *Fœniculum vulgare, Silybum Marianum, Leonurus Cardiaca, Satureia montana, &c.*; as additional species under the latter, *Petasites officinalis, Iris foetidissima, Corydalis lutea, Ruta graveolens, Sedum dasyphyllum, Atropa, &c.*

The Thorn Apple and Henbane apparently characterize a more recent epoch, as also *Urtica pilulifera, Asperugo procumbens, &c.* Notes are added upon the localities of the species and the uses to which they were applied,

Chatin, Ad.—Sur l'Androcèe des Crucifères. Bull. Soc. Bot. viii. 370. 471.

Referring specially to the doctrine of "dédoublement." M. Chatin adopts the view of Dr. Lindley, that the outer whorl of stamens is incomplete owing to the abortion of those opposite to the anterior and posterior sepals. The pistil he considers as consisting of four carpels alternating with the inner stamens (opposite to the sepals), the anterior and posterior carpels being constantly aborted.

Clarke, Joshua.—On a New British Plant. Linn. Proc. v. p. 187. *Lathyrus tuberosus*, from near Ongar, Essex.

Cleghorn, Dr.—List of Plants growing in the Bangalore Garden, Mysore. Trans. Ed. Bot. Soc. vii. 223.

——— Notes upon the Coco-Nut Tree and its Uses. Trans. Ed. Bot. Soc. vii. 155.

Clos, D.—Cladodes et axes ailés. Mém. Ac. Toul. (Ext. 8vo. pp. 31).

A detailed study of the foliaceous branches, termed *Cladodia*, of *Ruscus*, *Euphorbia*, *Opuntia*, &c. The leafy peduncle of *Tilia*, M. Clos considers due to a branching of the axis, one portion expanding into a sterile cladodium, the other elongating to bear the flowers.

He distinguishes three forms of winged stem,—with the wing an epidermal development, destitute of veins,—with veined wings, and wings which physiologically replace the leaf, termed *pseudophyllodia* as in *Acacia platyptera* and some species of *Statice*.

——— Nouvel aperçu sur la Théorie de l'Inflorescence. Bull. Soc. Botan. viii. pp. 11. 36.

——— Des caracterès pistillaires du genre *Ruscus*. Bull. Soc. Bot. viii. p. 280.

Relating chiefly to the fleshy covering of the ovary (which from analogy, the author considers to represent the androecium in the female flower), and the internal structure of the latter, which M. Clos finds in *R. aculeatus* and *R. Hypoglossum* constantly unilocular.

——— Remarques sur la germination du Cocotier et sur la Clandestine. Bull. Soc. Bot. viii. p. 294.

Upon the nature of the "Pomme-de-Coco" developed in the pericarp during germination, which the author appears to regard as tigellus; and the parasitism of *Clandestina* upon *Crithmum*.

——— Discussion de quelques points de glossologie botanique. Bull. Soc. Bot. viii. 615.

In continuation of previous papers. The terms commented on are *Lobum*, *Lacinia* (folii), *Folium compositum*, *laciniata*, *decomposita* (folia).

Cohn, Ferd.—Ueber d. Ursprung der schlesischen Flora. Schles. Ges. Bot. Bericht. 1860. p. 18.

Cohn, F.—Ueber Contractile Gewebe im Pflanzenreiche. Schlesisch. Abhand. 1861. p. 1.

Colmeiro, M.—Observaciones y reflexiones hechas sobre los Movimientos de las hojas y flores de algunas plantas, con motivo del eclipse de sol del 18 de julio de 1860. Mem. Ac. Cien. Madrid. v. 193.

Lychnis vespertina opened its flowers during the eclipse.

Commaile et Lambert.—Sur le fruit du Pin-à-pignons et sur la présence du cuivre dans plusieurs végétaux, notamment dans ceux de la famille des Conifères. Rec. Mem. de Méd. Sér. iii. v. 331.

Cooke, M. C.—A Manual of Structural Botany. London, 1861.

Corenwinder, B.—Études sur la Migration du Phosphore dans les Végétaux. Ann. S. N. Ser. iv. xiv. p. 39.

In a previous memoir in the Transactions of the Society of Sciences at Lille (1857), the author showed that at the time when the seeds of the Beet reach maturity phosphoric acid was no longer present in the root. This essay contains the result of further observations relative to the "migration" of phosphorus; important as the element accompanying nitrogenous matter in all phases of plant life. The cotyledons of seeds exhausted by the development of young shoots are found to be destitute of phosphoric acid, the ashes consisting in great measure of silica and lime. Substances excreted by plants as gum and manna contain no phosphorus. The author remarks the presence in notable quantity of phosphoric acid in marine Algae and Zostera, while analyses of sea-water afford no trace of it and conjectures the possibility that in the sea the phosphates may exist in combination with animal matter, as in the unctuous film found floating upon its surface. In pollen (of the White Lily) M. Corenwinder states that a larger proportion of phosphoric acid was found than in the seed of wheat. The acid was also found in the spores of *Lycopodium clavatum.*

Cornalia.—Sui caratteri del seme sano dei bachi da seta. Plate. Mil. All. ii. p. 255.

Cosson, E. et Germain de Saint-Pierre.—Flore des environs de Paris. Ed. ii. Paris, 1861. pp. 962.

Cosson, E.—Listes des plantes observées aux environs de Thurelles (Loiret), sur les déblais et les remblais récents du Chemin de fer de Moret à Montargis.—Bull. Soc. Botan. vii. p. 479.

——— Sur les Voyages Botaniques, &c. de H. de la Perraudière. Bull. Soc. Bot. viii. 591

Coutejean, M.—Un fait de géographie botanique à l'appui de la théorie de l'influence physique du sol sur la dispersion des plantes. L'Instit. xxix an. 231. A resumé of an article by this author, referring to the floras of gneiss and arkose regions in the Jura.

Dalzell, H. A. and A. Gibson. The Bombay Flora, or short descriptions of all the Indigenous Plants hitherto discovered in or near the Bombay Presidency; together with a Supplement of

Introduced and Naturalized species. Bombay, 1861. 1 vol. 8vo. pp. 332. Suppl. pp. 112.

With brief descriptions of the species, but none of Genera and Natural Orders.

DAUBENY, C.—On the Power ascribed to the Roots of Plants of rejecting poisonous or abnormal substances presented to them. Chem. Soc. Quart. Journ. xv. 209.

——— On the Physical Forces concerned in the phenomena of Vegetation, and especially on those which form the subject of the Memoirs "On Colloid Bodies," contributed by the Master of the Mint. Gard. Chron. 1074. 1098. 1861.

DEBEAUX, O.—Catalogues des Plantes observées dans le territoire de Boghar (Algérie.) Ext. Act. Soc. Linn. Bord. 1861. 8vo. pp. 121.

——— Sur la végétation de quelques localités du littoral de la Chine. Rec. Mém. Méd. Ser. iii. vi. 334. 1861.

Some account of the vegetation of Amoy, Shanghai, and Tchéfou.

DECAISNE, J.—Sur l'origine organique des vrilles de Cucurbitacées. Bull. Soc. Botan. vii. p. 461.

Observations upon an anomalous melon flower, in which one of the calycine segments was prolonged into an ordinary curled tendril,—confirmatory of M. Naudin's view that the tendril results from the nerves of a leaf deprived of parenchyma, proceeding from an axillary atrophied branch, and opposed to Dr. Clos' interpretation, that it is due to a collateral 'dédoublement' of its adjacent normal leaf.

DECANDOLLE, ALPH.—Flora Brasiliensis. Fasc. xxviii. Pars-Begoniaceae. pp. 337. With 11 plates.

All the species, 83 in number, are referred to the typical genus Begonia.

DECANDOLLE, C.—De la production naturelle et artificielle du Liège dans le chêne-liège. Ext. Mem. Soc. Phys. Genève. xvi. 1860. pp. 15. 3 plates.

Cork of commerce is obtained from *Quercus occidentalis*, Gay, in S. W. France and Portugal, and *Q. Suber* in S. E. France, Italy, Algeria, and the Mediterranean Islands. M. DeCandolle describes the first formation of true cork in the cortical layers. It is formed of polyhedric cells, square in section, deposited in annual layers alternating with one or two rows of tabular cells, with rather thicker walls. The square cells constitute the true cork, the tabular ones *Periderm.*

The cork formed prior to the first decortication of the oak is valueless: it is termed 'mâle,' and the operation of its removal 'démasclage.' The cellular tissue, with its subjacent liber laid bare by the process, the workmen call 'la mère,' and it is in this tissue at a variable distance from the surface, that the new cork (*liége femelle*) first forms, increasing by the addition of annual layers in

its inner face. After an interval of from seven to eight years the tree undergoes a second 'démasclage.' The anatomical relations of the 'liége mâle' and the 'liége femelle,' the structure of the periderm and of the zones, alternating in density, of the cork, are treated of and illustrated by figures.

Delavaud, C.—Étude tératologique sur des feuilles de l'Orme champêtre. Bull. Soc. Bot. 1861. p. 104.

Observations upon abnormal leaves of an Elm (*Ulmus campestris*), apparently resulting from the incomplete union of a pair of leaves free towards their summits; due, however, to a hypertrophy of single leaves.

——— Note sur une Fleur tétramère de *Tigridia Pavonia*. p. 146.

De Mélicocq, Le Baron.—Physiologie végétale aux xiv^{e}, xv^{e} et xvi^{e} Siècles. Bull. Soc. Bot. viii. p. 288.

Des Moulins, Ch.—Sur la pélorie anectariée du *Linaria vulgaris*. Bull. Soc. Botan. vii. p. 504.

Memorandum of two spurless-flowered specimens in the author's herbarium, collected in the South of France.

De Visiani, R.—Plantarum Serbicarum Pemptas, ossia Descrizione di cinque Pianté serbiane. Mem. dell Ist. Veneto ix. 165. 6 plates.

With detailed description and figure of *Pançiçia*, a new genus of Umbelliferae, noted in Sem. Hort. Bot. Patav. cat. 1857. Other new species are described and figured.

Dewey, C.—Caricography. Am. Journ. Sc. xxxi. 23. xxxii. 38.

Descriptions of new and imperfectly known species of *Carex*.

Dickson, Alexander.—Note on Baillon's Organogenic Researches on the Female Flower of the Coniferae. Ed. Phil. Journ. N. S. xiii p. 193.

"The small scale-like body situated near the apex of the apparent scale in most of the species of *Araucaria*," the author regards as the representative of the cone-scale of *Abies*. In *Dammara* the axillary scales are incorporated with the bracts of the cone, as in *Araucaria brasiliensis*: a union to a greater or less extent of the base of the bract and that of the 'scale' is usual, if not universal, in *Abies* and *Pinus*.

——— On some of the Stages of Development in the Female Flower of *Dammara australis*. Ed. Ph. Journ. 1861. Ext. pp. 8. With 1 plate. Also Trans. Ed. Bot. Soc. vii. 207.

Showing that the cone-scales of *Dammara* are, as in *Araucaria*, 'the leaves of the cone-shoot.' The author's observations confirm Baillon's view of the primitive duality of the envelopes of the "nucleus" or ovule.

Dickson, A.—Observations upon the Morphological Constitution of certain Abietineous Cones. Trans. Ed. Bot. Soc. vii. 47.

Doumet, Fils.—Souvenir d'une herborisation au mont Viso faite pendant la session extraordinaire de la Société botanique de France. 8vo. 22 pp. Ann. Soc. d'Hort. de l'Hérault.

Dowden, Prof.—On a Plant poisoning a Plant. Rep. Brit. Ass. 1860. 110.

Dresser, C.—On abnormal forms of *Passiflora cærulea*. Rep. Brit. Ass. 1160. 110.

——— On the Morphological Laws in Plants. Rep. Brit. Ass. 1860. 110.

Drummond, A. T. jun.—Contributions to the Local Flora of Kingston. Ann. Bot. Soc. Canada, Vol. i. pp. 33—40.

A list of species with their localities.

Duchartre, P.—Note sur deux particularités observées dans une Jacinthe. Bull. Soc. Bot. 1861. p. 158.

Two flowers had contracted an adhesion by the outer surface of one lobe of the perianth of each: the flowers were both complete. A slender scape, bearing a simple, terminal flower, sprung from the plant bearing the above.

——— Note sur une particularité qui s'est montrée, en 1860, dans la végétation de la pomme-de-terre Marjolin. Bull. Soc. Botan. vii. p. 456.

Noting a tendency in this variety of the potato to form subterranean branches and tubers without throwing up aerial stems. This anomaly usually occurs in winter, and M. Decaisne attributes it to defective warmth and light.

——— Note sur une Tulipe a tige tripartie. Bull. Soc. Botan. vii. p. 462.

Each division of the scape bearing well developed flowers of nearly equal size.

——— Sur une Monstruosité de *Delphinium Ajacis*. Bull. Soc. Botan. vii. p. 483.

The entire inflorescence was transformed into successively super-imposed whorls of sepals and carpellary leaves. Towards the summit of the stem were four or five concentric circles of free oval-lanceolate sepals—apparently resulting from the superior and lateral sepals of several flowers. Immediately within these, without the interposition of petals or stamens, were numerous distinct carpels, mostly of normal structure, and enclosing ovules. The interior were usually more or less open, and passing into simple leaves. Upon the margin of the open carpels were imperfectly developed ovules. Above the carpellary whorl was a second series of leaflets, less coloured and petaloid than the lowermost; then a second circle of carpels, most of which were imperfect. Above these, and terminating the axis, was a compact mass of small linear greenish leaflets.

——— Note sur trois fleurs monstreuses. Bull. Soc. Bot. viii. 450.

These were—1. A proliferous variety of *Rosa gallica*—the flowers with eight sepals and thirteen spirally arranged petals, upon a torus in no degree elongated. 2. A tetramerous flower of *Iris Xiphium*; and 3. Decandrous flowers of *Solanum tuberosum*.

Duchartre, P.—Note sur la sécrétion salée du *Tamarix gallica* au bord de la mer. Bull. Soc. Bot. viii. 514.

Showing that the saline deposit observed upon the leaves of the *Tamarix* is due to a glandular secretion formed when the plant grows in a soil containing more or less salt.

——— Floraison et Fécondation de *l'Agave potatorum*. Bull. Soc. Bot. viii. 629.

Fertilization was effected by a swarm of flies after carefully applied artificial means had failed.

Dufour, Léon.—Diagnoses et observations critiques sur quelques plantes d'Espagne mal connues ou nouvelles (suite). Bull. Soc. Botan. vii. pp. 426, 441.

Duval-Jouve, J. — Sur la Synonymie d'une espèce d'Equisetum. Bull. Soc. Bot. viii. 637.

Eichler, A. W.—Zur Entwickelungsgeschichte des Blattes, mit besonderer Berücksichtigung der Nebenblattbildungen. Marburg. 1861. 8vo. pp. 60. With 2 plates.

Engelmann, Dr.—On three hybrid *Verbenas*. Trans. Ac. Sc. St. Louis, i. 675.

Fenzl, Ed.—Diagnoses Plantarum Orientalium et Observationes botanicae (in Tchihatcheff, Asie mineure, iii[e] partie).

A new genus of Cruciferae (*Physalidium*) is described.

Fermond, Ch.—Note sur la Germination du *Sapindus divaricatus*. Bull. Soc. Botan. vii. p. 494.

——— Sur une Tige fasciée du *Cucurbita Pepo*. l. c. p. 496.

Fischer, J. C.—Verzeichniss d. Gefässpflanzen Neu- Vorpommerns und Rügens. 4to. pp. 56. Stralsund, 1861.

This catalogue, arranged alphabetically, includes 1070 species.

Fournier, E.—Mimoseae and Acacieae.—Thèse pour le Doctorat. (Des Ténifuges employés en Abyssinie.) Paris, 1861.

With a synopsis of the species of *Albizzia*, Dur., of the genera of Acacieae, and tribes of Mimoseae. *Vide* also A. Sc. N. iv[e]. Ser. xiv. 368.

Fritsch, K.—Resultate mehrjähriger Beobachtungen über d. Belaubung und Entlaubung der Bäume und Sträuche im Wiener botanischen Garten. With 1 pl. Wien. Sitzungsb. 1861. 81.

——— Begriff der Phänologie und über Belaubung und Entlaubung der Bäume und Sträuche. Wien. Verhandl. xi. 261.

——— Thermische Constanten für die Blüthe und Fruchtreife von 889 Pflanzenarten, abgeleitet aus zehnjährigen Beobachtungen im K. K. botanischen Garten zu Wien. Wien Sitzungsb. xliv. 711.

Garcke, A.—Die Gattung *Goethea*. Bonpl. 1861. p. 17.

With one-celled anthers and warted pollen, the author refers it, with Endlicher, to Malvaceae; he upholds the genus as distinct from *Pavonia*.

Garcke, A.—Die Stellung der Gattung *Morina* im natürlichen System. Bonpl. 1861. p. 49.

Confirming the received view, in opposition to that of the late Dr. Klotzsch, that *Morina* is Dipsaceous, not Acanthaceous.

——— Ueber Die Gattung *Trichanthera*. Ehrenb. Bonpl. 1861. p. 115.

Stating the genus *Trichanthera*, Ehrenb. to be identical with *Hermannia*, L.

Garreau, L.—Recherches sur la distribution des matières minérales fixes dans les divers organes des plantes. Ann. S.N. Ser. iv. xiii. p. 145. With 1 plate.

An account of experiments instituted with a view to ascertain the chief causes determining the distribution of mineral substances in the various organs of plants, their comparative quantity, and the part they play in the plant economy. The memoir is divided into two portions; the first treating of the inorganic constituents of plants, the second devoted to the function of the azotised cell-contents, and the circulation of cell-sap. Tables are given of—(1) The percentage of inorganic constituents in various organs gathered at different periods; also (2) in radicles and fibrils which have vegetated at the expense of their seed in distilled water solely; (3) in fibrils of aquatic and terrestrial plants; (4) in stems of various ages; (5) in the pith and cambium-layer of the elder; (6) in the axes and fronds of cryptogams; (7) in leaves; (8) in ripe seeds, as compared with ovules; (9) analyses of the ashes of seeds; (10) of the axes and youngest leaves of buds; (11) of the stems of trees, terrestrial and aquatic herbs, the leaves of ligneous plants, of cryptogams, &c.

The author shows the very unequal distribution of inorganic constituents, and the remarkable variation in respect to their amount in the different organs of plants. That while their proportion in the axial organs of ligneous plants decreases with lignification, in herbaceous species it increases with age. The same accumulation takes place, as a rule, in leaves, with the exception of those specially modified, forming calyx, pericarp, &c. The contrast is pointed out between the analysis of the seed, deprived of episperm, and that of other parts of the matured (monocarpic) plant. The former containing but the elements constituting the phosphates of lime, potash, soda, magnesia; the latter oxides of iron, manganese, carbonates of lime and magnesia, sulphates, chlorides, silica, &c.—phosphates having almost entirely disappeared. In reference to the azotised contents of cells, M. Garreau is of opinion that the threads (or *canaux*) of protoplasm, which radiate from the nucleus, are in direct communication with the corresponding processes of adjacent cells, and that thus the active formative matter, which possesses a similar composition and fulfils like essential functions with that of animals, may remove itself from old or thickening cells.

Gay, J.—Note sur l'Histoire du *Bidens radiata*, Thuill. Bull. Soc. Bot. 1861. p. 153.

With the synonymy of the plant.

——— Observations sur le travail de M. Grenier relatif au *Posidonia Caulini*. Bull. Soc. Botan. vii. p. 453.

——— Nouvelles observations sur une Anomalie bulbaire du *Leucojum aestivum*. Bull. Soc. Botan. vii. p. 457.

A form presenting two or three bulbs superimposed on the same axis, and separated by long internodes.

——— Le *Chamærops excelsa*, Thunb., sa patrie, le climat qui lui convient, son introduction dans l'Europe occidentale, les changes qu'il a d'y être naturalisé, son *fibrillitium*, les usages économiques auxquels il peut servir, &c. Bull. Soc. Bot. viii. 410.

In a postscript are given Wendland's characters of his genus *Trachycarpus*, based upon the Eastern species of *Chamærops*, (*C. excelsus*, *C. Fortunei*, *C. Martianus*, and *C. Khasianus*).

——— Sur la plante désignée sous le nom de *Pyrethrum Willemoti*. p. 459.

According to M. Gay, *P. cinerariaefolium*, Trev.

——— Une Excursion botanique a l'Aubrac et au Mont-Dore, principalement pour la recherche des *Isoetes* du plateau central de la France. Bull. Soc. Bot. viii. 508, 541, 619.

Germain de Saint-Pierre.—Nouvelles observations sur le *Posidonia Caulini*. Bull. Soc. Botan. vii. p. 474.

With detailed account of the reproductive organs and germination.

Godron, A.—Observations sur les Bourgeons et sur les Feuilles du *Liriodendron tulipifera*. Bull. Soc. Botan. viii. p. 33. With 1 plate.

Explaining the occasion of the truncate summit of the leaf.

Graells, M. de la Paz.—Ramilletes de Plantas Españolas escogidas. Mem. Ac. Cien. Madrid, iv. 459. With 9 plates.

Gras, Aug.—Note sur quelques rectifications de Synonymie. Bull. Soc. Bot. viii. p. 270.

Referring to names of Allioni's.

——— Sur le *Cardamine granulosa*. Bull. Soc. Bot. viii. 463.

Gray, Asa.—Note on the Genus *Graphephorum*, Desv., and its Synonymy. Ann. Bot. Soc. Canada, 1861. p. 55. also Am. Ac. Proc. v. 190.

Announcing the re-discovery of the *Dupontia Cooleyi* of the author's "Manual of the Botany of the Northern United States," and its identification with *Graphephorum melicoides*, Beauv. An enumeration of the species of *Graphephorum* is appended.

——— Characters of some Compositae in the Collection of the United States South Pacific Exploring Expedition, under Captain Wilkes, with Observations, &c. Am. Ac. Proc. v. p. 115.

With amended characters of *Wilkesia* and *Argyroxiphium*, and description of new species.

Gray, Asa.—Notes on Lobeliaceae, Goodeniaceae, &c. of the Collection of the United States South Pacific Exploring Expedition. p. 146.

The new species are described.

——— Enumeration of a Collection of Dried Plants made by L. J. Xantus, at Cape San Lucas, &c. in Lower California, between August, 1859, and February, 1860, and communicated to the Smithsonian Institution. p. 153.

A small collection made by Mr. Xantus at San Lucas and vicinity, containing a considerable proportion of new species. The distribution numbers are quoted.

——— A Cursory Examination of a Collection of Dried Plants made by L. C. Ervendberg around Wartenberg, near Tantoyuca, in the Ancient Province Huasteca, Mexico, in 1858 and 1859. p. 174.

Grenier, Ch.—Recherches sur le *Posidonia Caulini*, Konig. (*Suite*). Bull. Soc. Botan. vii. pp. 419, 448.

A minute account of its structure, together with technical descriptions of the genus and species. Observations are introduced upon typical forms, species, and genera—the author preferring the comprehensive Linnean genera, with brief diagnoses and subdivisions, to those of fragmentary character with long diagnoses which have multiplied so fast in recent times.

Grindon, L. H.—A Manual of British and Foreign Plants, with their Latin and English Names. London, 1861.

A Catalogue of upwards of 5000 species, either in cultivation, indigenous to Britain, or of economic or literary interest. The native country of each is given.

Gris, Arthur.—Du Développement de la Fécule et en particulier de sa Résorption dans l'albumen des graines en Germination. Ann. S. N. Ser. iv. xiii. p. 106. With 6 plates.

M. Gris' observations refer chiefly to the dissolution of the starch granules in the albumen of the seeds of wheat, barley, maize, and other Gramineae, *Arum*, *Polygonum*, *Rivina*, and a few other genera. Resorption takes place after two modes; either by a local action of the dissolving agent, attacking the granule irregularly, or uniformly diminishing its bulk insensibly. The simple starch granules examined, with the exception of those of *Bromus*, were subject to the former, and compound granules (also those of *Bromus*) to the latter mode of dissolution.

——— Sur le développement de la graine du Ricin. A. S. N. iv. Ser. xv. (Bot.) 5.

The author directs attention to the adhesion between the secundine and lower portion of the nucleus, and the ultimate disappearance of the free portion of the latter, with the increase in size of the embryo sac, within which the albumen is formed.

——— Sur le genre *Crossostylis* de Forster. Bull. Soc. Bot. viii. 379.

Including a description of the fruit and seed unknown to Dr. Gray (U. States Expl. Exped. 610, t. 77).

Gris, Arthur.—Sur le développement de la graine de Ricin. C. Rend. 21 Oct. 1861.

——— Essai sur la mesure du degré d'élévation ou de perfection organique des espèces végétales. Paris, 1861. 8vo. pp. 32.

Grisebach, A. H. R.—Flora of the British West Indian Islands. Pt. iv. (Caprifoliaceae to Apocynaceae).

Phialanthus (Rubiaceae, near *Scolosanthus*), *Monanthemum* (Vernoniaceae), and *Chænocephalus* (*Senecionideae*), are the new genera described. *Strychnos* is included under *Apocynaceae*, sect. *Rauwolfieae.*

——— Bemerkungen zu Willkomm's Monographie der europäischen Krummholzkiefern. Flora, 1861. 593.

With a synopsis of the eight, geminate-leaved, European Pines.

——— Zur Systematik der Birken. Flora, 1861. 625.

Groenland, J.—Sur les hybrides du genre *Ægilops.* Bull. Soc. Bot. viii. 612.

Hybrids obtained from the artificial fertilization of *Ægilops ovata* and *Æ. ventricosa* by different varieties of wheat were found rarely to retain their hybrid character, but to return almost invariably to the type of the male parent, and ultimately die out. A natural 'hybrid,' however, (known to be such from the circumstance that its produce was, in part, sterile, with all the character of a *Triticum*, and in part, true *Ægilops triticoides*) has perpetuated itself since 1858 with a rapid increase of fertility, the last generation, retaining all the hybrid character, having been as fertile as ordinary cultivated wheat.

Grosse, Ernst.—Flora von Aschersleben. Die im umkreise von einer Meile um Aschersleben wachsenden Phanerogamen, nach dem Linné'schen System geordnet und mit den zum Selbstbestimmen nöthigen characteren versehen. Aschersleben, 1861. 8vo. pp. 74.

Gubler, A.—Observations sur la flore du département des Alpes-maritimes. Bull. Soc. Bot. viii. 237.

——— De la mer comme source de calcaire pour les plantes du littoral. Bull. Soc. Bot. viii. 431.

——— Étude tératologique sur une anomalie du *Pinus Pinea,* constituée par la permanence de la foliation primordiale, transitoire. Bull. Soc. Bot. viii. 527.

Guibourt, M.—Observations sur le duvet des Chatons de Peupliers. Journ. Pharm. et Chem. 1861. p. 81.

Showing the down of the seed to be arilloid and not a *coma* or *corona* as described by some authors.

Guillard, A.—La Famille des Urticées. Presse Scient. iii. p. 305.

With observations on the structure of the stem, the character of the inflorescence, &c.

Gulliver, Geo.—On the Raphides of *Lemnaceae.* A. N. H. 3 ser. vol. vii. p. 423.

Noting their occurrence in all British species of Lemna.

HALL, H. C. VAN.—Bijdrage tot de Organographie der Planten, inzonderheid over Stipulae en Bracteae. With 3 plates. Ver. Med. K. Ak. Wet. Amsterd. 1861, 245.

HALLIER, ERNST.—Die Vegetation auf Helgoland. Ein Führer für den Naturfreund am Felsen und am Seestrand. Zugleich als Grundlage zu einer Flora von Helgoland. With 4 plates. Hamburg, 1861, pp. 48.

The Flora includes 150 Phanerogamia, 17 of which are stray plants in gardens or naturalized, and 13 more or less doubtful.

——— Die Flora der Insel Helgoland. Bonpl. 1861, p. 227.

With catalogue of native Phanerogamia.

HARTINGER, A.—Oesterreich's u. Deutschland's wildwachsende od. in Gärten gezogene Giftpflanzen, in naturgetreuen Abbildgn. Parts 1 to 3. 12 col. plates. Folio. Vienna, 1861.

HASSKARL, J. R.—Horti malabarici clavis nova (cont.) Flora, 1861. 401, 481, 545, 577, 609, 737.

HECTOR, J.—Physical Features of the central part of British North America, with special reference to its Botanical Physiognomy. Trans. Ed. Bot. Soc. vii. 168.

HELDREICH, TH. DE.—Descriptio specierum novarum. Ann. Soc. Nat. iv. ser. xiii. p. 379.

Species of *Campanula, Centaurea, and Mattia.*

HENSLOW, J.—On the supposed Germination of Mummy Wheat. Rep. Brit. Ass. 1860. 110.

HILDEBRAND, F.—Die verbreitung der Coniferen in der Jetztzeit und in den früheren geologischen Perioden. Bonn. Verh. 1861. 199.

——— Einige Beobachtungen aus dem Gebiete der Pflanzen-Anatomie. 1861. Bonn. 4to. pp. 28. 2 plates.

Upon (1) the occurrence of stomata upon petals; (2) the pollen of *Morina elegans;* (3) anatomical structure of certain capsules with circumscissile dehiscence, &c.; (4) the position of the embryo, with respect to the axes of the flower and stem, in Cruciferae and other Dicotyledons; (5) the anatomy of the winter buds of *Potamogeton crispus;* and (6) the occurrence of superimposed buds in the leaf-axils of *Lonicera, Passiflora cœrulea, Cornus mascula, Sambucus nigra*, the Ash, and other species. (Ext. Bot. Zeit.)

——— Anatomische untersuchungen über die Farben der Blüthen. Pringsh. Jahrb. iii. 59. With 1 plate.

Referring to the forms under which various colouring matters are found in flowers and their distribution in the tissue of the several organs. The author's observations warrant the following general conclusions:—(1.) That the colour of flowers is in constant connection with cell-contents, never with the cell-wall; (2.) Blue, violet, rose and, if there be no yellow in the flower, deep red, are due, with little exception, to a cell-sap of corresponding colour; (3.) Yellow, orange and green are usually associated

with solid, granular or vesicular substances in the cells. (4.) Brown and grey, and in many cases bright red and orange, apparently uniform to the unaided eye, are found to be compounded of other colours, as yellow, green or orange with violet, or green and red; bright red and orange, in like manner, of blue-red with yellow or orange; (5.) Black, excepting in the Bean, is due to a very deeply coloured cell-sap; (6.) All the cells of an organ are rarely uniformly coloured. (7.) The colour usually resides in one, or in a few, of the outer cell-layers. (8.) The coloured cells are but exceptionally covered by a layer of uncoloured ones. (9.) Combinations of colour are occasioned by diversely coloured matters in the same, or in adjacent cells.

Hincks, W.—An Attempt at an improved Classification of Fruits. Canad. Journ. 1861. 495.

Exhibited in a tabular form, which does not admit of material abridgement.

Hartig, Th.—Ueber die Bewegung des Saftes in den Holzpflanzen. Bot. Z. 1861. p. 17.

With the results of investigations subsequent to the publication of the author's previous paper on the same subject (Bot. Z. 1858).

1. The Bleeding of the Hornbeam (*Carpinus*). When the stem is tapped in April, the flow of sap varies at different hours of the day; beginning to flow about 9 p.m., it finds a maximum between 2 and 4 a.m., continues till about midday, and then ceases until evening. Dr. Hartig found, during the hours of the afternoon, that not only does the flow of sap cease, but that it is reabsorbed by the wound from the chamber of his apparatus. He describes the means employed to ascertain the force of this suction, which was found equivalent to a column of mercury 17½ inches in height, although at the time of the experiment it is probable the time of most active bleeding had already passed. The insufficiency of the endosmose hypothesis to explain the phenomenon is pointed out, and attention directed to the influence upon the ascent of sap of the varying relations of the fluid and gaseous contents of the conducting tissues, due to the increased or diminished density of the latter.

2. Liber Sap. Flowing in spring from incisions cut with the point of a knife obliquely or horizontally through the bark-layers of several trees (as the Maple, Beech, Oak, Lime, &c.) and usually abounding in sugar. If incisions be made from below upwards on the same side of the tree, sap flows from each wound; if cut from above downwards, from the uppermost only: hence the conclusion that Bast-sap descends. This is constant, however, only in *Robinia pseudacacia*. In the Maple, sap will flow from the lower wounds if they be cut more deeply than the upper.

3. Cambium Sap. By scraping the newly-formed wood-cells of the cambium-layer from the surface of the alburnum after the removal of the bark in spring, and separating their fluid contents

by pressure, the author obtained a sap differing from that formed in the wood and liber in the presence of phosphorus (phosphate of magnesia). Comparative examinations of the three saps are given. Phosphoric acid was found only in combination with magnesia.

4. Summer Evaporation. With table of estimated proportion of evaporation per square foot of leaf surface in nine species. This proportion was found to vary in different species independently of the number of leaves and extent of their surface.

5. Evaporation from the Pine in winter. Excepting during a period of frost (in the winter 1859-60), the amount of loss from evaporation was such that it could only be sustained by the absorption and ascent of fresh sap. The daily maximum of evaporation through the warmer season, from a fir 3 feet high, was $\frac{1}{4}$lb., the minimum, $\frac{1}{10}$lb.

6. The Economy of Evaporation. In the beginning of March, branches of two adjoining Weymouth Pines, the trunk of one of which had been 'ringed' some four years previously, were introduced into separate glass globes. The evaporation from the uninjured tree was sufficient to cover the surface of the glass with moisture in the course of half an hour, while, after an exposure of three days, no trace was deposited in the other.

7. On the difference in the soluble contents of the sap in the root and upper part of the tree.

8. Experiments on the absorption (aufsaugung) of coloured fluids by wounded surfaces. The result of several experiments is detailed. Water or tree-sap was found to be absorbed less rapidly than poisonous solutions.

Herbich, Fr.—Ueber die Verbreitung der in Galizien und der Bukowina wildwachsenden Pflanzen. Wien Verhandl. xi. 33.

——— Bemerkungen über den bei Krakau wildwachsenden *Sarothamnus vulgaris*. Wien Verhandl. xi. 399.

Hoelzl, K.—Botanische Beiträge aus Galizien. Wien Verhandl. xi. 433.

On the botanical observations made by Haequet on his Carpathian journey.

Hoffmann, Hermann.—Zur Kenntniss der Vegetations-normalen. Bot. Zeit. 1861. pp. 177, 185.

Hofmeister, W.—Ueber durch die Schwerkraft bestimmten Richtungen von Pflanzentheilen. Pringsh. Jahrb. iii. 77.

——— Neue Beiträge zur Kenntniss der Embryobildung der Phanerogamen. II. Monocotyledonen. Abh. K. Sachs. Ges. Wiss. vii. (1861). 631.

The author points out the remarkable general analogy obtaining in Monocotyledons in the mode of development of the sexual organs. The embryogeny, &c. of numerous species belonging to upwards of twenty Natural Orders is described and illustrated by figures.

HOOKER, J. D.—Introductory Essay to the Flora of Tasmania. (German Trans., Ext. from Bot. Zeitsch.) Wien. 1861. pp. 39.

Also resumé of above, Flora, 1861. 417-425.

——— et T. THOMSON.—Praecursores ad Floram Indicam. Cruciferae. Linn. Proc. v. p. 128. With a *Clavis generum* by Dr. Hooker.

The genera are grouped according to the arrangement to be adopted by Mr. Bentham and Dr. Hooker in their forthcoming 'Genera Plantarum.' The new genera described are—*Alloceratium*, founded on *Chorispora stricta*, DC.; *Atelanthera* (Arabideae, Hk. f.); *Loxostemon*, founded upon a little plant near *Cardamine*, with the longer stamens geniculately divaricate above (doubtfully included in Arabideae); and *Lepidostemon* (Sisymbrieae), from an elevation of 14,000 to 16,000 feet in the Sikkim Himalaya.

HOOKER, J. D.—On the Vegetation of Clarence Peak, Fernando Po; with Descriptions of the Plants collected by Mr. Gustav Mann on the higher parts of that Mountain. Linn. Journ. vi. 1.

Dr. Hooker's notes refer chiefly to the temperate plants, 56 in number, collected, with one exception, at or above 5000 feet elevation. Twenty additional species, ascending a little over this height, belong to tropical types, and are excluded from the temperate Flora. Of the 56 species, 32 are natives of Abyssinian mountains, and 13 others are closely allied to plants of that country. Of the total 76 Clarence Peak plants, 16 inhabit Mauritius, Bourbon or Madagascar, 8 more being closely allied to species from these islands. Only 12 of the 76 are known to be South African, and of these all but *Luzula* have been also found in Abyssinia. *Peddiea* is the only peculiarly South African genus, and this is not temperate at Fernando Po. Dr. Hooker's comparisons establish (1) an intimate relationship between the Flora of Clarence Peak and that of Abyssinia; (2) a curious relationship with the East African Islands; and (3) its almost total dissimilarity from the Cape Flora. The species are enumerated and the new ones described.

——— On the Distribution of Arctic Plants. Linn. Trans. xxiii. 251. With a North-circum-polar Map illustrating the Regions of Vegetation. *Vide* Nat. Hist. Rev. vol. i. Bibliog. p. 101.

——— On Three Oaks of Palestine. Linn. Trans. xxiii. 381.

Quercus pseudo-coccifera, Desf. (a portrait of an example of which, 'Abraham's Oak,' at Mamre, is given), *Q. ægilops*, and *Q. infectoria*. Their synonymy and distribution is given. *Q. pseudo-coccifera* is the most abundant tree throughout Syria, covering the rocky hills with a dense brush-wood. *Q. infectoria* was met with on the eastern slopes of Lebanon, to the south of Safed, and on the summit of Carmel. It is rendered conspicuous by an abundance of red-brown, shining galls. *Q. ægilops*, the Vallonea Oak, is gregarious in Syria, though never forming a brush-wood. It rises to the height of 20 to 30 feet. Two plates are given, exhibiting the variety in form, &c. of the acorn and cup of *Q. pseudo-coccifera* and *Q. ægilops*.

Howard, J. E.—Illustrations of the Nueva Quinologia of Pavon, with coloured plates by W. Fitch, and Observations on the Barks described. Part 7 to end. London, 1861.

Irmisch, Th.—Beiträge zur Morphologie der Amaryllideen. Halle, 1860. 4to. pp. 76. 12 plates.

Forming the first part of the author's "Beiträge zur Morphologie der Monocotylischen Gewächse."

——— Einige Bemerkungen über *Poterium sanguisorba* and *polygamum*. Bot. Z. 1861. p. 45.

A monstrous inflorescence of the former species is described, in which twenty-two long-stalked spikes were produced from the top of the peduncle. The aestivation of *Poterium* and *Sanguisorba* is stated to be imbricate, not valvate, as described in some works.

——— Ein neuer thuringischer Standort der *Diplotaxis muralis*. Bot. Z. 1861. p. 46.

——— Ueber *Polygonum amphibium*, *Lysimachia vulgaris*, *Comarum palustre* und *Menyanthes trifoliata*. Bot. Zeit. 1861. p. 105, 121. With plate.

A minute account of the germination of these species.

——— Ueber zwei varietäten der Brunnenkresse. Bot. Zeit. 1861. 316.

On two forms of *Nasturtium officinale*, water cress, differing in the fruit. They are named vars. *longi-* and *brevi-siliqua*.

——— Noch einige Beobachtungen über die Stipulae bei *Lotus*, *Tetragonolobus* und *Bonjeania*. Bot. Z. 1861. 329. With figures.

——— Eine monstrose Hyacinthe. Bot. Z. 1861. p. 342.

In the axil of two opposite lobes of the perigone double flowers had originated, while other smaller ones were inclosed in the envelopes of the central flower.

——— Ueber die Adventivknospen auf den Wurzeln von *Asclepias syriaca*, L. Verh. Bot. Ver. Brandenb. Hft. ii. p. 122.

Jaubert, M. le Comte.—Note sur quelques plantes du haut Pérou. Bull. Soc. Bot. 1861, p. 114.

With descriptions of two new species discovered by the MM. Grandidier in the Mountains of Peru, *Salpichroma Didieranum* and *Alstroemeria Didierana*.

——— Note sur *l'Attalea funifera*. Bull. Soc. Bot. 1861, p. 156.

Jessen, C.—Ueber *Alopecurus ruthenicus*, Weinm. Bot. Z. 1861. p. 49.

——— Ueber die Lilie der Bibel. Bot. Zeit. 1861. p. 77.

Jordan, A.—Quelques mots sur le Geranium purpureum, Vill. Suivis de la description de deux plantes nouvelles des environs de Grenoble. Paris. 8vo.

Kaesch, W.—Anatomische und Physiologische Beobachtungen über die Reizbarkeit der Geschlechts-organe. Bot. Z. 1861. pp. 25, 33. With 1 plate.

Relating to observations upon the irritable organs of *Berberis* and *Mahonia*, *Cynareae*, *Ruta graveolens*, *Parnassia* and the stigma of *Mimulus*. The minute structure of the filaments of *Berberis* and *Mahonia* is described and compared in young and mature stamens. The structure of the stamens also and the nature of their irritability in the *Cynareae* is explained. Herr Kabsch states the stigma to be fully developed subsequent to the shedding of the pollen by its surrounding anther-tube, consequently fertilization must require insect or foreign agency.

KABSCH, W.—Anatomische und Physiologische Untersuchungen über einige Bewegungserscheinungen im Pflanzenreiche. Bot. Zeit. 1861. pp. 345, 353, 362, 369. With 2 plates.

With detailed account of the structure of the irritable organs in *Stylidium*, *Helianthemum*, *Hedysarum gyrans*, and other species; the influence of an electric current upon their movements, &c. In the common Rock-rose the author considers the minute hairs which surround the base of the stamens to be the irritable organs, the stamens themselves being passive.

——— Ueber contractile und irritabile Gewebe der Pflanzen. Schles. Ges. Bot. Bericht. 1860, p. 4.

With observations on the contraction, through irritation, of the stamens of *Centaureae*.

KARSTEN, HERMANN.—Der unterstandige Fruchtknoten. Bot. Zeit. 1861. p. 153. With 1 plate.

Considered with special reference to *Pomaceae* and *Cactaceae*.

——— Ueber die Wirkung plötzlicher, bedeutender Temperaturveränderungen auf die Pflanzenwelt. Bot. Zeit. 1861. 289.

The author's observations are based upon the stems of tree-ferns (*Balantium* and *Cyathea*) which he had forwarded from Venezuela to Berlin, and which had been exposed to a very low temperature during the transit from Hamburg. Some placed in a warm house never recovered, others (*Balantium*) immersed in cold water were saved, though their temperature was so low that they were coated thickly with ice after some hours immersion. None of the *Cyatheas* lived.

——— De la Vie sexuelle des Plantes et de la Parthénogénèse. Ann. Sc. Nat. iv. Ser. xiii. p. 252.

Preceded by a historical introduction recounting from the earliest observations upon the sexuality of plants to the recent experiments of Braun and Radlkofer. The author claims priority of the discovery of the mode of fructification in *Vaucheria*, and criticises M. Pringsheim's remarks upon it. A detailed account of the structure of *Coenogonium* and of the pollen and formation of the embryo in *Coelebogyne* is given. In this plant the author states that in the Botanic Gardens of Berlin he finds a fifth part

of the flowers to be hermaphrodite. In conclusion Parthenogenesis in the vegetable kingdom is definitively stated not to occur.

Karsten, H.—Florae Columbiae Terrarumque adjacentium Specimina Selecta. Tom. i. fasc. iv.

Craepaloprumnon, a section of the genus *Flacourtia* of Endlicher, the author regards of generic rank. Two new species of *Cinchona* are described. *Sterculia Cola* figures as the type of a new genus of Terebinthaceae, *Siphoniopsis*, Karsten. *Talpinaria*, n.g. is founded upon a Pleurothalloid Orchid from the upper Cordillera. Fasc. v. (completing Vol. i.) includes the following new genera:—*Tammisia* (Rubiaceae) near *Sommera; Schmardæa* (Swieteniae)—this is *Elutheria*, Roem.; *Trimeranthus* (Melastomaceae), near *Chætolepis*, DC.

——— Blumenentwickelung aus der Wurzelspitze. Flora, 1861. p. 232.

Notice of the development of a flower at the extremity of an adventitious root of a Balsam.

——— On the Sexual Life of Plants and Parthenogenesis. A. N. H. iii. viii. ser. v. 7, 81. 200. (Trans.)

——— Plantarum Familiae secundum ordines naturales dispositae. Fol. 1 sheet. Berlin, 1861.

Phanerogamae are divided between the sections *Teleocarpae* (*Angiospermae*, Lindl.) and *Nothocarpae;* the latter grouped under *Ecarpidiatae* (*Balanophoraccae*, *Cynomorieae*, *Loranthaceae*) and *Carpelligerae*, (including *Coniferae*, Juss. and immediate allies.) *Burmanniaceae*, *Rafflesiaceae* and *Cytineae* form the alliance *Aphyllae*, in Monocotyledones. The Natural Orders generally are grouped under the Alliances of Endlicher, Bartling and Linnæus.

Keddie, W.—Notice of a Botanical Trip to Ben Lawers and Schiehallion. Trans. Ed. Bot. Soc. vii. 202.

Kerner, A.—Die Wälder des ungarischen Tieflandes. Bonpl. 1861. pp. 31, 55, 78.

Kerner, J.—*Salix Erdingeri*, eine neue Weidenbastart. Wien Verhandl. xi. 243.

A hybrid between *S. daphnoides* and *S. Caprea*.

Kickx.—Rapport sur une hybride de *Cirsium*, décrite par Wesmael. Brux. Bull. xii. p. 240.

——— Rapport sur quelques plantes recueillies dans les environs de Bruxelles, par L. Piré. Ibid. p. 290.

Kirchhoff, Alf.—De Labiatarum organis vegetativis commentarium anatomico-morphologicum. Erfurti. 1861. 8vo. 31 pp.

Kirschleger, Fr.—Observations sur la derniere livraison des annotations à la Flore de France et d'Allemagne. Bull. Soc. Bot. vii. pp. 435.

Klinggraeff, v.—Zur Flora der Provinz Preussen. Verh. Bot. Ver. Brand. Hft. ii. p. 103.

——— Ueber die Verbreitung einiger Holzpflanzen in der Provinz Preussen. Konigsb. Schrift. Jahrg. ii. 119.

KLINSMNAN, E. F.—Clavis Dilleniana ad Hortum Elthamensem. 4to. Danzig.

KOTSCHY, TH.—Der westliche Elbrus bei Teheran in Nord-persien. Wien. 1861. 8vo. pp. 46.

Giving an extended account of the botany of the region.

——— Umrisse von Südpalästina im Kleide der Frühlingsflora. V. Z.-B. Ges. Wien. 1861. pp. 16.

Notes on the Spring-botany of Southern Palestine, visited by the author in 1855.

KOTSCHY, TH.—Die Eichen Europa's und des Orients. Liefg. vi. With 5 plates.

LACROIX, S. DE.—Des Capsella Bursa-pastoris, Moench, *C. rubella*, Reut. *C. rubescens*, Pers. *C. gracilis*, Gren. Bull. Soc. Bot. viii. p. 258.

LANDERER, X.—Zusammenstellung der Forstgewächse in Griechenland. Bonpl. 1861. p. 192.

LASSUS, A. DE.—Analyse du Mémoire de Gaetan Monti sur *l'Aldrovandia*, suivie de quelques observations sur l'irritabilité des *follicules* de cette plante. Bull. Soc. Bot. viii. 519.

Noting the irritability of the terminal appendages of the leaves.

LECOQ.—Botanique populaire, contenant l'histoire complète de toutes les parties des plantes et l'exposé des règles à suivre pour décrire et classer les végétaux, avec application à l'agriculture et à l'horticulture. In-18 jésus, 408 p. Paris.

LEFÉVRE, ED.—Aperçu sur la flore de l'arrondissement de Chartres, Supplément. Chartres. 8vo. 1860. pp. 8.

LEMAIRE, C.—Genre nouveau de la Famille des Asparagacées. (Ext. de l'Illust. Hort. 1861.) With 1 plate.

Beaucarnea founded on three Mexican species.

LÉPINE, JULES.—Note sur le Veppamarum Vembou (*Azadirachta indica*, Juss.) Bull. Soc. Bot. 1861. p. 95.

On the medicinal properties of the plant, and characters of an oil extracted from the seeds, &c.

LETOURNEUX, T.—Sur la Distribution Géographique des Plantes dans le Département de la Vendée et les Régions voisines. Bull. Soc. Bot. 1861. pp. 91, 124, 160.

LINDLEY, JOHN.—On Japanese Coniferae. Gard. Chron. 1861, p. 265. With a description of *Veitchia*, n. g.

LINDSAY, W. L.—The Flora of Iceland. 40 pp. 8vo. Ext. Phil. Ed. 1861, and Trans. Ed. Bot. Soc. vii. 114.

With a revised catalogue of species hitherto found in the island. The total number of Phanerogams is stated at 426, of which 136 are Monocotyledons. Of Cryptogams 437 species are enumerated.

LIVINGSTON, JOHN S.—Expériences sur les effets des Gaz narcotiques et caustiques sur les Plantes. Ann. Sc. Nat. iv. Ser. xiii. p. 297.

Translated from the "Transactions of the Edinburgh Botanical Society."

LLANOS, FR. A.—Nuevo apéndice ó suplemento a la Flora de Filipinas del P. Fr. M. Blanco. Mem. Ac. Cien. Madrid. iv. 495.

Including descriptions of the genera *Zarcoa* (apparently a *Briedelia*, referred to Sterculiaceae), *Baranda* (Barringtoniaceae), *Castañola* (Terebinthaceae).

LLOYD, JOHN.—*Isatis tinctoria*. Phytol. 1861. p. 151.

On the occurrence of the plant near New Wandsworth. (The *Isatis* was sown by Mr. Hanbury, *Ed.*)

LOGIE, ALEX.—List of Plants found growing in the Neighbourhood of Hamilton, during the years 1859 and 1860. Ann. Bot. Soc. Canada, Vol. i. p. 90.

LOTHIAN, J.—Botany of Argyleshire. Phytol. 1861. 331.

LOWE, JOHN.—On the Homologies of the Floral Organs of Phanerogamia and the Higher Cryptogamia. Trans. Bot. Soc. Ed. vii. 215.

LUCAS, C.— Flora der Insel Wollin. Verh. Bot. Ver. Brandenb. Hft. ii. p. 25.

MACVICAR, DR.—The Theory of Terminal Fructification in the Simple Plant, of Ovules and Pollen, and of Spores. Trans. Ed. Bot. Soc. vii. 13, and Ed. Phil. Journ. 1861.

MANN, G.—Account of the Ascent of Clarence Peak, Fernando Po; altitude 10,700 feet. Linn. Journ. vi. 27.

Shrubs grow to between 400 to 500 ft. of the top, amongst them a tall *Erica*. A large *Hypericum* forms the greatest part of the bush at a high elevation.

MARCHAND, LÉON.—Du *Croton Tiglium*. Recherches botaniques et thérapeutiques. Paris, 1861. 4to. pp. 94. 2 plates.

——— Recherches botaniques sur le *Croton Tiglium*. Baill. Rec. d'Obs. Bot. i. 232. With 2 plates.

A minute account of the structure of the plant.

MARSSON, TH.—Ueber Corydalis pumila, Rchb. Verh. Bot. Ver. Brandenb. ii. p. 72.

MARTINS, C.—Des circonstances qui peuvent déterminer la floraison de *l'Agave americana*. Bull. Soc. Bot. viii. 575.

M. Martins suggests that the flowering of the Aloe may, in certain cases, be the result of 'debilitating causes,' as a recent transplanting or mutilation.

MARTIUS, C. F. PH. VON.—Flora Brasiliensis. Fasc. xxvii. pars.

Antidesmeae (vide Tulasne), Begoniaceae (v. A. De Candolle), Celastrineae, Ilicineae, et Rhamneae (v. Reissek).

——— Ueber den Charakter und die Systematische Stellung der beiden Pflanzengattungen *Labatia*, Swartz, und *Pouteria*, Aubl. Münch. Sitzb. 1861. 571.

Pouteria is a spurious genus, based upon flowering specimens of a *Labatia* and fruits of a *Tiliacea*, near *Sloanea*.

——— *Mourouca*, Aubl., eine ächte Convolvulaceen-Gattung. p. 578.

A detailed description founded on Surinam specimens of Splitgerber's. The genus is shown to be truly Convolvulaceous; the stamens alternating with the corolla-lobes, not opposite to them, as stated by Aublet.

MASON, F.—Burmah, its People and Natural Productions, &c. Including a Catalogue of Plants, with their vernacular names and native uses. Rangoon, 1860. 1 vol. 8vo.

MASTERS, M. T.—On the Normal and Abnormal Variations from an assumed Type in Plants. Rep. Brit. Ass. 1860. 112.

——— Remarks on the Theory of the Metamorphosis of Plants. Trans. Ed. Bot. Soc. vii. 54.

——— Note on an unusual mode of Germination in the Mango. Linn. Journ. vi. 24. With cuts.

Referring to two specimens in the Kew Museum. One of the cotyledons is absent in both: the plumule, in one case, gives off no shoot at all; in the other, it gives rise to three shoots from its side: adventitious roots, moreover, spring from one of the cotyledons.

——— On Prolification in Flowers, and especially on that Form termed Median Prolification. Linn. Trans. xxiii. 359.

European Natural Orders most frequently affected by Median Prolification (the development of an adventitious bud from the centre of the flower) are *Ranunculaceae*, *Caryophyllaceae*, and *Rosaceae*: it is also commonly met with in *Scrophulariaceae*, *Primulaceae*, and *Umbelliferae*. Mr. Masters considers plants having an 'indefinite' inflorescence to be more subject to it than those with a 'definite' one. The relation is pointed out between this deviation and the normal prolongation of the axis occurring between the whorls of the flower, or in the carpellary cavity. Instances of prolification are figured from *Geum rivale*, *Phlomis fruticosa* (in which a sessile adventitious flower-bud and a single carpel with a basilar style occupy the place of the 4-lobed ovary), *Digitalis purpurea*, *Aquilegia*, *Campanula* (with a free calyx, and a bud replacing the pistil), and *Fuchsia*.

MICHALET, EUGÈNE.—Sur la Floraison des *Viola* de la section NOMIMIUM, de *l'Oxalis acetosella* et du *Linaria spuria*. Bull. Soc. Botan. vii. p. 465.

The structure of the so-called 'apetalous' flowers of *Viola alba*, Bess. is described. These are found to have minute hyaline petals, sometimes reduced to one or two in number. The anthers were never found open, even in flowers the ovary of which had been fecundated. The stigma is described as obliquely truncate and hollowed into a funnel, the lower part of which communicated directly with the cavity of the ovary. After fecundation, the canal becomes obliterated. The mode of fertilization of the ovules remains obscure. *V. hirta* and *V. odorata* present a similar structure in their 'apetalous flowers.'

In *Oxalis acetosella*, M. Michalet finds the ordinary pedunculate spring flowers to be succeeded by others about the size of a pin's head, very shortly pedunculate and often hypogean. The structure of these is described. The emission of pollen from the anthers has not been observed. The seeds produced by these flowers do not appear to differ from those of the first

flowering. In *Linaria Elatine* axes are found to develop from the lower leaf-axils which bury themselves beneath the surface, bearing flowers imperfectly developed, but not offering any remarkable structural peculiarity. Fertilization takes place as in ordinary flowers.

MIÈGEVILLE, L'ABBÉ DE.—*Trisetum agrostideum*, Fr. in the Pyrenées. Bull. Soc. Bot. viii. 448.

MIERS, JOHN.—Observations on the Bignoniaceæ. A. N. H. 1861. Ser. 3, vol. vii. p. 153.

A minute description is given of the structure of the seeds and fruit in several genera of the Order. The former are usually provided with three distinct integuments—the outermost often expanding into a broad wing, shown to be the true testa by the passage through it of the raphe,—and an intermediate coriaceous layer, probably a development of the secundine, and a third, provided with distinct chalaza, attributed to the tercine. In reference to the carpellary structure of Bignoniaceæ, Mr. Miers advances the hypothesis that the pistil (in *Eubignonieæ*) is composed of four plicate carpellary leaves bearing ovules, not on their margins but midribs, and confluent by the sterile margins and adjacent faces of each pair,—thus constituting a bilocular ovary. The bilobate stigma is assumed as composed of four stigmata confluent in pairs, as, according to the author, is constant in Boraginaceæ, Labiatæ, &c. In *Catalpeæ*, with the dissepiment of the fruit transverse to its faces, a quadricarpellary origin is also maintained,—the arrangement of the carpels and the placentation being different. In the tribe *Platycarpeæ* (Miers) the pistil is normally bi-carpellary. *Amphicoma* Mr. Miers considers to belong to *Cyrtandraceæ*. A description is added of a Bignoniaceous fruit (referred to *Tanaecium albiflorum*, DC.) in the British Museum collection, remarkable from the parietal attachment of the seeds. —ibid. pp. 255-268. In *Crescentiaceae*, Mr. Miers regards the ovary as made up of two carpels, placentiferous on their midribs and conjoined by their thickened sterile margins. In *Cyrtandreae*, held of Ordinal rank, and *Pedaliaceae*, a similar structure of the ovary obtains. *Sesameae*, having an ovary normally composed of four carpels, placentiferous on their inflected margins which form a central column, the author would exclude from Bignoniales. A placenta-bearing midrib of the carpels he believes to be universal among Bignoniaceae, Crescentiaceae, Cyrtandraceae, Pedaliaceae, and Gesneraceae. Observations upon the relative position, &c. of the anther-lobes in certain genera of Bignoniaceae are given.—ibid. pp. 386 to 396. An amended description of *Adenocalymna*, and descriptions of five new species. —Vol. viii. pp. 111 to 120. *Tanaecium* is referred to Eubignonieae, near to *Adenocalymna*. In the remodelled diagnosis of this genus the ovary and fruit are described as bi-locular. *T. parasiticum*, Sw. is considered to be a *Schlegelia*, and truly Crescentiaceous.

Miers, John.—On the History of the 'Maté' Plant, and the different species of *Ilex* employed in the Preparation of the 'Yerba de Maté,' or Paraguay Tea. A. N. H. 3. Ser. viii. 219, 389.

Mr. Miers points out that several species are theiniferous, and furnish Maté tea. The *Ilex Paraguayensis* described by Reissek in Martius' 'Flora Brasiliensis' is not the plant of St. Hilaire, but made up of two species, discriminated by Bonpland, and published by Mr. Miers under his M. S. names. Several other Maté *Ilices* are described.

Mik, Joseph.—Flora der Umgebung von Olmütz. Olmütz. pp. 148. 12mo.

Milde, Dr.—Mittheilungen über die schlesische Flora. Schles. Ges. Bot. Bericht. 1860. p. 9.

Miquel, F. A. W.—Flora Indiae Batavae. Supplementum ii. Amsterdam, 1861. With 1 plate.

With a continuation of the list of Sumatra plants and statistical summary of the Flora. The total number of species enumerated is 2642, of which 1409 have not yet been found in Java. Monocotyledons form over one-seventh of the Phanerogamous vegetation. The catalogue is followed by descriptions of plants new to the first volume of the author's 'Flora Indiae Batavae.'

The new genera described are *Parapanax* (Araliaceae), *Gonocaryum* (Phytocreneae?), *Skaphium*, *Inodaphnis* (Thymeleaceae). *Parartabotrys* (Anonaceae), *Trigoniastrum* (Malpighiaceae), *Carpophyllum*, *Ptychopyxis* (Sterculiaceae), *Anaua* (Elaeocarpeae), *Microsepala*, *Austrobuxus*, *Leiopyxis*, *Coccoceras*, *Tetragyne*, *Samaropyxis* (Euphorbiaceae et aff.), *Calyptroon* (Aporoseae), *Rhinostigma* (Guttiferae), *Paranephelium* (Sapindaceae), *Nothoprotium* (Amyrideae?), *Nothocnestis*, *Troostwykia* (Connaraceae), *Tetramerista* (Ochnaceae?), *Strobidia* (Scitamineae).

——— Prodromus systematis Cycadearum. 4to. Utrecht, 1861.

——— Remarques sur la flore du sud de la Chine. Jour. Bot. Ned. 1861. 84. With descriptions of new species.

——— Revue des Palmiers de l'île de Sumatra. Journ. Bot. Néerland. i. p. 1.

An enumeration of species, including novelties collected by M. Teysmann. Referring to the important differences subsisting between the Flora of Sumatra and that of Java, and the relations between the former and that of the Malay Peninsula, Borneo, Celebes, and the Moluccas, Prof. Miquel observes that species and genera of Palmaceae are found in Sumatra which have not yet been discovered in Java (*Bentinckia*, *Iguanura*, *Calyptrocalyx*, *Pholidocarpus*, *Teysmannia*), while some of them are represented at Malacca and in the Moluccas.

——— *Elodea canadensis*, Rich. acclimatée dans les Eaux d'Utrecht. p. 29.

With an analysis of the ash of this plant by M. Bisdom.

MIQUEL, F. A. W.—Plantes nouvelles cultivées dans le Jardin Botanique de l'Université d'Utrecht. p. 33.

——— Remarques sur la Flore du Sud de la Chine. p. 84.

An enumeration of plants, with description of novelties, collected by B. Krone in the S. E. of China, principally in the province of Canton.

——— Bourgeons développés sur les racines des Fougères. Jour. Bot. Ned. 1861. 134. Directing attention to buds which form on the adventitious roots of a *Diplazium.* These separate, forming independent plants.

——— Note sur quelques espèces de *Cinchona.* Jour. Bot. Ned. 1861. 139. Descriptions of two species collected by Lechler in Peru.

——— Temperature élevée du Spadice d'un *Philodendron Selloum,* C. K. dans le jardin botanique de l'université d'Utrecht. Journ. Bot. Ned. p. 144.

With a register of hourly observations. The maximum difference between the temperature of the spadix (the polleniferous surface) and that of the conservatory, was 36° F.

——— Note sur les Figuiers de la Nouvelle-Hollande. Jour. Bot. Ned. 1861, 230.

New species are described. All the sections of the genus *Urostigma* are represented in New Holland.

——— Remarques sur quelques espèces de *Nepenthes.* With 2 plates. Journ. Bot. Ned. 1861. 272.

With an account of species collected by Teysmann. General observations are added upon the distribution of *Nepenthes,* and the structure of the stem. Most of the species occupy a limited area, but one ranges in S. E. Asia from the Khasia Mountains, Cochin China, and Macao on the North, to New Guinea, Java, and the Louisiade Archipelago. Species occur from the sea-level to the summits of the volcanic mountains, growing upon calcareous and syenitic rocks, sandy plains, and the vegetable soil of the forests.

MOHL, H. VON—Ueber das Kieselskelett lebender Pflanzenzellen. Bot. Zeit. 1861. pp. 209, 217, 225.

The results of the author's own investigations are preceded by a review of previous observations on the occurrence of silica in plants, the methods employed for the removal of organic matter and isolation of the siliceous framework, general remarks on the distribution through Phanerogamous Orders of plants abounding in silica, and the relation of the amount of silica in an organ, as the leaf, to its external appearance—in respect of which Herr von Mohl states that, as a rule, its aspect does not determine whether or not it would leave a siliceous skeleton on being burnt. With regard to the relation of the silica to the cell-membrane,—whether it occur in a kind of organic union with the cellulose wall, or, as suggested by several observers, in the form

of minute laminae, granules, or spiculae embedded in its substance, or as an encrusting layer on the outer or inner side of the cell,—the author's observations establish the first condition; the question, however, as to the precise mode of union of the silica with the membrane, whether there is a chemical combination between them, or a mechanical deposition of silex between the molecules of cellulose, is left for chemists to determine. It is shown that the deposition of silica certainly takes place in living and even growing organs, contrary to Crüger's opinion that tissues do not become siliceous during active life. From the shields of *Diatomaceae*, which Kützing believed to consist of pure silica, H. v. Mohl finds an organic membrane, retaining the form and markings of the valve, to remain after removal of the silica by fluoric acid. The cells of the mesophyllum and also the vascular bundles of leaves are found sometimes to be more or less silicified; yet, between the siliceous character of the epidermis and that of these inner tissues, there is no constant relation. In many plants with a strongly silicified epiderm, no trace of silica is found in the veins and midrib, while on the other hand, the vascular bundles may have a large deposit of silica, as in the Oak, Beech, &c., while the epidermis is but very slightly silicified. Observations are added on the occurrence of siliceous masses or nuclei in the cavity of the cells, as observed by Crüger.

Mohl, H. von.—Ein Beitrag zur Geschichte der Keimung. Bot. Z. 1861. p. 257.

The author finds in the albumen of *Pinus Pinea*, and *Ricinus communis* during germination, a change of the oily cell-contents into sugar, through an intermediate stage of starch formation, as in the case of embryos had been previously remarked by Dr. Sachs, who, however, failed to observe this sequence of change in the albumen of *Ricinus*.

The exceptional character of starch formation as a transitional stage in the formation of sugar from the fatty oil of the albumen, suggested the probability that it might stand in connection with a growth of the albumen, which measurements of germinating seeds of *Ricinus* showed to be the case. The increase in bulk is shown not to be dependent on the hygroscopicity of the albumen cells, but to be due to an actual growth. H. v. Mohl confirms Dr. Sachs' observation of the formation of Chlorophyll in the cotyledons and upper part of the axis of germinating plants of Pines notwithstanding complete exclusion of light.

——— Nachtrag zu dem Aufsatze über des Kieselskelett lebender Pflanzenzellen. Bot. Zeit. 1861. 305.

The author finds siliceous deposits in 42 Natural Orders. Species are enumerated in which both the epiderm and vascular bundles of leaves were silicified, also those in which silex was found in the epiderm only. In connection with the unequal distribution in the epidermis of silex and its deposit in more

marked degree in the cells forming the boss or shield around the base of the hairs, the occurrence is remarked in these of cystolith-like, white bodies, penetrated with carbonate of lime; after the removal of the latter by muriatic acid, excentrically stratified processes remain, projecting from a corner of the cell, analogous to the peduncles of cystoliths. These exhibit cellulose reaction with chloride of zinc and iodine.

MOORE, ALEX. G.—On the occurrence of *Festuca ambigua*, Le Gall, in the Isle of Wight. Linn. Proc. v. p. 189.

A description is furnished from fresh Isle of Wight specimens. The plant is contrasted with its allies *F.* (*Vulpia*) *ciliata* and *F.* (*V.*) *pseudo-myurus*.

MÜLLER, K. (Berol.)—Annales Botanices Systematicae. (Walpers.) vi. Fasc. i. ii. Fluviales to Orchidaceae.

MÜLLER, C.—De Graminibus novis vel minus cognitis. Bot. Zeit. 1861. pp. 313, 323, 338.

Description of species from various quarters, including several of Griffith's East Indian plants.

MUELLER, F.—Observations on some hitherto undescribed Plants from New Zealand. Trans. Ed. Bot. Soc. vii. 153.

——— Indigenous Vegetable products of the Colony of Victoria. Technol. ii. 120.

MÜLLER, PH. J.—Rubologische Ergebnisse einer dreitägigen Excursion in die granitischen Hoch-Vogesen der Umgegend von Gérardmer (Vogesen-Depart. Frankreich). Bonpl. 1816. 276.

The author found on his three-days' tour 43 'species' of *Rubus* of which 31 are said to be new! German descriptions of these are given.

MÜNCH, PFARRER.—Mittheilungen über einige Nelkenarten. Flora, 1861. p. 385.

Critical, &c., observations on four species of *Dianthus*.

MUNRO, W.—On the Identification of the Grasses of Linnaeus's Herbarium, now in the possession of the Linnean Society of London. Linn. Journ. vi. 33.

NAEGELI, C.—Ueber die Siebröhren von *Cucurbita*. Münch. Sitz. Ber. 1861. 212. With 2 plates.

Siebröhren was the term applied by Hartig to certain vertically superimposed series of cells, the septa of which he believed to be perforated, found in the bast-layers of various plants. These apparent perforations v. Mohl regarded as thinner portions of the membrane, and proposed to substitute the name 'Gitterzellen' for *Siebröhren*. The author's investigations apply chiefly to the minute structure of the transverse septa of the 'Siebröhren' and their influence on the transmission of fluids.

——— Ueber die Verdunstung an der durch Korksubstanz geschützten Oberfläche von lebenden und todten Pflanzentheilen. p. 238.

With tabulated results of numerous experiments upon peeled

and unpeeled potatoes and apples, instituted with a view to determine whether living and dead tissues are alike affected when exposed to evaporation, or diversely, and to what extent. In order to kill the tissues they were exposed to frost; the kinds of apple, however, submitted to experiment were not affected by it. Potatoes and apples were selected on account of the cork-cells of their superficial layers, which prevent rapid evaporation and enable the tissues to retain vitality some time after separation from the parent plant.

NAEGELI, C.—Ueber die Wirkung des Frostes auf die Pflanzenzellen. p. 246.

Upon the questions (1), Are there cells the fluids of which may be frozen without detriment to vitality?, and (2), What alterations does frost occasion in the cell-membrane and contents?

NAUDIN, M.—Sur les Plantes hybrides. Rev. Hort. 1861. 396.

M. Naudin considers hybrid plants more frequently fertile than sterile. *Petunia violacea* and *P. nyctaginiflora* two species which are perfectly stable when fertilized by their own pollen, may be easily hybridized, yielding intermediate forms, closely resembling each other, and as fertile as their parents. Naudin's experiments generally establish the fact that hybrids of the first generation are very uniform; the second and subsequent generations show, however, great inconstancy. Of 47 plants raised from a hybrid between the above species of *Petunia*, but one repeated its parent.

NITSCHKE, TH.—Morphologie des Blattes von *Drosera rotundifolia*, L. Bot. Zeit. 1861. p. 145.

——— Einige Bemerkungen zu meinem Aufsatze: "Morphologie des Blattes von *Drosera rotundifolia*, L." und des Herrn Prof. Caspary Beurtheilung desselben. Bot. Zeit. 1861. p. 221.

——— Anatomie des Sonnenthau-blattes (*Drosera rotundifolia*, L.) Bot. Zeit. 1861. pp. 233, 241, 252. With 1 plate.

——— Wider des H. Prof. Caspary neuste Polemik gegen meine Aufsätze über *Drosera rotundifolia*, L. Bot. Zeit. 1861. 308.

NORMAN, A. M.—Notes on the Botany of the South Durham Ballast Hills in the year 1861. Trans. Tyneside Nat. Club. v. 136.

——— On the Species into which the Linnean *Polygonum aviculare* has been divided by Continental Botanists. ibid. 140.

ŒRSTED, A. S.—Til Belysning af Slaegten Viburnum. Vidensk. Medd. 1860. Ext. pp. 38. With 2 plates.

A monograph of the Linnean genus *Viburnum*, here treated as a tribe of Sambuceae, and broken up into five genera, *Oreinotinus* (America), *Microtinus* (Himalaya, China), *Solenotinus* (India), *Viburnum* and *Tinus*.

OLIVER, DANIEL.—The Natural Order *Aurantiaceae*, with a Synopsis of the Indian Species. Linn. Proc. Suppl. Vol. v. (Bot.) p. 1.

The species of *Sclerostylis* of Dr. Wight and *Triphasia monopylla* are referred to *Atalantia*, *Sclerostylis* being suppressed.

Bergera is included in *Murraya: Piptostylis* of Dalzell, and *Cookia* in *Clausena: Arthromischus*, Thwaites, is reduced to *Paramignya*. A synopsis of the genera is given, with an enumeration of Indian species, many of which are described at length. A few extra-Indian species are also described within brackets.

Oliver, Daniel.—Official Guide to the Kew Museums. A Handbook to the Museums of Economic Botany of the Royal Gardens. London, 1861. pp. 82.

Ondaatje, W. C.—On the Sack-tree of Ceylon (*Antiaris saccidora*). Technol. ii. 105.

Oudemans, C. A. J. A.—Notice sur un *Pandanus spiralis*, R. Br. (♂), qui a fleuri dans le Jardin botanique d'Amsterdam. 4to. pp. 6. 2 plates.

——— Ueber den Sitz der Oberhaut bei den Luftwurzeln der Orchideen. Amst. Verh. 1861. p. 32.

——— Note préliminaire sur quelques Cupulifères de Java. Journ. Bot. Ned. 1861. 241.

Critical Notes on Blume's species, &c.

——— Voorloopige mededeeling aangaande de uitkomsten verkregen bij eene herziening van eenige Javaansche Cupuliferen. (Ext. K. Ak. Wet. Amst. xii. 1861).

Ozanon, Ch.—Note sur les Plantes les plus remarquables du versant méridional de la Montagne-noire, recueillies en Juin 1860, dans le Canton de Mas-Cabardès, Arrondissement de Carcassonne (Aude). Bull. Soc. Bot. 1861. pp. 119. 165.

Parlatore, Ph.—Deuxième note sur la composition du cone des Conifères. 5 pp. 4to. Paris, 1861.

The author regards the cone of Coniferae as a branch, the leaves of which are reduced to bracts, the flower-bearing branches frequently abbreviated, with scaly, more or less connate bracteoles, and the female flowers reduced to a pistil, consisting of a uniovulate ovary with style and two short stigmata. The form and arrangement of the bracteoles, &c., in Abietineae, Cupressineae, Taxineae, Podocarpeae and Gnetaceae are described, and the relation of their structure to that of Amentaceous Dicotyledons indicated.

——— Note sur *l'Araucaria brasiliensis*, et sur une nouvelle espèce *d'Araucaria* d'Amerique. Bull. Soc. Bot. 1861. p. 84.

With a description of *A. Saviana*, sp. nov. cultivated in the Botanic Garden at Pisa, and believed to be from Bolivia.

——— Description de trois espèces nouvelles de Cyprès cultivèes dans le Jardin botanique du Muséum de Florence. Ann. Sc. Nat. iv. Ser. xiii. p. 377.

All probably of Eastern origin, and species which have been hitherto confused with *Cupressus pyramidalis* and *C. horizontalis*.

——— Note sur la Composition du cône des Conifères. Comptes Rend. iii. p. 164.

Upon the cone-scale, which the author regards as a modified

flower-bearing axis, borne by a bract or bracts with which it is adnate. The envelopes of the nucleus M. Parlatore believes to be carpellary.

Pauckert, C. A.—Flora von Treuenbrietzen (Schluss). Ver. Bot. Ver. Brandenb. Hft. ii. p. 1.

Payen, M.—Amidon des fruits verts. Relations entre ce principe immédiat, ses transformations, et le développement ou la maturation de ces fruits. C. Rend. viii. 814.

Showing the presence of starch in ripe fruits.

Perger, A. R. von. — Ueber den Gebrauch unserer heimischen Pflanzen bei kirchlichen und weltlichen Festen. Wien Verhandl. xi. 279.

Personnat, V.—Sur une forme inédite du *Capsella bursa-pastoris.* Bull. Soc. Botan. vii. p. 511.

C. rubescens, V. P. distinguished at sight from *C. bursa-pastoris* by the red and white flowers and red coloration of upper part of fruit.

——— Sur quelques Plantes des Alpes de Savoie. Bull. Soc. Bot. viii. 461.

Peter, Herm.—Untersuchungen üb. den Bau u. die Entwickelungsgeschichte der dicotyledonischen Brutknospen. Inaugural-Dissertation. Mit 2. Taf. gr. 8. Hameln.

Philippi, R. A.—Ueber *Ocymum salinum*, Molina. Bot. Z. 1861. p. 259.

This plant described by Molina in "Saggio sulla storia naturale del Chili," as being found every morning covered with small particles of salt glittering like dew drops, Dr. Philippi shows to be *Frankenia Bertœroana*, Gay. An analysis is given of the salt. *O. salinum* is quoted as a synonym of *O. minimum*, L. by Mr. Bentham in the Prodromus (xii. 33). Molina's mistake the author explains in the same way that he would his describing an *Erodium* as a *Scandix*, a stag as a horse, &c. &c.!

——— Botanische Excursion in die Provinz Aconcagua. Bot. Zeit. 1861. 377.

——— Zwei neue Gattungen der Taxineen aus Chile. Linnaea. xxx. p. 730.

Lepidothamnus and *Prumnopitys.* The author remarks the very limited distribution of most of the Chilian Coniferae. *Libocedrus andina* and a *Podocarpus* appear to be the only species universally distributed.

Pitra, Adolph.—Ueber die Anheftungsweise einiger phanerogamen Parasiten an ihre Nährpflanzen. Bot. Zeit. 1861. pp. 53, 61, 69. With 1 plate.

An account of the parasitism of *Viscum album*, *Lathraea*, *Rhinantheae*, *Thesium ramosum*, *Phelipœa ramosa*, *Cuscuta.*

Planchon, J. E. et J. Triana.—Sur la Famille des Guttifères. Bull. Soc. Botan. viii. p. 26.

The authors attribute much importance, in classification, to the

characters of the seed and embryo. The Tribes *Calophylleae* and *Quiineae* have a small tigellus with large, free, or connate cotyledons. Observations are recorded on the varied structure of the episperm of the *Clusieae*, the position of the raphe, aestivation of the floral whorls, and symmetry of the flowers.

Planchon, J. E. et J. Triana.—La vraie Nature de la Fleur des Euphorbes expliquée par un nouveau genre d'Euphorbiacées. p. 39.

Confirming the view of R. Brown and others as opposed to the Linnean view and recent arguments of Payer and Baillon, founded on organogenic study, that each stamen is a monandrous male flower, &c. With description of *Calycopeplus*, gen. nov.: perhaps the undescribed genus alluded to by R. Brown in Remarks on Botany of Flinders' Voyage, as possessing, at the point of articulation of the several male and female flowers, a true calyx.

——— Sur la Famille des Guttifères. Conspectus Diagnosticus. Bull. Soc. Bot. 1861. pp. 66, 96.

The new genera are *Oxystemon* (New Grenada), *Polythecandra* (Amazon and Guiana), *Balboa* (New Grenada), *Oedematopus* (Brazil), *Pilosperma* (New Grenada).

——— Mémoire sur la Famille des Guttifères. A. S. Nat. Ser. iv. xiii. 306, xiv. 226, xv. 240.

The first section of this important monograph is devoted to the systematic treatment of the Order—the classification, synonymy, and affinities of the genera. The authors attach a primary importance to the characters of the embryo for the distribution of the genera. Three marked types of its structure are recognized: viz.—1. With a very large tigellus, and small but distinct cotyledons (constant in all Guttiferae with capsular fruit and axile placentation). 2. With a very large, more or less tuberiform tigellus, presenting a pith which has been sometimes taken for the embryo, and sometimes described as the commissure of united cotyledons, or as an internal radicle. The cotyledons are absent, or represented by superficial folds on the seed. And 3. With a very small tigellus and large cotyledons, free or united. Besides reforming the characters of published genera, the following, in addition to those mentioned above, are described as new:—*Clusiella*, *Havetiopsis*, *Tovomitopsis*, and *Montrouziera* (Pancher). Many new and imperfectly known species are described.

Ples, M.—Examen d'une matière blanche inorganique, déposée dans l'interieur du tronc de l'arbre Djati *(Tectona grandis)*, à Java. Jour. Bot. Ned. 1861. 135.

The concretion was formed of phosphate of lime.

Pokorny, A.—Untersuchungen über die Torfmoore Ungarns. Wien. Sitzungsb. xliii. 57. With 1 map.

Polonio, A. F.—Osservazioni di botanica diagnostica, tratte dall' erbario Gasparrini esistente nell' orto botanico di Pavia. A. Soc. Ital. Sc. Nat. iii. 344.

Prillieux, Ed.—Observations sur la Germination du *Miltonia*

spectabilis et de diverses autres Orchidées. Ann. Sc. Nat. iv. Ser. xiii. p. 288. With 1 plate. And Bull. Soc. Bot. viii. 19.

In *Miltonia*, the ovoid embryo contained within the testa presents neither cotyledon, plumule, nor radicle. On the side next to the foramen (?) (l'ouverture du sac (testa)), is a cellular process commonly found in the ripe seed of a considerable number of species: it consists of cells placed end to end, and disposed either in one or two rows. With germination, the embryonary body (of *Miltonia spectabilis*) becomes green, enlarges, and bursts the testa; then develop, at various points on its lower surface, papillae similar to the hairs borne on the roots of Phanerogamia. These papillae, which originate in groups of from two to four, are destined to derive the needful food for the growing plant from the soil. When the embryo has acquired the size of a poppy-seed, the apex flattens and becomes rather depressed towards the centre. At the bottom of the depression originates the first leaf of the plant. Finally, after very various intervals, roots appear: their absence in the earlier stages of germination the author couples with the rudimentary, arrested condition of the embryo.

Prillieux, Ed.—Note sur des Fleurs monstrueuses dimères et monomères d' *Epidendrum Stamfordianum*. Bull. Soc. Bot. 1861. p. 149.

These monstrous flowers, which occurred under three forms, were scattered here and there upon the branches of an inflorescence. The departure from the normal condition consisted in a reduction in the number of parts of the perianth. These forms were—(1.) With each verticil of the perianth consisting of two segments, viz. two sepals, a petal, and labellum—the parts of the perianth decussating. (2.) The inner verticil, instead of a petal and labellum, presented two labella opposed to each other, and each united to the base of the column; the flower being both regular and symmetrical. (3.) In two flowers the verticils were reduced each to a single segment, the outer being represented by a sepal, the inner by a labellum—these being opposite to each other.

——— Note sur des Fleurs monstrueuses de *Fuchsia*. Bull. Soc. Bot. viii. 194.

In which the petals were provided with a long claw, often adnate to the opposing stamen.

Puel, T.—Note sur l'herbier de feu M. Chaubard. Bull. Soc. Bot. vii. p. 499.

——— Note sur le *Clypeola Jonthlaspi*. Bull. Soc. Bot. viii. 229.

Its occurrence in the Département Du Lot.

———Revue critique de la Flore du Département Du Lot. (Suite.) Bull. Soc. Bot. viii. pp. 291, 300, 331, 445, 467, 538, 584, 630.

Rand, E. S., jun.—The Heather *(Calluna vulgaris)*, a native of the United States. Am. Journ. Soc. xxxiii. 22.

Found near Tewkesbury, about twenty miles N.W. of Boston.

Ratzeburg.—Anfrage, ob Ueberwallung abgehauener Fichten und Tannen (Stocküberwallung) auch an ganz isolirten Stämmen, oder nur an verwachsenen vorkommt. Verh. Bot. Ver. Brandenb. Hft. ii. p. 69.

Ravin, E.—Catalogue méthodique et raisonné des plantes qui croissent naturellement dans le département de l'Yonne. Extr.—Bull. Soc. Sc. de l'Yonne, 1861. xiv. 39.

Regel, E.—Catalogus Plantarum quæ in horto Aksakoviano coluntier. 1 vol. 8vo. 1860.

Some novelties are described.

Regel, E.—Uebersicht der Arten der Gattung *Thalictrum*, welche im russischen Reiche und den angraenzenden Ländern wachsen. Moskau, 1861. 1 vol. 8vo. With 3 plates.

Preceded by observations on the peculiar difficulties of the study of this group, in which the more abundant and complete the material, and the more closely it is studied, the more difficult it becomes to define the various forms, whether as species or varieties. The species treated of are 19. They are grouped under sections in the author's *Clavis* according to the length or absence of a stipes to the carpels. The sub-sections rest upon the form of the filament. No new species are described. *T. saxatile*, Schl. and *T. flexuosum*, Bernh. are treated as varieties of *T. minus*, L.

——— Nachträge zur Flora der Gebiete des Russischen Reichs östlich vom Altai bis Kamtschatka und Sitka. Being the Botany of Radde's Expedition in Eastern Siberia, 1858-9. Vol. i. pp. 211. Moskau. 1861. With 5 plates.

This enumeration, which extends from Ranunculaceae to Cruciferae (*Brassica*), includes, besides Radde's Baikal, Dahurian and Amur plants, those collected by Stubendorff, Rieder and others in Kamtschatka, or on the route thither. Some critical genera, as *Aconitum*, *Pulsatilla*, &c., are elaborated in much detail. No new genera are published.

——— Monographia Betulacearum hucusque cognitarum. Mosquae. 1861. 4to. pp. 129. With 17 plates.

A monograph of the Betulaceae of Bartling, including the genera *Betula* and *Alnus*. Of the former genus 19, of the latter 14, species are described. A *Clavis specierum* is prefixed to the detailed Latin descriptions of the species of each genus; the extended observations are in German. *Betula glutinosa*, Fries (Summa Veg.), and *B. pubescens*, Ehrh. are treated as varieties of *B. alba*.

Regel, E. et F. ab Herder.—Annotationes botanicae. Appended to *Index Seminum Hort. Petrop.* 1861.

Including a 'Conspectus specierum generis Aconiti, quae in Flora Rossica et in regionibus adjacentibus inveniuntur.'

Regnault.—Recherches sur les Affinités de Structure des Tiges des

Plantes du Groupe des Cyclospermées. Ann. S. N. Ser. iv. xiv. p. 73. With 6 plates.

Preceded by a brief general review, in respect of anatomical structure, of various Natural Orders investigated by previous observers. M. Regnault includes under Cyclospermeae the following Orders: Crassulaceae, Mesembryaceae, Tetragonieae, Portulaceae, Paronycheae, Caryophylleae, Amarantaceae, Chenopodiaceae, Phytolaccaceae, and Nyctagineae,—a more or less extended account being given of the stem-structure in each. Two conspicuous characters prevail throughout these Orders, distinguishing them from the majority of Dicotyledons, viz.—The presence in the wood of a generating tissue, and the absence of concentric annual zones. The thin-walled cells of this generative tissue are variously disposed through the ligneous mass,—sometimes as isolated cords in the midst of compact wood, sometimes forming complete or partial zones separating corresponding ligneous zones concentrically. Attention is drawn to the relation subsisting between this intraligneous generative tissue and the vessels of the stem as a point upon which further research is required. Minor characteristics of the anatomy of Cyclospermeae consist in (1) the frequency with which vascular bundles containing spiral vessels are found isolated in the pith: (2) the absence of medullary rays; (3) the absence in several Orders of liber, its partial or abnormal character in others; and (4) the abundance of crystalline concretions in the parenchyma of the stem. Viewed in a classificatory point of view, the author concludes—(1) that in each Family of the Cyclospermeae the stem presents special characters, which establish a type around which the various genera may be arranged with but secondary variations. *Camphorosma* is the sole exception known to this rule. (2) The entire group offers, at least when fully developed plants are examined, certain general structural characters, which impress on its members the stamp of affinity.

Reichardt, H.—Einige Nachträge zu Garcke's Flora von Halle. Verh. Bot. Ver. Brandenb. Hft. ii. p. 116.

Reichardt, H. W.—Ueber eine Monstrosität der *Carex praecox*. Wien Verhandl. xi. 237.

Affording evidence in favour of Kunth's view of the structure of the female flower in *Carex*. Forms occurred intermediate between the normal flower of Carex and others apparently quite analogous to those of *Schoenoxiphium*.

—— Beitrag zur Kenntniss der Cirsien Steiermarks. Wien Verhandl. xi. 379.—*Verbascum pseudo-phoeniceum* (V. *Blattaria-phoeniceum*) ein neuer Blendling. 403.

—— Beitrag zur Flora von Niederösterreich. Wien Verhandl. xi. 337 and 371.—*Verbascum Neilreichii* (V. *specioso-phlomoides*), ein neuer Blendling. 367.

Reichenbach, L. et H. G. (fil.)—Icones Florae Germanicae et Helveticae. Tom. xx. Dec. 1.

Including *Solaneae* and *Scrophularineae* (*Linaria*).

Reichenbach, fil.—Ueber *Carex obtusata*, Lilj. Bot. Z. 1861. p. 246.—*Orobanche minor*, Sutt. p. 255.

Reinsch, Paul.—Bemerkungen über einige Bastardformen der Gattung *Cirsium*. Bonpl. 1861. p. 73.

Reissek, S.—Flora Brasiliensis. Fasc. xxviii. Celastrineae, Ilicineae et Rhamneae, pp. 115. With 41 plates.

Celastrineae: the genus *Plenckia* is founded upon a single species of the Central Provinces. Of *Maytenus* 59 species are described.

Ilicineae: the genus *Ilex* includes 63 species.

Rhamneae: *Rhamnidium*, a new genus, with the habits of *Berchemia*, is described.

Remy, E. A.—Essai d'une nouvelle classification de la Famille des Graminées. Première partie—Les genres. Paris, 1861. 8vo. pp. 308.

The Graminaceae are grouped under five principal classes.

1. *Hermaphroditées vœrées*, with complete flowers, all hermaphrodite.

2. *Hermaphroditées incomplétés*. Hermaphrodite flowers accompanied by rudimentary ones without apparent sex and always sterile.

3. *Polygamées*. The same spike or panicle bearing male, female and hermaphrodite flowers.

4. *Monoïcées*. With but male and female flowers on the same plant.

5. *Diocées*. Male and female flowers on separate plants.

Descriptions (in French) are given of all the genera, with the distribution of the species and an estimate of their number.

Ritschl, G.—Neuigkeiten der Posener Flora aus dem Jahre 1860. Verh. Bot. Ver. Brandenb. Hft. ii. p. 105.

Rochebrune, A. de.—Observations sur le *Ruscus aculeatus*. Bull. Soc. Bot. viii. 523.

The author agrees with Kirschleger and others, in opposition to the view of M. Clos that the urceolus surrounding the ovary in the female flowers of *Ruscus* answers to the *tubus stamineus* of the male. He considers the plant to be monœcious—Sur le *Dracocephalum virginianum*, p. 547.

Rodet, J. A.—Note sur l'Anatomie et sur la Physiologie d'un cône de Pin. C. Rend. liii. 535.

Relating to the structure of the scales and bracts and the hygroscopicity of the latter.

Schenk, A.—Botanische Notizen. Zur Kenntniss des Baues der Saamenschale. Würzb. Zeitschr. ii. 216.

On the structure of the testa and hairs of the seed of *Ricinus purpurascens*, and observations on the epidermal cells of the testa of seeds swelling up in water.

SCHLECHTENDAL, D. F. L. v.—Abnorme Pflanzen-Bildungen. Bot. Z. 1861. p. 4.

Notice of the observation, by C. Lemaire, of leaf-like appendages developed upon the midrib of the under surface of the leaf in *Caladium auritum* and *Gesneria spicata*. Similar irregularities were observed in the leaves of *Heterocentron macrodon* and on the summit of the petiole of a *Begonia*. Herr Schlechtendal notices the occurrence of *Stachys excelsa* with the lower lip of the corolla having a double median lobe and a fifth stamen developed. *Stachys coccinea* is stated sometimes to have the upper corolla-lobe more or less divided.

——— Ueber den Quebracho der Argentinischen staaten nach Prof. Burmeister's Mittheilungen. Bot. Zeit. 1861. p. 137.

There are two species of *Quebracho*, called *Q. blanco* and *Q. colorado*. These are referred to the genus *Aspidosperma*, M. and Z. A detailed account is given of the fruit and seed of *A. Quebracho blanco*.

——— Geschichte der Gattung *Zizania*. Linnaea xxx. p. 714.

——— Bemerkungen ueber *Pontederia azurea* und die Familienverwandten. (Ext. Abh. Nat. Gesell. Halle) 1861. 4to. pp. 30. With 1 plate.

Descriptions of the six genera of Pontederiaceae are appended to this memoir.

SCHLEIDEN, M. J.—Grundzüge der wissenschaftlichen Botanik nebst methodologischen Einleitung. Ed. 4. Leipsic, 1861.

SCHLOTTHAUBER, A. F.—Physiologische und Systematische Beiträge zur Botanik, (Fortsetzung) xii. Rüge einiger Mängel neuerer natürlicher Pflanzen-systeme, A. Kritik. B. Uebersicht der Hauptgruppen und Klassen des natürlichen Systems des Gewächs- oder Pflanzenreiches. Bonpl. 1861. pp. 23-31.

——— Blüthenbau von *Euphorbia*. Bonpl. 1861. p. 370.

SCHNITZLEIN.—Botanische Beobachtungen. Abh. Nat. Ges. Nürnb. 1861. Bd. ii.

1. On the nature of the aculei of the section *Grossularia* of the genus *Ribes*. 2. On the scales in the flowers of some species of *Sedum*.

SCHOTT, H. G.—Aroideologisches. Bonpl. 1861. 367.

Descriptions of new Aroids from the Fijis, Central America, &c.

SCHULTZ, J. C.—On the Botany of the Red River Settlement and the Old Red River Trail. Ann. Bot. Soc. Canada, vol. i. p. 22.

With list of species collected near Fort Garry and the Trail to St. Paul.

SCHULTZ-BIPONT, C. H.—Ueber die Hieracien Amerika's. Bonpl. 1861. p. 172.

——— Eine neue *Mikania*. p. 175.

——— Hieraciorum Americanorum descriptiones. Bonpl. 1861. 325.

SCHULTZ-BIPONT, C. H.—*Hamulium Cassini.* Bonpl. 1861, 365.

——— Ueber die Gattung *Zaluzania*, Pers., eine historisch-kritische Untersuchung. Flora, 1861. 553, 561.

SCHULTZ, F.—Ueber einige Arten und Bastarde von *Hieracium* und einige Laubmoose. Flora, 1861. p. 33.

With a table of Synonymy of German Piloselloideae. *Hieracium stoloniferum*, W. et Kit. is stated to be a hybrid between *H. pilosella* and *H. pratense.*

SCHULTZ-SCHULTZENSTEIN.—Ueber rückschreitende Metamorphose und Hemmungsbildung der Blumen. Flora, 1861. p. 65.

——— Die Bedeutung der Verzweigung im Pflanzenreich. Flora, 1861. pp. 273, 297.

SCHUMACHER, W.—Die Diffusion in ihrer Beziehung zur Pflanze. —Theorie der Aufnahme, Vertheilung und Wanderung der Stoffe in der Pflanze, &c. Leipzig, 1861. 8vo. pp. 288.

SCHWARZENBACH, V.—Untersuchung der Blattstiele von *Rheum undulatum.* Wurz. Zeitsch. ii. 97.

Referring to the chemical composition of the sap.

SCHWEINFURTH, G.—Ueber Bidens radiatus, Thl. With 2 plates. Verh. Bot. Ver. Brandenb. Hft. ii. p. 142.

——— Ueber eine neue Pflanzenbastard, *Dianthus Carthusianorum arenarius.* Verh. Brand. Bot. Vereins. Hft. ii. p. 205. 1 plate.

SEEHAUS, C.—Hydrilla verticillata, Casp. var. pomeranica. Verh. Bot. Ver. Brandenb. ii. p. 95.

SEEMANN, B.—*Podocarpus? dulcamara*, sp. nov. Bonpl. 1861, 253.

A tree of unknown origin cultivated in the Palm-stove at Kew.

——— Plantae Vitienses. Bonpl. 1861. 253.

A preliminary catalogue of Fiji plants collected in 1860. A few new genera are indicated (in Rhamneae, Leguminosæ, Ternstroemiaceae, Rubiaceae, Asclepiadeae, Palmeae) but not described. Eight new Cyrtandreae are mentioned.

——— *Storckiella Vitiensis.* Bonpl. 1861. 363.

Description and figure of this new genus of Caesalpinieae. *Cyrtandra Pritchardii*, also from the Fijis, is described in the same number.

SELIN, G.—Ett bidrag till Nordvestra Nylands Flora. Notiser Sällsk. pro Fauna et Flora Fennica Forhand. Ny. Ser. Tredj. Häft. Helsingf. 1861. p. 123.

SEUBERT, M.—Lehrbuch der gesammten Pflanzenkunde. Leipsic, 1861. Ed. iii.

——— Die Pflanzenkunde in populärer Darstellung mit besonderer Berücksichtigung der forstlich, ökonomisch, &c. Pflanzen. Leipzig. 1861. 8vo. 592.

SIMING, TH., P. A. KARSTEN, ET A. J. MALMGREN.—Botanisk resa till Satakunta och Södra österbotten, med understöd af Sällskapet pro Fauna et Flora Fennica, verställd sommaren 1859.—Notiser ur Sällskapets Pro Fauna et Flora Fennica Forhandlingar. Ny. Ser. Tredj. Häft. Helsingfors, 1861.

SOURD-DUSSIPLES, E. C.—Note sur une anomalie présentée par une fleur d' *Orchis mascula*. Bull. Soc. Bot. viii. 227.

A pollen-mass had been projected upon the labellum.

SOURD-DUSSIPLES, C. E. ET G. BERGERON.—Note sur un cas de métamorphose ascendante. Transformation des étamines en feuilles carpellaires. Bull. Soc. Bot. viii. 348.

Showing the development of the anomalous carpels to be, to a considerable extent, at the expense of the filaments of the transformed stamens, and not as, according to the authors, M. von Mohl maintains, of the connective and anther-cells.

STOHMANN, F.—Versuche über die vegetation von Maispflanzen in Wässerigen Lösungen ihrer Nährstoffe. Flora. 1861. 679. Also Gött. Nachr. 1861. 137.

An account of experiments, yet in progress, instituted with a view to ascertain how far the development of a plant was possible, removed from the soil; and further, the influence upon vegetation of the abstraction of any element of its food, and the extent to which one element might be substituted for another. The author's experiments thus far warrant the following general conclusions:—1. That, in the case of maize, normal vegetation is quite possible without contact with soil, provided its mineral constituents be supplied to it in proper amount in a weak acid solution, 1000 parts of which hold not more than 3 parts of the solid. 2. The plant derives its organic matter from the carbonic acid of the air, taken up by the leaves. 3. Nitrogen must be supplied in the form of nitric acid and ammonia. The plant will not succeed if, with the mineral constituents, either of these be given alone. 4. Maize requires both lime and magnesia. The one cannot supply the place of the other. 5. At first soda is not essential, though without it vegetation soon slackens.

STUR, D.—Beiträge zur Monographie des Genus *Draba* in den Karpaten: Ungarns, Galiziens, Siebenbürgens, und des Banates nördlich der Donau. Wien, 1861. 8vo. 46 pp. 3 plates. (Ext. Oest. Bot. Zeitsch. No. 5.)

TASSI, A.—Esame d'una singularità di struttura dell fiore dell' *Aquilegia vulgaris*. I. Giardini, vii. 295.

The carpels were transformed into small lobulate leaves, bearing leaflets answering to the ovules.

TATNALL, EDW.—Catalogue of the Phænogamous and Filicoid Plants of Newcastle County, Delaware, U.S. arranged according to the Natural System, with the Synonyms of Modern Authors. pp. 112.

THIENEMANN, H. W.—Skizze der Flora Masurens. Flora, 1861. 689, 725, 756.

Masuren is a tract of varied surface in S. E. Prussia, including about 600 Phanerogamia, a catalogue of which is given.

THWAITES, G. H. K.—Enumeratio Plantarum Zeylaniæ. Pt. iv. p. 241—320.

New genera described are *Podadenia, Dimorphocalyx, Des-*

mostemon (Euphorbiaceae), *Octarrhena*, *Cylindrochilus* (Orchidaceae).

TIMBAL-LAGRAVE, ED.—Étude sur quelques Cistes de Narbonne. Toulouse, 1861. Mem. Ac. Sc. Toulouse, Ser. v. t. v. 8vo. pp. 33, *Ext.*

A monograph of the species of *Cistus* growing in the South of France. The author remarks a character serving to distinguish hybrid from true species. According to his observations, the leaves of the branches of hybrids put out in spring, assume the form of those of the male parent, while those borne by the summer branches resemble the leaves of the female. In true species, the leaves are alike in both seasons.

M. T.-Lagrave is of opinion that hybrid plants are more common than has been generally believed, and that many of these are fertile, reproducing themselves, though not without more or less of a return to one of the parent species, through several generations. His observations rest chiefly upon *Cistus Monspeliensis*, L., *C. laurifolius*, L., and *C. salviaefolius*, L. Minute descriptions are given, with synonymy of the various forms, grouped under the heads of—1. Plants reproducing themselves precisely from seed; and, 2. Plants which do not exactly reproduce themselves from seed—crossed or hybrid species. Of these latter are *Cistus albido-crispus*, *C. crispo-albidus*, *C. salviaefolio-populifolius*, *C. populifolio-salviaefolius*, *C. Monspeliensi-populifolius*, *C. salviaefolio-Monspeliensis*, *C. Monspeliensi-salviaefolius*, *C. laurifolio-monspeliensis*, *C. albido-monspeliensis*. Other hybrid Cistuses are formed between *C. laurifolius*, *C. ladaniferus*, and species crossing with them. In concluding, the author groups the forms of *Cistus* under species and hybrid-species. The former he states to be common, and represented by numerous individuals; the latter rare, scattered, and always in few examples. That the first reproduce themselves precisely in every mode, especially by seed; while the latter vary with each evolution, presenting a tendency towards one of the parents.

——— Note sur une nouvelle espèce du genre *Linum*. Bull. Soc. Botan. vii. p. 509.

Linum ruscinonense, T.-L. Confounded with *L. alpinum* by authors.

TOMMASINI, M. R. v.—Ueber zwei zweifelhafte Pflanzen Wulffen's, *Hypecoum litorale* und *Fumaria acaulis*. Wien. Verhandl. 331.

TREVIRANUS, L. C.—Ueber das Einschliessen jeder Pflanzenspecies in eine Papierhülse als Mittel Herbarien gegen Insekten zu sichern. Bonn. Verh. 1861. 391.

——— In Hyperici genus eiusque species animadversiones. Bonn. 1861. 4to. pp. 15.

——— Ueber Fruchtbau und einige Gattungen der Doldengewächse. Bot. Z. 1861. p. 9.

1. Observations on the adhesion of the calyx and ovary in some

genera of *Umbelliferae* (*Pleurospermum*, *Echinophora*, *Bowlesia lobata*). (2.) The abortion or imperfect development of one of the carpels of the fruit in various genera. Unequal wings or ribs. (3.) Critical notes on the genus *Reutera*. (4.) *Athamanta verticillata*, Sm. (5.) Fruit of *Thapsia scabra*, Trev. (*Meliocarpus*, Boiss.). (6.) *Conioselinum*. (7.) *Callisace*. (8.) *Dorema* and *Diserneston*, Jaub. and Sp. (9.) *Archangelica Gmelini*, DC. (*Coelopleurum*, Led.) identical with *Ligusticum scoticum*, L. (10.) *Cachrys eriantha*, DC. and *C. involucrata*, Pall. (11.) *Exoacantha*, Lab. (12.) *Grammosciadium*.

Treviranus, L. C.—*Lychnis praecox*. Bonpl. 1861. p. 205.

A new species, of doubtful origin, cultivated by the author, in habit resembling *L. diurna*, in characters *L. declinis*, Lag. Observations are added on *Lychnis Viscaria* and *L. alpina*, and the weakness of the characters depended upon for their discrimination.

Tulasne, L. R.—Flora Brasiliensis. Antidesmeae, p. 330. With 4 plates.

Hieronymia of F. Allemao supersedes *Stilaginella* of Tulasne. It is the only Brazilian genus of the group. But three species are described.

Unger, F.—Beiträge zur Anatomie und Physiologie der Pflanzen. Wien. Sitzungsb. xliv. 181, 327.

Recent investigations on the Transpiration of plants. The author's chief results are:—1. Transpiration is a purely physical process modified by the condition of the plant and dependent on the temperature, humidity and motion of the air, the character of the soil, and the surface adapted for exhalation. 2. Transpiration undergoes a periodical alternation, the maximum and minimum depending upon the daily temperature. 3. The two leaf-surfaces bear different relations to Transpiration: generally, the underside exhales more than the upper. 4. Although the Stomata may be regarded as the organs best suited for Transpiration, yet the Epiderm also permits it. 5. During Transpiration the crescentic cells of the Stomata are turgescent and tense according to the extent to which they are open. 6. As the amount of evaporation is in proportion to the evaporating surface, so the amount of water evaporated from a surface covered with vegetation is much greater than, under like conditions, from a surface of water of equal area: the influence of Transpiration on the condition of the atmosphere is consequently not unimportant in countries covered with meadows, grass, and woods. 7. In Water-plants, an elimination of water takes place corresponding to transpiration. 8. The absorption of water by the root under normal conditions exceeds the loss by exhalation but very little.

Verlot, B.—Sur quelques Arbres remarquables plantés dans le Département du Loiret. Bull. Soc. Bot. viii. 354.

VERLOT, B.—Sur deux *Epilobium* et sur un *Festuca* cultivées au Muséum d'Histoire Naturelle de Paris. Bull. Soc. Botan. vii. p. 507.

The *Epilobia* are *E. tetragonum* and *E. Lamyi*, Fr. Sch. The sole difference between which the author finds to be in the mode in which the leaves are decurrent. Seeds of *Festuca ciliata.* Danth., were found to produce *F. Myurus*, L.

VISIANI, R. DE.—Plantarum Serbicarum Pemptas ossia Descrizione di cinque Piante Serbiane. Extr. Vol. ix. Mem. Istit. Venezia, 1860. pp. 11. With 6 plates.

One new genus of Umbelliferae is described, *Pançiçia.*

VRIESE, W. H. DE.—Remarques sur les arbres qui produisent le *Getah-pertja.* Nat. Tijdsch. Neerl. Ned. xxi. 299, and Journ. Bot. Ned. 1861. 254.

With description of new species collected by the late Mr. Motley.

VULPIUS, FR.—Noch ein Wort über *Fragaria Hagenbachiana.* Flora, 1861. p. 393.

WACKER, H.—Uebersicht der Phanerogamen flora von Culm. Culm, 1861. p. 24.

WALPERS, vide *C. Mueller.*

WALSER, Dr.—Die grosse Linde in Leutkirch mit Beziehungen zu den Wachsthumsverhältnissen sehr alter Linden unseres clima's überhaupt. Württ. Jahreshefte, 1861. 57.

Eleven Linden-trees are enumerated to which ages are assigned as under "with more or less probability."

Linden at Leutkirch . .	346 years.
——— do. (*T. parvifolia*) .	364 ,,
——— Friburg, Switzerland .	384 ,,
——— Leutkirch (*T. grandifolia*) .	405 ,,
——— Nürnberg . . .	500 ,,
——— Leutkirch (*T. grandifolia*) .	660 ,,
——— Norwich . . .	815 ,,
——— Neustadt . . .	892 ,,
——— Villars en Moing . .	961 ,,
——— Donndorf . . .	1235 ,,
——— Chaillé (nr. Melles) . .	1252 ,,

WARTMANN, Prof.—Botanische Notizen. (St. Gall. Nat. Gesellsch. 1860-61). 8vo. pp. 16.

Referring to monstrous and hybrid forms. (1.) *Blechnum spicant*, dichotomy of; (2.) Marigold, with proliferous capitulum; (3.) *Geum intermedium;* (4.) *G. rivale*, sepals reduced to leaves; (5.) *Prunus avium*, with several carpels in the flower; (6.) *Pyrus communis*, persisting petals of; (6.) *Sambucus nigra*, variety in symmetry and relative position of stamens and corolla-lobes; (8.) *Veronica Anagallis*, various abnormal flowers. (*Ext.* Bot. Zeit.)

WEDDELL, H. A.—Mémoire sur le *Cynomorium coccineum*, parasite

de l'Ordre des Balanophorées. (Ext. Arch. Mus. t. x.) Paris. p. 39. With 4 plates.

Embracing a detailed consideration of (1.) The geographical distribution of the *Cynomorium;* (2.) Its nurse-plants, mode of vegetation, duration; (3.) Organography and anatomy of the rhizome and its appendages, the organs of attachment; (4.) Scape, scales, inflorescence and the reproductive organs, with the result of experiments on its germination. In respect to the latter a remarkable circumstance was the ascending direction always taken by the radicle, a direction which it resumed, if inverted, with a sharp curve. M. Weddell partially succeeded in observing the first stage of its parasitism, upon which further observations are required. The seed is described as being provided with a testa, consisting of from five to ten layers of cells containing resinous matter. This is opposed to the view of Dr. Hooker who regards the covering of the seed as the adherent inner layer of the ovary.

WEDDELL, H. A.—Chloris Andina. Essai d'une Flore de la Région Alpine des Cordillères de l'Amérique du Sud. Vol. ii. p. 185 to end of Vol.

Including Umbelliferae, Araliaceae, Saxifragaceae, Cactaceae, Ribesiaceae, Passifloraceae, Loasaceae, Onagrariaceae, Halorageae, Melastomaceae, Rosaceae, Leguminosae, Polygaleae, Hypericineae, Malvaceae, Geraniaceae, Hypseocharideae, Oxalideae, Berberideae, Ranunculaceae, Frankeniaceae, and additions to vol. ii. The section *Oreosciadium* of *Apium* (DC. Prodromus, iv. 101) is raised to generic rank. The species of this genus are confined to the Andes where some of them reach the level of perpetual snow. No other new genera are described. The species of *Malvastrum* with involucrate flowers and free axillary or radical peduncles are restored to the genus *Malva:* the true *Malvastra* being limited to acaulescent plants having the peduncles more or less adnate to the petiole subtending them, and the carpels dehiscent as in *Sida.* They are confined to the alpine region of the Andes. M. Weddell proposes *Hypseocharis* of Remy as the type of a new natural order. The fruit of this plant is unknown. *Oxalis tuberosa* is very largely cultivated in some of the upper valleys of Peru and Bolivia, where it replaces to a certain extent the potato.

WEGENER, E.—Zur Flora von Pommern. Verh. Bot. Brand. Hft. ii. p. 102.

WEISS, A. und J. WIESNER.—Beiträge zur kenntniss der chemischen und Physikalischen Natur des Milchsaftes der Pflanzen. Bot. Z. 1861, p. 41.

Observations upon the microscopical character, chemical analysis, density and physical relations of the milk-sap of *Euphorbia Cyparissias, L.*

WELWITSCH, F.—Sur la Végétation du Plateau de Huilla dans le Benguela. Bibliothèque Univ. July, 1861. Ext.

With observations by M. De Candolle.

——— Extract from a Letter, addressed to Sir William J. Hooker, on the Botany of Benguela, Mossamedes, &c. in Western Africa. Linn. Proc. v. p. 182.

Dr. Welwitsch notices the medley of species cultivated at Mossamedes (Little Fish Bay), Bananas and Potatoes, Mandiocca and Wheat, Sugar-cane and Flax, *Hordeum distichum* and *Batatas paniculata*, &c. An extraordinary tree of doubtful affinity, growing on the table-land near Cape Negro, is described in brief. It is said to attain 1 foot in height with a diameter of 4 feet; the pair of leaves thrown up at germination persist through the lifetime of the tree, no others being produced. The flowers are described as amentaceous, hexandrous, and monogynous. *A Rafflesiacea* was found upon the branches of a Leguminosa.

WESMAEL, A.—Nouvel hybride de *Cirsium*. Ac. Belg. 2 Nov. 1861.

Between *C. arvense* and *C. lanceolatum*. It is described in much detail.

WHITE, F. B. W.—List of some of the rarer plants observed in the vicinity of Perth. Trans. Ed. Bot. Soc. vii. 235.

——— Botany of Methven, Perthshire. Phytol. 1861. 330.

WICKE, WILH.—Ueber das Vorkommen und die physiologische Verwendung der Kieselsäure bei den Dicotyledonen. Bot. Zeit. 1861. p. 97.

WIESNER, J.—Untersuchungen über den Bogenwerth der Blattbasen. Sitzungsbericht. K. Ak. Wien. xlii. 417.

WIGAND, A.—Beleuchtung von Schacht's Behandlung der Frage über die Intercellularsubstanz und die Cuticula. Flora, 1861, pp. 81, 97.

——— Ueber die Deorganisation der Pflanzenzelle, insbesondere über die physiologische Bedeutung von Gummi und Harz. Pringsh. Jahrb. iii. 115. With 3 plates.

The author is of opinion that gums frequently if not generally originate more or less as Tragacanth, which has been shown by von Mohl to result from a change in the character of the cell-walls of the pith and medullary rays in certain species of *Astragalus*. In the first section of this paper the mode of origin of cherry-gum is minutely detailed. It is a mixture of gum arabic and cerasin, the latter allied to bassorin, from which it differs in its solubility in boiling water. It originates both in the wood and cortical layers, in the latter especially from a transformation of the cells associated with the fibres of liber, which H. Wigand terms *Hornprosenchym* or Hornbast. Numerous species belonging to various orders are named in which this tissue is conspicuous. It is suggested that in some cases Sugar may be formed by a similar change in the cell-wall, as, *e.g.*

in Manna. The second section is devoted to resins and balsams which are shown in part to be of similar origin. The third to intercellular substance and cuticle.

WILLEBRAND, F. v.—Jakttagelser rorande verkan af *Secale cornutum.* Act. Soc. Fen. vii. p. 1.

WILLKOMM, M. und J. LANGE.—Prodromus Florae Hispanicae, Vol. i. part 1. Stuttgardt, 1861. Filices to Melanthaceae (*Erythrostictus*).

No new genera appear to be described.

WIMMER, F.—Salicologische Beiträge. Bresl. Abh. 1861. i. 2.

WINKLER, A.—Nachträge und Bemerkungen zur schlesischen Flora. Verh. Bot. Ver. Brandenb. Hft. ii. p. 107.

WOSSIDLO, P.—Ueber die Structur der *Jubaea spectabilis.* Ein Beitrag zur Anatomie der Palmen. Nova Acta, 1861. xxviii. Abh. v. With 5 plates.

The author appends the following conclusions:—

1. The form of the terminal bud in Palms with undeveloped internodes is never convex, though often flattened, and indeed concave, according to the greater or less intensity of growth.

2. The structure of *Jubaea spectabilis* essentially agrees with that which H. v. Mohl has represented as characteristic of the *Cocos* type of stem structure.

3. There is distinguishable in the stem of *J. spectabilis*, as also more especially in the Cocos type, a so-called bast-layer under the rind which surrounds the proper woody-mass or pith.

4. The vascular bundles of the bast-layer consist solely of prosenchyma.

5. They do not enter the interior of the stem, but run through their entire length, to their entrance into the leaf, within the bast-layer.

6. They form the principal portion of all the vascular bundles entering the leaf.

7. Between the woody-mass and the bast-layer under the terminal bud is a Cambium zone in which the formation of new tissues of the stem takes place.

8. All the vascular bundles originate in this Cambium-layer, including the fascicles of the bast-layer, which are consequently not, as Schacht maintained, branches of the vascular bundles of the adventitious roots.

9. The difference in the course and anatomical composition of the liber-layer and the central vascular bundles is explained by the origin of the former on the outer side and of the latter on the inner side of the Cambium zone.

10. Moreover the bast-fascicles on their entrance into a leaf are transformed in great measure into complete vascular bundles.

ZOLLINGER, H.—Quelques observations sur l'Histoire naturelle de l'île de Madoura. (To the east of Java.) Journ. Bot. Ned. 1861. 130.

XLI.—Cryptogamia.

1. *Filicales.*

Bolle, Carl.—Zur Vegetations geschichte der *Asplenium Seelosii.* Bonpl. 1861. pp. 2-4.

Bosch, R. B. van den.—Hymenophyllaceae Javanicae, sive descriptio Hymenophyllacearum Archipelagi Indici, iconibus illustrata. Edidit academia regia scientiarum. 52 plates. 4to. Amstelaedami, 1861.

——— Hymenophyllaceæ Novæ Caledoniæ Auct. Vandenbosch. A. S. N. xv. p. 88.

An account of some new species of Hymenophyllaceæ, by the same author, will be found in the Nederlandsch Kruidkundig Archief v. (1861). pp. 135-186.

Braun.—Ueber eine neue Art der Gattung Isoëtes. Berl. Mon. 1861. p. 460. Dr. Braun describes a new species of Isoetes from Japan, resembling in some respects *I. riparia*, Engelm.

Bridgeman, W. Kencely.—On the Influence of the Venation in the Reproduction of Monstrosities among Ferns. An. N. H. 3 ser. viii. p. 490.

Durieu, de Maisonneuve.—A note relative to three new species of Isoetes, presented to the Botanical Society of France—one being a variety of *I. Hystrix*, the two others new species. Bull. Soc. Bot. Vol. viii. p. 164.

Duval-Jouve.—Note sur l'acumen qui termine l'epi de quelques especes d'Equisetum par M. J. Duval-Jouve. Bull. Soc. Bot. Vol. viii. p. 368.

——— Note sur la Synonymie d'une espece d'Equisetum par M. Duval-Jouve. Bull. Soc. Bot. Vol. viii. p. 637.

This note relates to the synonymy of the plant usually called *Equisetum Telmateia*, Ehrh. which M. Duval-Jouve, identifies with *Eq. maximum* of Lamarck and *Equisetum fluviatile* of Smith and other authors, but *not* of Linnæus.

Gottsche.—Hepaticologische Notizen von Dr. C. M. Gottsche in Altona. Bot. Zeit. January 4, 1861, Vol. xix. p. 1.

The contents of this paper are as follows:—

1. Observations upon Symphyogena flabellata, in which are discussed the characters of the several plants described under this name by Labillardiere (Nov. Holl. Plant. spec. t. ii. p. 109, tab. 254, fig. 1); Hooker (Musci Exotici, Tab. 13); Montagne (Voy. au Pole Sud. 1, p. 216); and Mitten (Flora Novæ Zeelandiæ and Flora Tasmaniæ). These characters the author cannot reconcile, and he proposes a new genus, "Umbraculum," to take in the two former, in which he thinks it probable Montagne's and Mitten's plants might also be included.

2. Observations on the inflorescence of *Radula complanata.*

3. On *Riccia Klinggræffii* (Bot. Zeit. 1859, p. 88), which,

the author states, is now proved to be only a variety of *Riccia fluitans.*

HANSTEIN.—Erlaüterung des Nardoo genannten Nahrungsmittel der Urbewohner Australiens, einer *Marsilea*-frucht, nebst Bemerkungen zur Entwickelung dieser Gattung. Berl. Mon. Feb., 1862.

Dr. Hanstein describes the structure of the fruit of a species of Marsilea, called *Nardoo* by the aborigines of Australia. It is eaten by the natives, and was used as food for some time by King, the survivor of the late unfortunate Australian exploring expedition. The species appears to be new—so far, at least, as can be judged from fruit alone. Some remarks upon other species of the genus are also given. The paper is illustrated by a plate containing a number of well-executed figures.

HOOKER.—Species Filicum, being descriptions of all known Ferns, illustrated with plates. By Sir William Jackson Hooker, K.H., &c. This work has reached the 14th Part, or Vol. iv., Part ii. The 15th Part is promised shortly. Part xiv. concludes with the commencement of the genus Onoclea.

—— The British Ferns; or, Coloured Figures and Descriptions, with the Needful Analyses of the Fructification and Venation of the Ferns of the British Isles, systematically arranged. By Sir W. J. Hooker, K.H., D.C.L., &c. With 66 plates, by W. Fitch.

—— Garden Ferns; or, Coloured Figures and Descriptions, with the Needful Analyses of the Fructification and Venation of the Ferns best adapted for Cultivation in the Garden, Hothouse, and Conservatory. By Sir W. J. Hooker, K.H., D.C.L, &c. With 64 plates, by W. Fitch.

LASCH (W.)—*Aspidium spinulosum* mit seinen Unterarten u. varietäten. Brand. Bot. Ver. ii. p. 77.

METTENIUS.—Filices Novæ Caledoniæ a Cl. Viellard collectæ. Elaboravit G. Mettenius. A. S. N. xv. p. 55.

MILDE (J.)—Neue Beiträge zur Systematik der Equiseten. Bresl. Abh. 1861. I. 2.

—— Ueber exotische Equiseten von Dr. J. Milde. Wien Z. V. B. Vol. xi. p. 345.

Dr. Milde describes at length five species of Equiseta, some of which have been previously shortly noticed by other authors. At the end of the paper are some remarks upon the importance of the position of the stomata in classifying Equiseta, and on the assistance in distinguishing species which is afforded by the differences exhibited under the compound microscope by the siliceous coverings of the furrows of the branches. Dr. Milde divides Equiseta into "phaneropora" and "cryptopora," the former having the stomata in the same plane with the epidermis, and the latter having the stomata underneath the epidermis, which is ruptured transversely. The cryptopora are again divided into "monosticha" where the stomata are in a single row, and pleiosticha where they form two or more rows. Dr. Milde considers that a vast deal of trouble and uncertainty in distinguishing species will be avoided by attention to the above characters.

Miquel.—Bourgeons developpés sur les racines des Fougerès, par F. A. W. Miquel. Journ. de Bot. Néerlandaise, 1861. p. 134.

Moore.—Index Filicum. This work has reached the 18th part, which closes in the middle of the Genus Elaphoglossum.

Müller.—Zur Kenntniss des Lycopodium cernuum L. von Karl Müller. Bot. Zeit. June 14, 1861. Vol. xix. p. 161.

The object of the author in the present paper is to show that an entire group of species has hitherto been included under the common name of *Lycopodium cernuum.* He divides the group into seven species, placing in it a Sikkim-Himalaya plant, found by Dr. Hooker, and a doubtful one from Cuming's collection called *Lycopodium Marianum.*

Stenzel (K. G.)—Untersuchungen über Bau und Wachsthum der Farne. II. Ueber Verjüngungserschemungen bei den Farnen. Von Karl Gustav Stenzel, M.D. K.L.C. D.A. Nov. Act. Vol. xxviii.

2. *Muscales.*

Areschoug (F. W. C.) *Tortula papillosa* Wils. ein neuer Bürger der deutschen Flora. Brand. Bot. Ver. ii. p. 141.

Dozy, Molkenböer, van den Bosch et van der Sande Lacoste.—Bryologia Javanica seu descriptio muscorum frodosorum archipelagi Indici. Fasc. 21 à 26. In. 4. Lugduni Batavorum. Paris, J. B. Bailliere et fils.

Gerber.—Die Laubmoose Oberbayerns. Von G. Gerber. Reg. Fl. pp. 305, 321, 337.

Heufler.—Nachtrag zu den "Untersuchungen über die Hypneen Tirols," von Ludwig Ritter v. Heufler. Bonplandia, 1861. p. 191.

——— Ueber die Südgrenze einiger Laubmoose, von Ludwig Ritter v. Heufler. Bonplandia, 1861. p. 190.

Juratzka.—Zur Moosflora Oestereichs, von J. Juratzka. Wien. Z. V. B. Vol. xi. p. 121 and pp. 235 and 431.

——— Ueber ein neues Laubmoos, von J. Juratzka. Wien. Z. V. B. Vol. xi. p. 267.

A description of a new Hypnum called *H. fallaciosum*, nearly allied to H. polygamum.

Le Dien.—Sur un phenomene teratologique observé chez quelques mousses par M. Emile Le Dien. Bull. Soc. Bot. Vol. 8 (1861), p. 73.

The monstrosity observed by Mons. Le Dien was the production of two capsules upon a single pedicel in three plants of *Trichostomum rigidulum* collected at the great waterfall of Mont Dore. A letter on the subject by Mons. Durieu de Maisonneuve is published in the same volume, p. 297.

MILDE.—Uebersicht über die Schlesische Laubmoos-Flora, von Dr. J. Milde.

This account of the Silesian Moss-Flora forms an Appendix to the Botanische Zeitung for 1861. It contains a list (with localities and comments) of the species, and this is followed by a short account of the published works on Silesian mosses. The author then speaks of their distribution with respect to altitude and soil, and of the relation of the Silesian Moss-Flora to that of other countries. As the result of his observations he states that Silesia produces 389 mosses, being far more than half of those which occur in Europe, and he notices a number of species which find their northern and southern limits within the province.

——— Die Verbreitung der Schlesischen Laubmoose nach der Höhen und ihre Bedeutung für die Beurtheilung der Schlesischen Flora von Dr. J. Milde. Nov. Act. Vol. xxix.

——— *Hypnum insigne* Milde, nov. spec. von Dr. J. Milde. Bot. Zeit. 6 Sept. 1861. Vol. xix. p. 260.

This new species of Hypnum is described at length by Dr. Milde. He found it in August, 1861, near Ludwigsbad by Salzburg.

PANČIĆ.—Zur Moosflora des nordöstlichen Banates von Dr. Josef Pančić. Wien. Z. V. B. Vol. xi. p. 93.

POKORNY.—Untersuchungen über die Torfmoose Ungarns V. Sitz. 1861. xliii. iii. 1. p. 123.

REICHARDT.—Beitrag zur Moosflora des Wechsels in Niederösterreich von Dr. H. W. Reichardt. Wien. Z. V. B. Vol. xi. p. 161.

REINSCH (P. F.) Ueber einige Eigenthumlichkeiten der Sporen und Fruchtbildung von *Bryum caespiticium* und *Funaria hygrometrica*. Linn. 1861. xv. p. 216.

ROSE ET BESCHERELLE.—Deuxieme note sur quelques mousses rares ou nouvelles, recemment trouvées aux environs de Paris par M. M. Ernest Roze et Emile Bescherelle. Bull. Soc. Bot. Vol. viii. 1861. p. 82.

SCHIMPER.—Observations sur quelques cas de Teratologie Bryologique par M. W. Ph. Schimper. Bull. Soc. Bot. Vol. viii. p. 351.

These observations relate to some monstrosities observed in the fruit of certain mosses, and arose out of the communication made to the same Society by Mons. Le Dien, to which we have referred above.

SCHULTZ.—Ueber einige Arten und Bastarde von Hieracium und einige Laubmoose, von Dr. F. Schultz. Reg. Fl. 1861. p. 33.

ZETTERSTEDT.—Revisio Grimmiearum Scandinaviæ; auct. Joh. Em. Zetterstedt, phil. doct. 8vo. p. 139. Upsala. 1861.

3. *Lichens.*

ARNOLD.—Die Lichenen des Fränkischen Jura, von F. Arnold. Reg. Flora, 1861. pp. 241 and 257.

Fries.—Genera Heterolichenum Europææ recognita; auct. Th. M. Fries. 8vo. pp. 116. Upsala, 1861.

Dr. Fries uses the term "Heterolichenes" to include the Lichénacés of Dr. Nylander or the Lichenes heteromerici of Wallroth and Koerber.

——— Lichenes arctoi Europæ Grœnlandiæque hactenus cogniti. Collegit, examinavit, disposuit Th. M. Fries. Nov. Act. Regiæ Soc. Scientiarum Upsaliensis. 3 ser. Vol. 3, p. 103.

——— Miscellanea Lichenologica. Scripsit Dr. Th. M. Fries. Reg. Fl. 1861, p. 409.

Hepp.—Further fascicles of Dr. Philip Hepp's European Lichens have appeared. An account of them is given in the Regensburg Flora for 1861. pp. 414, 426, 446.

Koerber.—Parerga Lichenologica von Dr. G. W. Koerber. Dritte Lieferung. Breslau, Verlag von Edward Trewendt. 1861.

Krempelhuber.—Die Lichenen Baierns, oder Aufzählung der bisher in Baiern aufgefundenen Lichenen, von M. A. Krempelhuber. Rat. Denk. Vol. iv.

Lindsay, Lauder.—What to observe in Canadian Lichens. Can. Nat. vi. 1861, p. 282.

Nylander.—Expositio Lichenum Novæ Caledoniæ scripsit William Nylander. A. S. N. Vol. xv. p. 37.

An account of some further collections of Lichens from New Caledonia, examined since the publication of the author's former paper in Vol. xii. of the A. S. N. Eighteen new species are now described; the whole number of New Caledonian species now amounts to 105.

——— Additamentum ad Lichenographiam Andium Boliviensium scripsit William Nylander. A. S. N. xv. p. 365.

——— Animadversiones quædam circa A. von Krempelhuber, die Lichenen-Flora Bayerns, Regensb. 1861, scripsit W. Nylander. Bot. Zeit. xv. November, 1861. Vol. xix. p. 337.

——— Lichenes Scandinaviæ sive Prodromus Lichenographiæ Scandinaviæ. Scripsit W. Nylander. Helsingforsiæ, 1861.

This work (which forms the 5th part of the Society for investigating the natural history of Finland) embraces the Lichen Flora of Norway, Sweden, and Finland, extending into the Arctic regions. It contains some prefatory remarks upon Lichens in general, a list of the principal published works and collections of specimens, and a detailed account (with synonyms and critical remarks) of 494 Scandinavian species. The whole number of known Lichens is estimated by the author at 1499. Of the 494 Scandinavian species 27 are new. The author had access to the herbarium of Acharius, which renders the synonymy very valuable. There is an appendix relative to nine species which came to hand during the printing of the book. There is one plate, containing figures by the author of the spores of different species, amongst which those of *Variceellaria*, Nyl. are remarkable for their

size, being about 0.3 mm. long by 0.1. mm. wide. The single species of this genus occurs in Southern Lapland, Arctic America, and in Switzerland, on the bark of trees.

——— Circa historiam Lichenographiæ observatiuncula. Scripsit W. Nylander. Reg. Fl. 1861. p. 513.

——— Conspectus Squamariarum. Exposuit breviter W. Nylander. Reg. Fl. 1861. p. 716.

NORMAN.—Descriptio speciei novæ Lichenis, quam detexit et sub nomine *Tholurna dissimilis* proponit J. M. Norman. Reg. Fl. 1861. p. 409.

STIZENBERGER.—Anzia, eine neue Flechten-gattung, aufgestellt von Dr. Ernst Stizenberger. Reg. Fl. 1861. p. 390.

——— Actinopelte, eine neue Flechten-Sippe beschrieben von Dr. Ernst Stizenberger. Regensburg Flora, 1861. p. 1.

TREVISAN.—Ueber *Atestia*, eine neue gattung der Ramalineen aus Mittel- Amerika. Von Victor Gr. Trevisan, K. K. wirklichem Kämmerer. Reg. Fl. 1861. p. 17.

——— Synopsis generum Trypethelinarum, auctore V. Trevisan. Reg. Fl. 1861. p. 17.

4. *Fungi.*

AFZELIUS.—Reliquiæ Afzelianæ, sistentes Icones Fungorum, quos in Guineâ collegit et in aere incisas excudi curavit Adamus Afzelius. *Interpretatur* E. FRIES. 4to. Upsaliæ, 1860.

This work consists of 12 plates, printed in brown, and 4 pages of text, giving definitions, &c. of the 30 species figured.

BAIL.—Mykologische Studien besonders über die Entwicklung der *Sphæria typhina* Pers. von Dr. Th. Bail. Nov. Act. Vol. xxix.

Dr. Bail states that *Sph. typhina* is strictly epiphytal. He describes the perithecia as produced by the germination and growth of the conidia after the latter have fallen upon the underlying stratum or conidial layer; and he suggests, as a probability, that the perithecia in Rhytisma, Polystigma, Hypoxylon, Nectria and other allied genera are produced by the germination of the conidia. He discusses the nature of the so-called spermatia of fungi in general, and contends that they are not distinct from conidia. As far as he could count, each ascus contains four sporidia,* each sporidum being divided by transverse septa into numerous cells. The systematic position of the plant Dr. Bail considers to be in the genus Claviceps. At the end of the paper are a few remarks upon the early state of *Poronia punctata*.

BARY, DE.—Die gegenwärtig herrschende Kartoffelkrankheit, ihre Ursache und ihre Verhütung. Eine pflanzen-physiologische Untersuchung in allgemein verständlicher Form dargestellt von Dr. A. de Bary, Prof. d. Bot. zu Freiburg, i. B. Mit. 1 Stein-

* The figures (Pl. 2, figs. 8 and 9) appear inconsistent with this supposition.

drucktafel. Leipzig, A. Förstnersche Buchhandlung (Arthur Felix), 1861.

This treatise, as its title shows, relates to the well-known potato disease, which the author, in common with other writers, attributes to the action of *Peronospora infestans*, a mould which Dr. de Bary states to be peculiar to the potato, and the allied species of Solanum. Suggestions are given with regard to the mode of cultivation, and other precautions which should be adopted to ward off the disease.

Bary, A. de.—Ueber die Geschlechtsorgane von Peronospora. Bot. Zeit. 5 April, 1861. Vol. xix. p. 89.

The author states that he has observed in *P. calotheca* and *P. Alsinearum* small curved clavate cells, springing from the mycelium, which press with their upper end against the wall of the large vescicular spore cells observed by Tulasne and Caspary. He considers these latter cells to be 1-spored oogonia, and the small clavate cells to be antheridia. The spore-cells in their early stage exhibit an accumulation of granular matter in their interior, not at first clothed by a membrane. As soon as this ball of granular matter is formed, the antheridium emits a delicate prolongation (similar to those of the antheridia of Saprolegnia), which pierces through the wall of the oogonium, and reaches the granular ball. The latter then becomes immediately clothed with a delicate colourless membrane, and thus forms an oospore. The contents of the prolongation are similar to those of the main body of the antheridia, and no traces of spermatozoa are visible. The formation of the outer membrane of the oospore of *P. Alsinearum* from the surrounding plasma within the oogonium is then described. The ripe oospore is stated to possess a firm colourless cellulose membrane inside the dark-brown outer one. The author considers that his observations prove the possibility of the formation of a cell-membrane directly out of proteine matter, and otherwise than by secretion from the contents which it surrounds.

Bonorden.—Beiträge zur Mykologie. Bot. Zeit. July 12 and 19, 1861. Vol. xix. pp. 193, 201.

Dr. Bonorden's papers contain descriptions of a number of fungi considered by the author as new species. There are some remarks upon the genus Cystopus, and upon the specific distinctions of *C. cubicus* and *C. candidus*, and a doubtful new Cystopus occurring upon Alisma. He states that the plant figured as Oidium Tuckeri by von Mohl, in Bot. Zeit. Vol. xi. No. 33, plate 11, and as Oidium leucoconium by Preuss, in Sturm's Deutschland's Flora, III. Heft. 29-30, Tab. 34, are both identical with his species Crocysporium fallax. Two new genera are proposed, "Phacellium" (published in Rabenhorst's Fungi Europæi, Cent. III. 288), belonging to the Isarieæ, and distinguishable by its septate spores; and "Polythecium," which is a compound Cryptosporium. The new species described include an Alysidium, a Fusidium, a Fusisporium, four Torulas, an Oidium, a Hormodendron, two Crocysporiums, a Cephalosporium, an Aspergillus, a Cylindrophora and a Boletus.

BERKELEY and BROOME.—Notices of British Fungi. By the Rev. M. J. Berkeley, M.A. F.L.S. and C. E. Broome, Esq., A. N. H. 3d Ser. Vol. vii. pp. 373 and 449.

BROOME.—See Berkeley.

CIENKOWSKI.—Ueber parasitische Schläuche auf Crustaceen und einigen Insektenlarven (*Amœbidium parasiticum*, m.) von Prof. L. Cienkowski. Bot. Zeit. 21 June, 1861. Vol. xix. p. 168.

Lieberkuhn (Müller's Archiv. 1856. p. 494) and Schenk (Verh. der ph. med. Ges. in Würzburg, 1858) have described certain organisms parasitic upon the gills of the larvæ of Phryganea, *Asellus aquaticus*, and *Gammarus pulex*. These organisms have been since examined by Prof. Cienkowski, who considers them to be forms of a unicellular plant, to which, from the amœboid character of its oospores, and its parasitic habit, he has given the name of *Amœbidium parasiticum*. Cienkowski found the plant on Phryganea and *Gammarus pulex*, and also very plentifully upon the larvæ of gnats. It is tubular or sac-shaped, unicellular, and variable in form; the largest plants were 0.5^{mm} long by 0.01^{mm} broad; the smallest 0.015^{mm} long. In the spring they produce in their interior spindle or sac-shaped bodies which escape through the cell-wall of the mother plant, being sometimes projected by the elastic contraction of that cell-wall. Pear-shaped zoospores are afterwards formed, which when free exhibit amœboid expansions and contractions, but are distinguishable from Amœba diffluens, which they much resemble, by the absence of a contractile cavity. These zoospores eventually become motionless, and at once produce spindle-shaped bodies (young Amœbidia) in their interior, or they become transformed into resting spores which, after a time, also produce young Amœbidia. The author concludes that Amœbidium is a plant belonging to the lower algæ or fungi. He then proceeds to describe a very singular growth as to which he was long in doubt whether it belonged to, or was parasitic upon, the Amœbidium. He describes the stages of development of this growth, which is attached to the sides of the Amœbidium, and when perfect consists of a large obovate or pear-shaped cell, crowned with moniliform rows of cells like the head of an Aspergillus. He concludes that it is a fungus, but of doubtful affinity, and calls it *Basidiolum fimbriatum*.

COEMANS.—Eugène, contra Bonorden. Bot. Zeit. 6 Sept. 1861.

Bonorden, in the paper noticed above, had objected that the plants No. 232 and 233, in Rabenhorst's third Century, had been wrongly described by Coemans as the pycnidiferous and spermogoniferous forms of *Dermatea Cerasi*. Coemans here states that the name given to No. 232 has been confirmed by Tulasne; but with regard to No. 233, he now considers it a spermogoniferous

form of *Valsa leucostoma*, Fr. He objects that Bonorden's proposed genus, Polythecium, does not differ from Leveillé's Micropera.

COEMANS.—Monographie du genre Pilobolus, Tode, Specialement étudié au point de vue anatomique et physiologique, par Eugène Coemans. Mémoires couronnés et mémoires des savants étrangers publiés par l'Académie royale des Sciences, des lettres, et des beaux-arts de Belgique. Tom. xxx.

This monograph is divided into four parts. The first contains a concise account of the different works which have from time to time appeared on the genus Pilobolus, commencing with Henry Baker's essay in 1744, and concluding with Mons. Coeman's own paper in the 8th vol. of the Bull. de l'Acad. royale de Belgique.

The second part relates to the anatomy of the plants, and treats separately of the root-like rhizome, the stem or fruit-bearing cellule, and the globule or sporange. The author observes that one rhizome may produce as many as fifty fructifying cellules. The stem with its membrane and septa is then described; after that the sporangium, the structure of which is somewhat complicated; and lastly, the spores.

The third part relates to the physiology, commencing with the germination of the spores, which is stated to commence by expansion and ramification of the *outer* membrane. A mycelium is formed after from 4 to 8 days, and from this the fructification arises. The author considers that the pearly drops of moisture so common on the stem of Pilobolus, are produced from the *sap* of the plants by the pressure of a gentle endosmotic current passing into the stem through the basal septum. M. Coemans observed that the sporangum was projected to different distances, the greatest being 1 mètre 5 centimètres, or more than 300 times the height of the plant. This projection is supposed by the author to be caused by the force of the ascending endosmotic current, assisted probably by the contraction of the "cellule fructifère," under the influence of light. The different "*habitants*" of Pilobolus, and the curious oscillations in the dewdrops, are noticed and explained. The plant is said to have its proper place amongst the Mucorineæ, next to Ascophora. We have not space to notice the fourth (or systematic) part of this paper beyond saying that after a careful review of the five known supposed species, M. Coemans reduces them to two certain ones, *P. crystallinus* and *P. œdipus*, and one very doubtful one, viz. *P. roridus*

FAVRE, L.—*Tuber brumale* (truffe d'hiver).—*Morchella conica* (morille conique). Bull. de la Soc. d. Sc. Nat. de Neuchatel, Vol. v. p 522.

FRIES.—Note sur la distribution geographique des Champignons, par M. Elie[m] Pierre Fries. A. S. N. 4 Ser. Vol. xv.

FRIES, E.—Sveriges ätliga och giftiga svampar tecknade efter naturen, utgifna af Kongl. Vetenskaps-Akademien. 8 plates, folio. Stockholm, 1860.

Fuckel.—Enumeratio fungorum Nassoviæ, collectorum a Leopoldo Fuckel, Series I. cum tabulâ lithographicâ (Figuræ ab auctore ipso coloratæ). Ex Annal. Soc. Nass. Nat. scrut. F. xv. p. 1. Wiesbaden, Julius Niedner, 1861.

——— A Collection of dried Fungi has been published by this author. It contains 800 of the species referred to in the above "Enumeratio."

——— Mykologisches, von L. Fuckel. Bot. Zeit. 30 Aug. 1861. Vol. xix. p. 249.

This paper contains some detached observations on different fungi (accompanied by figures), of which the following is a summary:—

1. *Sclerotium compactum*, D. C. b. Helianthi Rabh. This Sclerotium, sown in March, produced at the beginning of June a new Peziza, called by the author *P. Sclerotii.* It is nearly allied to *P. Caucus*, Fr.

2. A new species of Actinothyrium (called *A. Cytisi*), on Cytisus sagittalis, Kch.

3. Remarks on the double fructification of *Uredo Alchemillæ*, proposing a new genus for its reception under the name of Trachyspora. Unless there is some error of observation, which we strongly suspect, the genus seems admissible.

4. Remarks on the destructive effects of *Cytispora rubescens*, Fr. upon living plants of *Prunus Armeniaca.*

5, 6, 7, and 8. Descriptions of new species of Ceratostoma, Dilophospora, Peziza, and Fusidium. The Peziza seems a fine species. It is considered by the author to be allied to *P. vogesiaca*, M. and N., and *P. rhizopus*, A. and S.

9. A new genus, *Byssothecium circinans*, highly destructive to Medicago sativa. An interesting plant, classed by the author with the Perisporiacei, but apparently more nearly allied to Hendersonia.

Hoffmann.—Icones analyticæ Fungorum. Abbildungen und Beschreibungen von Pilzen mit besonderer Rucksicht auf Anatomie und Entwickelungsgeschichte von Hermann Hoffmann, Professor der Botanik in Giessen. Heft. I, und II. Giessen. 1861 und 1862. 12 plates.

Keferstein, W.—Ueber parasitische Pilze aus *Ascaris mystax.* Z. W. Z. 1861. xi. p. 135.

Muenter.—Sur l'ergot du Seigle et sur les Sclerotium en general, considérés au point de vue morphologique, par M. J. Muenter, professeur de botanique à l'Université de Greifswald. Bruss. Bull. 2me Ser. vol. xi. p. 215.

M. Muenter saved some specimens of *Sclerotium varium* in the month of December 1857; after the lapse of a year and a half—viz. in July 1859—the Sclerotium gave rise to a Peziza differing from *Peziza tuberosa*, Bull. in its pedicel and disk, as

well as in its size and colour. The author has named the plant *Peziza Antzii*, in memory of the late Dr. Antz.

OTTH. G.—Ueber die Brand- und Rostpilze. Bern. Mitth. 1861. p. 57.

PASTEUR.—De l'influence de la Temperature sur la fecondité des spores de Mucedinées, par M. L. Pasteur. C. Rend. 7 Jan. 1861.

—— Sur la fermentation acetique, par M. Louis Pasteur.

This note relates to some properties of plants belonging to the genus Mycoderma, with regard to the acetification of alcoholic liquids.

POKORNY.—Ueber die angeblich thierische Natur der Schleimpilze (Myxomycetes), von Dr. A. Pokorny.

This paper consists of a short argument against De Bary's proposal to transfer the Myxomycetous fungi to the animal kingdom. De Bary's views will be found in Siebold and Kölliker's Zeitschrift für wiss. Zool. vol. x. p. 88.

REMY.—Champignons et truffes, par Jules Remy. Avec 12 planches. Paris, Libraire Agricole. 18mo. 179 pp.

ROUSSOL.—Des Champignons comestibles et veneneux qui croissent dans les environs de Paris, par Ernest Roussel. 8vo. pp. 68. Rouen. Paris, V. Masson et fils.

SALLE.—Culture des champignons, avec l'indication d'une méthode nouvelle pour en obtenir en tous lieux par l'emploi de la mousse. 2me édition, 18. 51 pp. Paris.

SCHLECTENDAL.—Eine neue Phalloïdee, nebst Bemerkungen über die ganze Familie derselben, von D. F. L. v. Schlectendal. Linnæa. vol. xxxi. p. 101.

This paper commences with some account of the literature relating to the Phalloideæ, including Oschatz's observations of the germination of the spores of *Phallus impudicus*. The author then proceeds to a rearrangement of the family, retaining the genus Phallus, with which he unites Dictyophallus of Corda. Next to Phallus is placed Simblum: and it is in this genus that the new plant referred to in the title of the paper occurs. It is called by Prof. Schlectendal *Simblum sphærocephalum*, and is the first of the genus which has occurred in South America. A coloured figure is given at the end of the paper. Simblum is followed by Fœtidaria of St. Hilaire (a genus nowhere figured and only imperfectly known, but which the author considers to have much resemblance to Simblum); then comes Colus, Cav. and Sech.; then Laternea of Turpin, and then Clathrus, in which latter genus is placed Berkeley's *Ileodictyon gracile*.—the genus Ileodictyon (which follows Clathrus) being confined to *I. cibarium* of Tulasne. Staurophallus, Mont., Aserophallus, Lap. and Mont., Lysurus, Fr., and Aseroe, La Bill., form the group of Lysoroideæ, Calathiscus of Montague being united with the latter genus in a separate section. The paper concludes with a notice of two plants observed by Loureiro in Cochin China, and called

by him respectively *Phallus impudicus* and *Clathrus Campana.* The author is of opinion that both these plants belong to the genus Phallus, but that the former is not identical with P. impudicus. We may add that the account of the growth of the spores in Phallus given at the head of that genus is probably incorrect, resting as it would seem to do solely upon Oschatz's observations. Tulasne, in his "Selecta Fungorum Carpologia," recently published, states that the cellular body supposed by Oschatz to have been produced by the germination of *Phallus impudicus* was, in fact, the spore of some Sporidesmium.

STREINZ.—Nomenclator Fungorum exhibens ordine alphabetico nomina tam generica quam specifica ac synonyma a scriptoribus de scientia botanica fungis imposita auctore Wenzeslao Materno Streinz. Karl Gorischek, Wien.

This work goes beyond its title in containing a Bibliography of Mycology, in addition to the catalogue of genera and species.

WIGAND.—Zur Morphologie und Systematik der Gattungen Trichia und Arcyria von A. Wigand. Pringsheim's Jahrbücher für wiss. Bot. vol. 3. p. 1.

This paper treats of the anatomy of the genera Trichia and Arcyria, and contains a systematic account of the species. At the end are some remarks as to the position of the Myxomycetes with regard to the animal and vegetable kingdoms, in which the author disputes De Bary's views. The paper is illustrated with three plates.

5. *Algæ.*

ARRONDEAU.—Essai sur les conferves des Environs de Toulouse; par M. Arrondeau. Act. Soc. Linn. de Bordeaux. 3e Serie, t. iv. p. 27.

BRADY, G. S.—Algological Notes. Tynes. Trans. v. 74.

CIENKOWSKI.—(See under the head "Fungi.")

DONKIN, ARTHUR SCOTT.—On the Marine Diatomaceæ of Northumberland, with a description of several new species. Q. J. M. Sc. New Ser. I. p. 1.

DUCHESNE-DUPARC, L.V.—Du *fucus vesiculosus* (chêne marin, laitue marine), de ses propriétés fondantes et de son emploi contre l'obésité, etc. Paris.

FLEISCHER.—Ueber *Protococcus roseo-persicinus,* Kq. Wurt. Jahrb. xvii. p. 55.

FRESENIUS.—Ueber einige Diatomeen von G. Fresenius, Senckenb. Proc. Vol. iv. p. 63.

Dr. Fresenius describes and figures four species of Navicula, one being new, *Pinnularia Silesiaca,* Bleisch. and *Amphora Salina,* W. Smith. In his introductory remarks he proposes the adoption of the terms "frons" and "latus," to express what English observers call the "front view" and "side view."

GRAY, J. E.—On the Arrangement of the Families and Genera of Chlorospermous Algæ. An. N. H. 3 Ser. viii. p. 404.

GRESSLY.—Plantes marines du genre des Ulves. Bull. de la Soc. d. Sc. Nat. de Neuchatel. Vol. v. p. 522.

GREVILLE, R. K.—Descriptions of New and Rare Diatoms.

Ser. I. London Mic. Trans. Vol. ix. p. 39.
Ser. II. ,, ,, ,, p. 67.
Ser. III. ,, ,, ,, p. 73.
Ser. IV. ,, ,, ,, p. 79.

HARVEY.—Phycologia Australica; a History of Australian Seaweeds, by William Henry Harvey, M.D., F.R.S. Vol. iv.

HENDRY, W.—On *Hyalodiscus subtilis* (*Craspedodiscus Franklini*). Q. J. M. S. New Ser. I. p. 179.

——— On *Amphipleura pellunda.* Q. J. M. S. New Ser. I. p. 87.

——— On *Navicula rhomboides.* Q. J. M. S. New Ser. I. p. 231.

HICKS, J. B.—On the Motionless Species (*stato-spores*) of *Volvox globator.* Q. J. M. S. New Ser. I. p. 281.

——— Contributions to the Knowledge of the Development of the Gonidia of Lichens, in relation to the Unicellular Algæ. Q. J. M. S. New Ser. I. pp. 15, 90.

——— On the Diamorphosis of *Lyngbya*, *Schizogonuim*, and *Prasiola*, and their connection with so-called Palmellaceæ. Q. J. Mic. Sc. New Ser. I. p. 157.

HILDEBRAND.—Ueber ein Chroolepus mit Zoosporenbildung, von Dr. Hildebrand. Bot. Zeit. 29 March, 1861. Vol. xix. p. 81.

Dr. Hildebrand gives an account of a species of Chroolepus considered by the author to be new, but which he states to have been pronounced by Kützing to be a form of the protean *Chroolepus aureum.* The author gives an account of the production of zoospores from flask-shaped cells which appear to be sometimes terminal, sometimes lateral. The zoospores do not differ materially from those described by Caspary in the Flora for 1858 as produced by *C. aureum* var. *tomentosum.* The author's experiments tend to show that warmth and moisture are necessary for the production of the zoospores, but that the presence of light is not essential. He observed that as a rule the number of zoospores is always either 32 or 64. He observed the commencement of their germination by self-division. The author proposes "lageniferum" as the specific name on account of the shape of the zoosporangia. The plant occurred on the bark of climbing plants in the Palm House of the Botanical Garden at Bonn.

JANISCH, C.—Zur Charakteristik des Guano's von Verschiedenen Fandorten. (Figures of Diatomaceæ.) Schlesisch. Abhand. 1861. p. 150.

KÜTZING, F. T.—Tabulae phycologicae od. Abbildgn. der Tange. Vol. 12, pts. 1 to 5. 8vo. 50 plates.

LAMBERT et BURGUE.—Etudes sur les Algues dans le departement de l'Aisne; par M. M. Ed. Lambert et Burgue, in 8vo. pp. 109. (Extr. du Bulletin de la Société littéraire et scientifique de Chauny (Aisne). Paris, F. Savy.

LESPINASSE.—Les Zoospores et les Antherozoides des Algues, histoire de la decouverte, du mouvement et des fonctions physiologiques de ces organes; par M. G. Lespinasse. Bourd. Soc. Linn. 1861.

LEWIS, F. W.—Notes on new and rare species of Diatomaceæ of the United States Sea Board. Phil. Proc. 1861. p. 61.

LOBB.—On the self-division of *Micrasterias denticulata.* Lond. Mic. Trans. 1861. p. 1.

NÄGELI.—Beiträge zur Morphologie und Systematik der Ceramiaceæ. Sitzungsberichte der konigl. bayerischen Akademie der Wissenschaften zu München. Vol. ii. p. 297.

The reputation of the author will ensure the attention of Botanists to this paper on the structure, reproduction, and classification of the Ceramiaceæ. Its length precludes any detailed account of it in this place.

NAVE.—Algologische Notizen von J. Nave in Brünn. Bot. Zeit. 17 May, 1861. Vol. xix. p. 131.

In this paper the author in the first instance endeavours to show that Microhaloa originates from the discharged contents of the cells of the threads of Tolypothrix. The formation of Merismopædia by division of the cells of Microhaloa, is afterwards noticed, and he then mentions the occurrence of a Microcystis very like *Microcystis æruginosa,* Ktzg. which appeared to arise from the irregular division and subsequent disintegration of the Merismopædiæ. He considers the connection between Tolypothrix and Microhaloa extremely probable, that the connection between Microhaloa and Merismopædia is beyond doubt, and the connection between the latter and Microcystis a very probable one.

NORMAN, GEORGE.—On some undescribed species of Diatomaceæ. Lond. Mic. Trans. 1861. p. 3.

NYLANDER.—Diatomaceis Fenniæ fossilibus additamentum; auct. M. W. Nylander. Sællskapets pro Fauna et Flora fennica Notiser. Vol. vi. N. S. p. 147. (Published separately in 8vo. pp. 12).

—— — Notula circa Spermosiram et Nodulariam Algarum genera, scripsit William Nylander. A. S. N. Vol. xv. p. 34.

In this note Dr. Nylander expresses an opinion that *Nodularia Suhriana,* Kütz. Tab. Phyc. is probably only a young state of *Spermosira littoralis,* Harv., and that possibly *Spermosira Vrieseana,* and *litorea* Kütz. may be also only states of *S. littoralis.*

SCHENK.—Zur Kenntniss der geschlechtlichen Fortpflanzung der Gattung Vaucheria, von Schenk. Würz. N. Z. Vol. ii. p. 201.

The first portion of this paper contains a very short account of the development of the male and female organs of *Vaucheria* *terrestris* and *V. cæspitosa*, and of the act of impregnation. The rest is devoted to a discussion of Karsten's opinions on the subject of Vaucheria, which the author (adopting Pringsheim's views) considers to be erroneous.

STODDER, CHARLES.—Report on Slides of Diatomaceæ, mounted by E. Samuels, for Boston (U. S.) Society of Natural History. Lon. Mic. Trans. 1861. p. 25.

6. *Miscellanea of Cryptogamic Botany.*

BERG.—Charakteristik der für die Arzneikunde und Tecknik wichtigsten Pflanzen-Gattungen, oder Atlas zur pharmazeutischen Botanik, von Dr. Otto Berg, Zweite Auflage. Berlin. 1861. Gaertner.

This volume relates principally to phænogams; but contains also figures of a few species of Fungi, Algæ, Lichens, Mosses, and Ferns.

COMMENTARIO della Societá crittogamologica Italiana. N. 1. Febbrajo, 1861. Genova co' tipi del R. J. de' Sordo-Muti. A spese degli Editori dell Erbario crittogamico Italiano. 1861. pp. 45 and 2 lith. plates.

This work is a companion to a collection of Italian cryptogamic plants in course of publication. The following are the contents of the present part:—1. Cesati on the cryptogamic vegetation in the neighbourhood of Vercelli and Biella. 2. Baglietto on some new lichens. 3. De Notaris and Baglietto on *Opegrapha poetarum*. 4. De Notaris on Stereopeltis, a new genus of lichens. 5. De Notaris on a new Octaviana. 6. De Notaris on a new species of Coccosporium. 7. Dufour on some marine Algæ. 8. Caldesi on *Sphæria Petrucciana*. 9. Gennari on a new species of Isoetes. The part concludes with an account of the works on cryptogamic botany published in 1860; from which it appears that Fasc. VII. VIII. and IX. of the "Erbario crittogamico Italiano" appeared in that year.

HEDWIGIA.—Ein Notizblatt für kryptogamische Studien.

This publication appears very irregularly at considerable intervals of time. We have not been able to meet with all the parts for 1861. Those which we have seen contain a paper on Pseudogonidia by Nave, and one on *Sphæria Hoffmanni*, Fr. by Hoffmann.

MONTAGNE.—Florula Gorgonea seu Enumeratio plantarum cellularium quas in Promontorio Viridi (Cap Vert) insulisque adjacentibus a diversis botanicis et imprimis Cl. Bolle, beroliniensi, huensque collectas, recognovit descripsitque C. Montagne, D. M. A. S. N. 4 Ser. xiv. p. 211.

—— Neuvième centurie de plantes cellulaires nouvelles tant indigenes qu' exotiques. Par Camille Montagne, D. M. Decades I et II. A. S. N. xiv. p. 167.

This paper contains descriptions of some new Algæ, Lichens, Fungi, and Hepaticæ. There is one new genus, an Alga, called Trichosolen, belonging to the Valonieæ, and allied to Ascothamnion and Valonia.

Nylander.—Grana quædam botanica parva offert W. Nylander. Bot. Zeit. 24 May, 1861. vol. xix. p. 142.

Dr. Nylander suggests some alterations in cryptogamic terminology with regard, 1st, to the fruit, and 2ndly, to the mode of cell-division.

Rabenhorst.—Additional fascicles have appeared of the following:—Bryotheca Europæa.—Die Algen Europa's.—Lichenes Europæi exsiccati.—Hepaticæ Europææ.—Fungi Europæi exsiccati.

Specimen Floræ cryptogamæ septem insularum editum juxta plantas Mazziarianas herbarii Heufleriani et speciatim quoad Filices herbarii Tommasiniani:

1. Cryptogamas vasculares recensuit Dr. H. W. Reichardt.
2. Muscos frondosos recensuit J. Juratzka.
3. Hepaticas recensuit Dr. C. M. Gottsche.
4. Algas recensuit A. Grunow.

Wien. Z. V. B. vol. xi. p. 411.

Jack, Lenier, and Stitzenberger.—Kryptogamen Badens.

The tenth fascicle of this collection has been published.

Mitten.—Musci et Hepaticæ Vitienses. Auctore W. Mitten. Bonplandia, 1861, p. 365.

Stizenberger.—Versuch zur Bereinigung der Terminologie fur die Fortpflanzungsorgane der blüthen-losen Pflanzen, von Dr. Ernst Stizenberger, Arzt in Constance. Reg. Fl. 1861. pp. 193, 208, 225.

Uloth.—Beiträge zur Flora der Laubmoose und Flechten in Kurhessen. Von Wilh. Ulott, Chemiker in Nanheim. Reg. Fl. 1861, passim.

Westendorp.—Sur quelques Cryptogames nouvelles ou inedites pour la flore belge, septième notice; par G. D. Westendorp, medecin de bataillon au 12me régiment de ligne. Bruss. Bull. 2me Ser. vol. xi. p. 644.

Miscellanea.

The Pile Dwellings on Lake Prasias.

Our readers will remember the passage in which Herodotus describes the Lake dwellings on L. Prasias. We learn from the "Revue de l'Instruction Publique" that these have been re-discovered by M. Deville.

"L'auteur," it is said, "détermine l'emplacement de l'ancien lac Prasias, décrit ses habitations lacustres sur pilotis, analogues à celles qu'avait décrites Hérodote, et fixe avec plus de précision qu'on ne l'avait fait jusqu'ici les situations d'Œsyme, de Datos et de Néapolis. Enfin quelques inscriptions qu'il a recueillies sur les marbres antiques nous apportent aussi d'intéressantes notions particulièrement sur les mœurs des peuples thraces."

We shall read with much interest the detailed account of M. Deville's discovery.

On the Genus Cynips.

The genus Cynips is specially interesting to physiologists because, though the species are numerous and the individuals innumerable, no Entomologist has yet found any male representative of the group. In the Phil. Trans. for 1858, Mr. Lubbock has described and figured the development of the ova in *Cynips Kollari*, then known (though as it appears erroneously) under the name of *C. lignicola*, a species which lives on the oak, and makes round hard galls about as large as a nut. It presents in addition an interesting example of a change in geographical distribution. Unknown in this country until within the last few years, it then appeared in the south-west of England, whence it gradually spread eastward. Mr. Frederick Smith, President of the Entomological Society, at the July meeting of the Society, stated that about three years ago it appeared in the woods near London, especially on the north side, in very large numbers; but in the second year of its appearance the tomtits had discovered that each gall contained a fine fat grub, and the result was that it was now difficult to obtain a perfect gall. Mr. Walker corroborated Mr. Smith's account, both of the appearance and the approximate extermination of the species in the woods near Highgate; and Prof. Westwood expressed a hope that the fact would be made known as widely as possible, since it afforded an additional argument to the many already produced in opposition to the indiscriminate slaughter of small birds.

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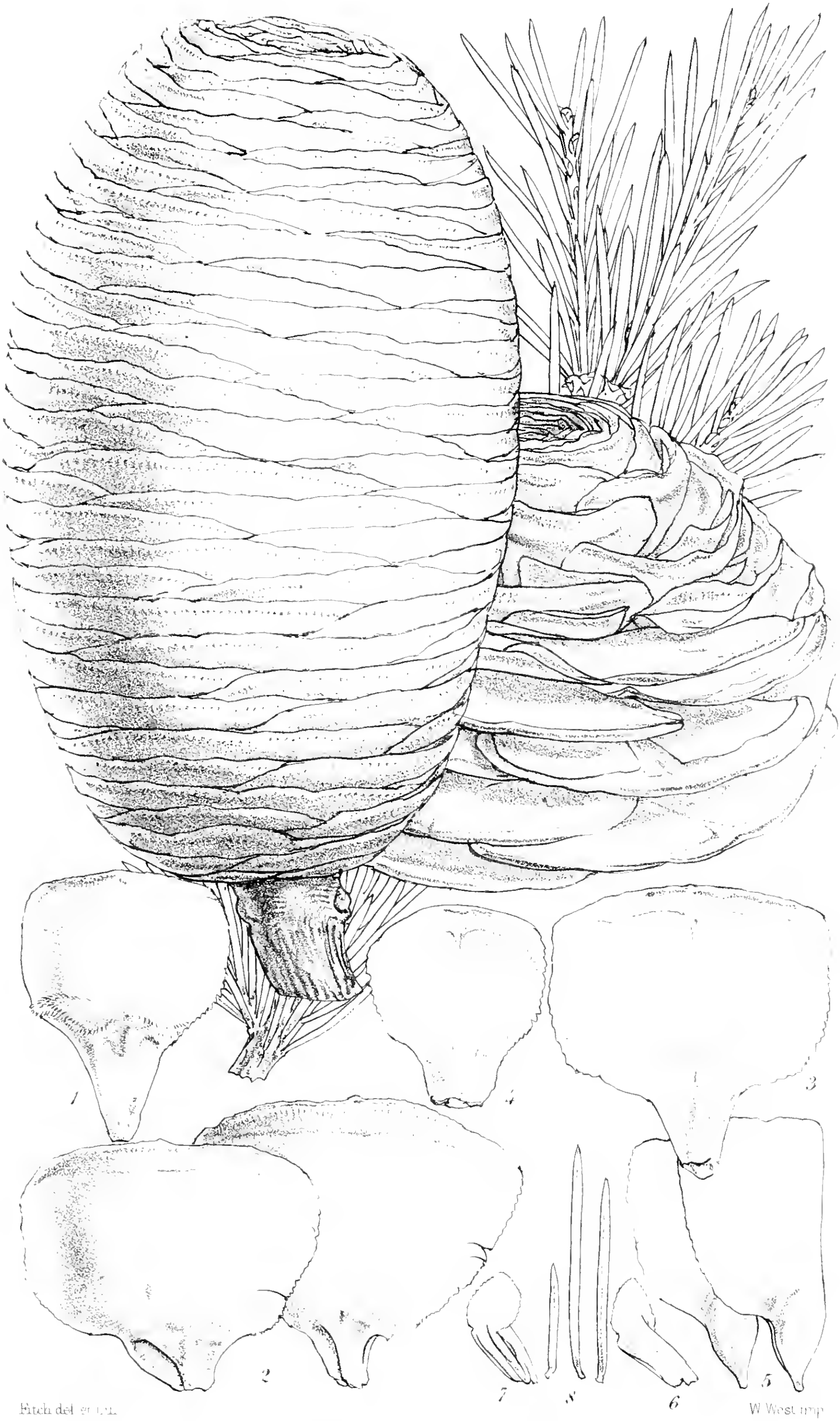

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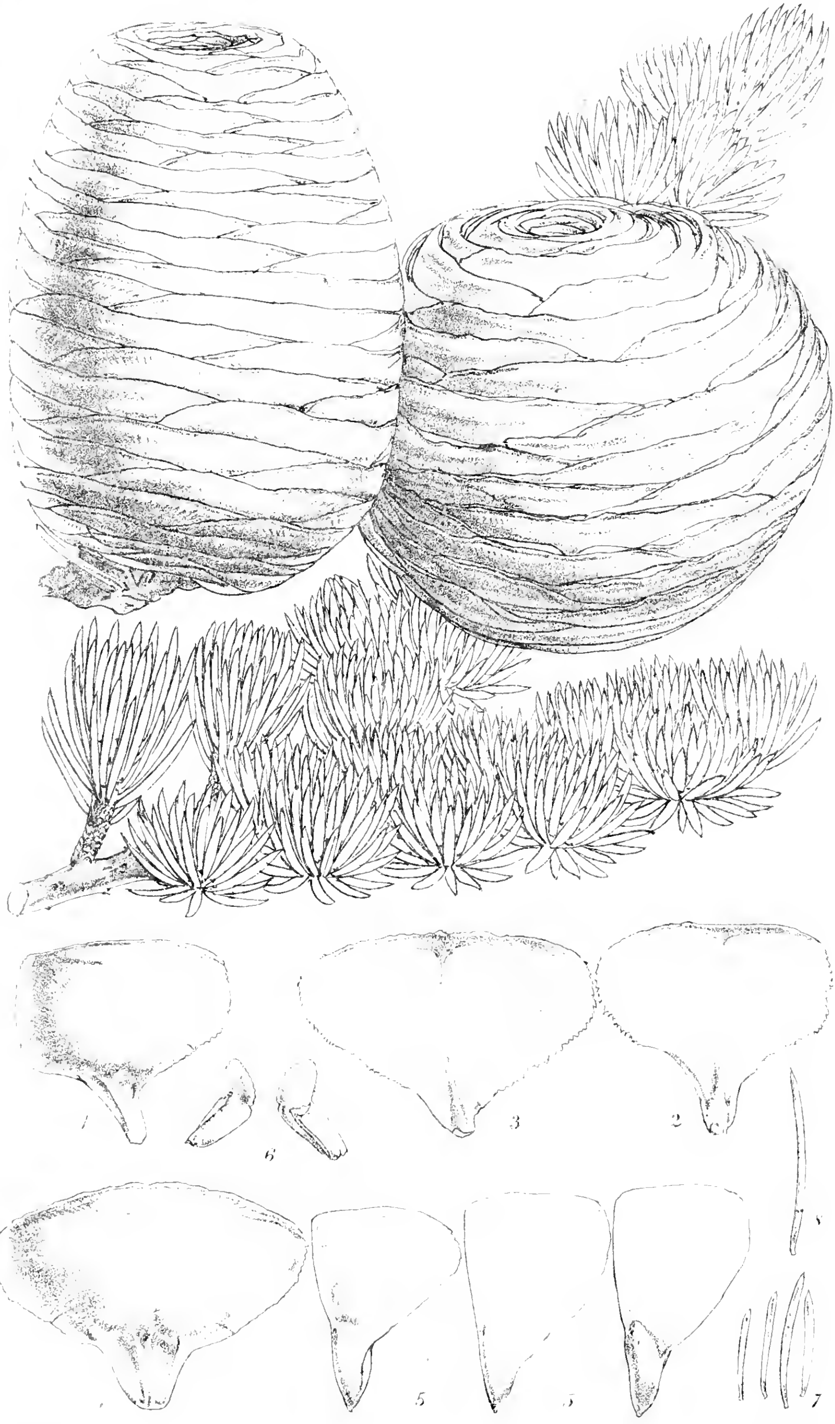

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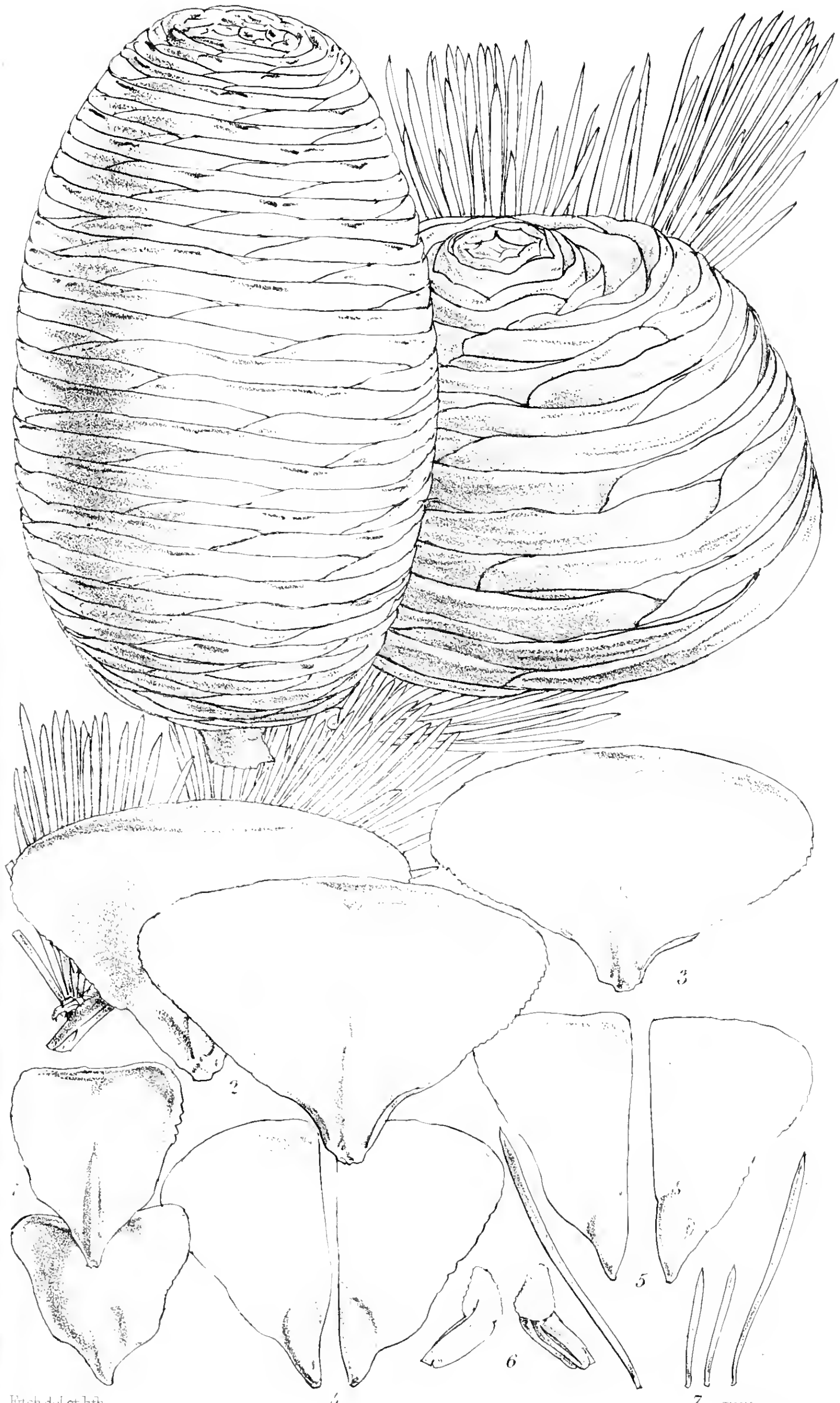

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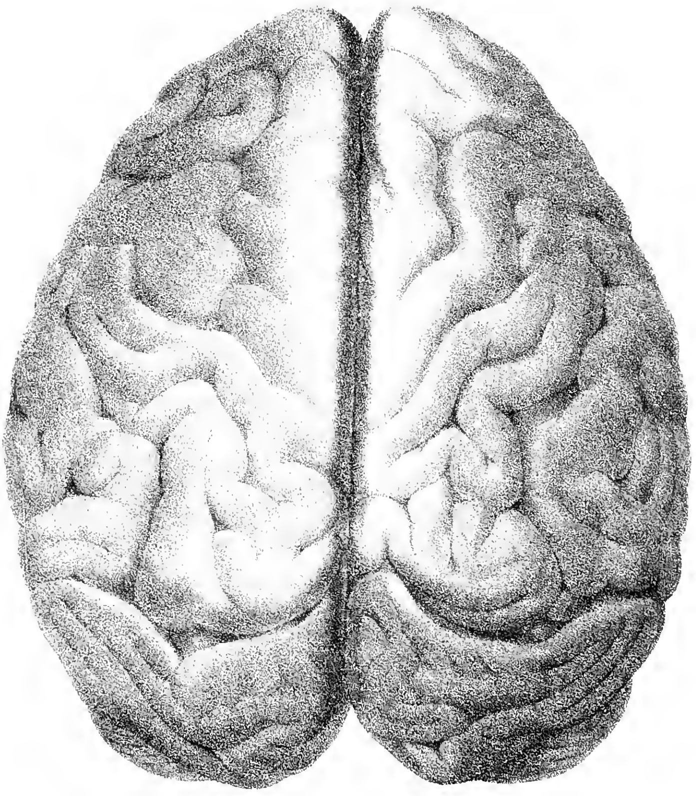

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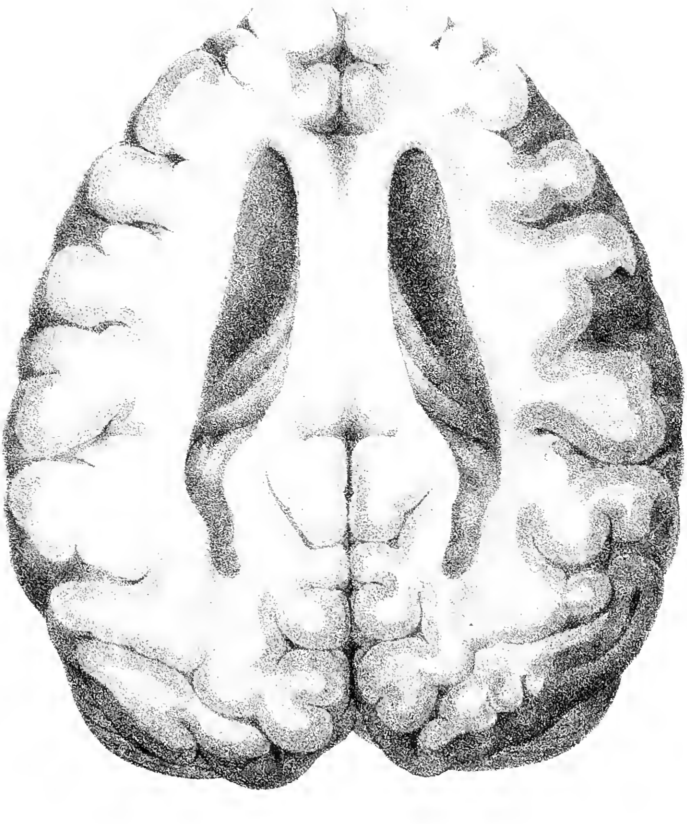

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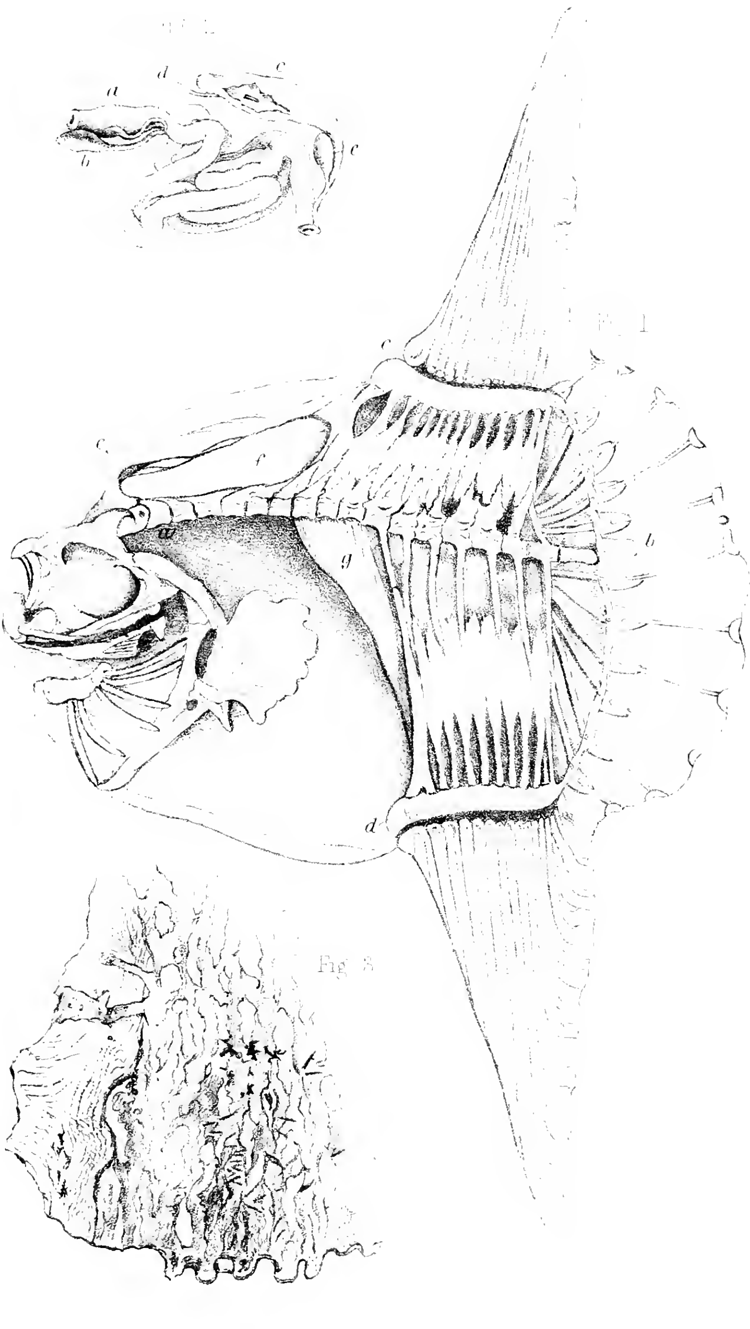

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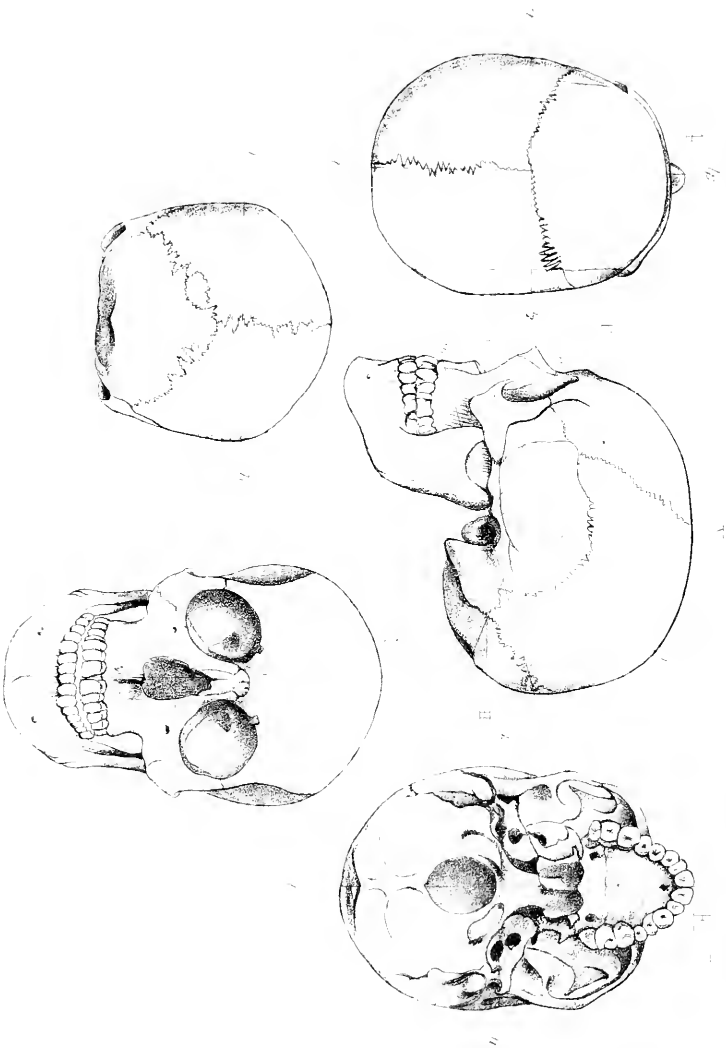
Fig. 4

Fig. 1

Fig. 2



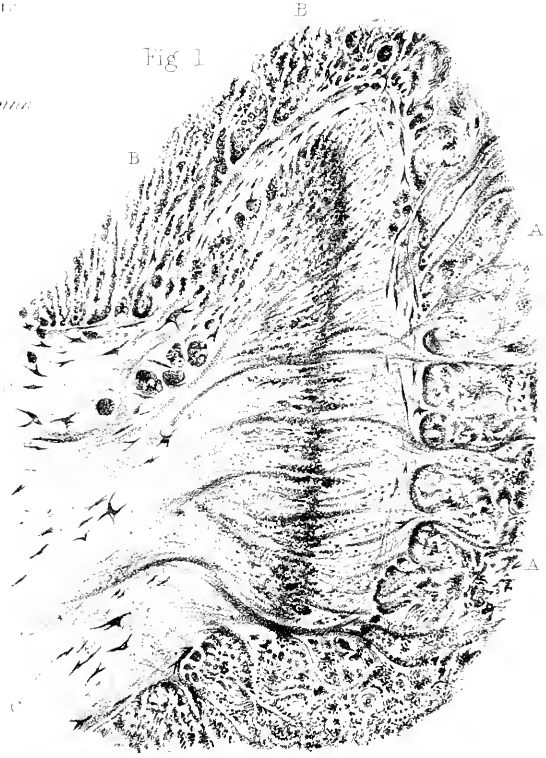
G. Busk del. Ashbee & Dangerfield lith. Bedford St. Covent Garden

...VERSE SECTION OF THE CAPUT CORNU POSTERIORIS AND ... THE CERVIX CORNU WITH A PORTION OF THE SURROUNDING ... AND LATERAL WHITE COLUMNS, FROM THE MIDDLE OF THE ...RV... ENLARGEMENT OF THE OX.

... Diameters

... Vide

Fig 1



... white columns

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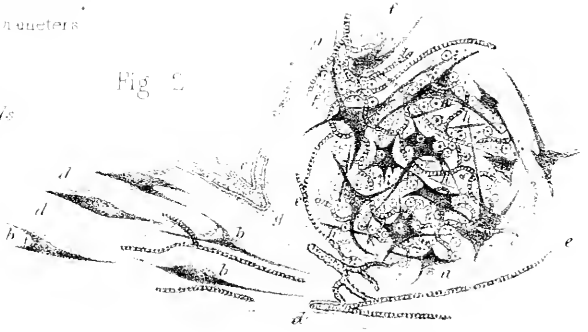
...vessels of blood ... & nerve fibres ... transversing ... substance ... the ... longitudinal fibres

A COLLECTION OF CELLS IN THE ANTERIOR HORN OF THE CERVICAL ENLARGEMENT OF MAN

Magnified ... Diameters

After Goll

Fig 2



a a Large multipolar cells

b Elongated cells

c ... vessels

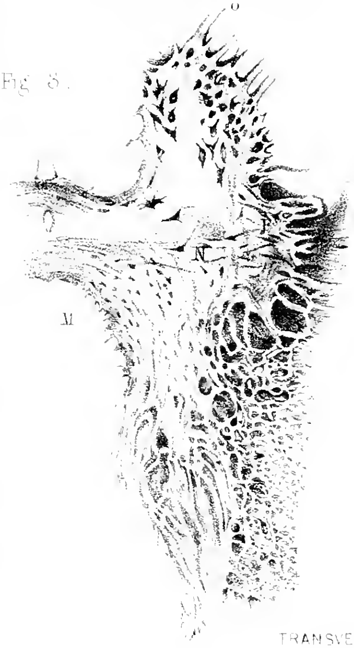
d Nerve fibres

e e ...capillaries

f f ... of nerve fibres

g h h Nerve processes

Fig. 3.



SECTION AT UPPER PART OF THIRD CERVICAL NERVES

Magnified 60 Diameters

After Clarke

F *Tractus intermedio lateralis*
O *Fibres of anterior roots*
M *Posterior vesicular column*
N *Spinal accessory Nerve roots*

TRANSVERSE SECTION OF GREY SUBSTANCE FROM DORSAL REGION OF OX

60 Diameters

After Clarke

Fig. 4.

D *Posterior cornua, the extremities of which are cut off*
E *The gelatinous substance*
F *The anterior cornua*
G *Tractus intermedio lateralis*
H *Central Canal*
I *Posterior transverse commissure*
K *Anterior D°*
L *Anterior Median fissure*
M *Posterior vesicular columns*

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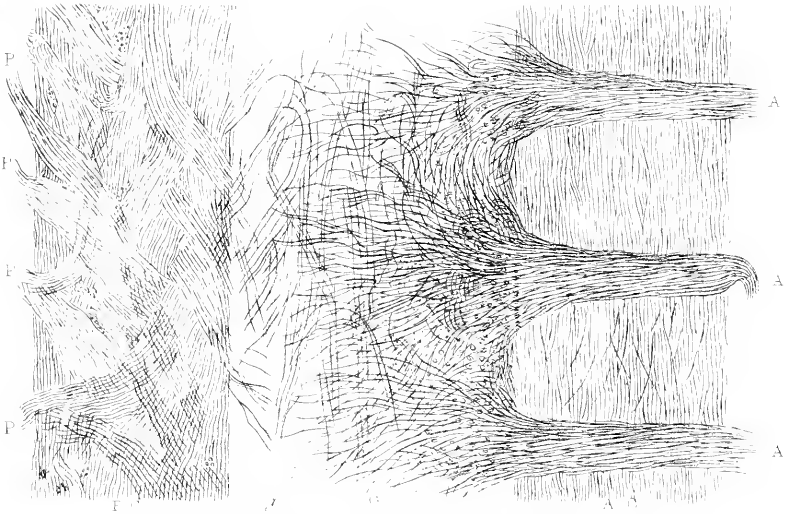
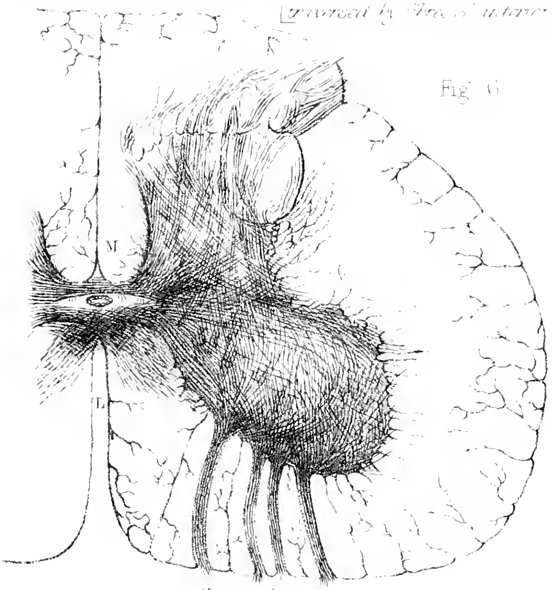
LONGITUDINAL SECTION THROUGH THE LUMBAR ENLARGEMENT OF THE OX. 80 Diameters

Fig. 5



P. Posterior Columns showing interlacement by posterior roots
P. Posterior roots. A. Anterior Columns. A. Anterior roots
g. Substantia gelatinosa. G. Anterior and posterior grey substance traversed by fibres of anterior & posterior roots

Fig. 6



SHOWS COURSE OF THE FIBRES OF THE ROOTS OF THE NERVES AND TRANSVERSE COMMISSURES THROUGH THE GREY SUBSTANCE

30 Diameters.

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