THE NATURAL HISTORY REVIEW:

A

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QUARTERLY JOURNAL OF BIOLOGICAL SCIENCE.

Reviews and Notices.

I.—The Zoology of British India.

(1.) Catalogue of the Mammalia in the Museum of the Asiatic Society of Bengal. By Edward Blyth, Curator, Calcutta, 1863.

(2) The Birds of India, being a Natural History of all Birds known to inhabit Continental India. By T. C. Jerdon, Surgeon-Major, Madras Army, 3 vols. 8vo. Calcutta, 1862-4.

(3.) The Reptiles of British India. By Dr. Albert Günther. London, 1864. Published for the Ray Society, by Robert Hardwicke.

Whatever other advantages may have resulted to civilization from the British occupation of the Indian Peninsula, it cannot be said that the established authorities of our kith and kin in that country have as yet done much for the benefit of the Natural Sciences. A whole host of private collectors and amateurs have, it is true, worked long and laboriously on different branches of Indian Zoology and Botany. But up to the present time we look in vain for anything like an attempt to reduce into order the mass of materials thus accumulated, and to combine them into a Natural History of British India—such as has been prepared by other European Governments, in the case of similar foreign dependencies.

It would, nevertheless, appear that the governmental mind of India is at length awakening to the fact that it is the part of an enlightened administration, if not to take such matters in hand altogether, at least to suffer others to do so, and in certain cases even to mete out some slight encouragement to their labours. The "Flora Indica" of Drs. Hooker and Thompson, which some years ago was refused all assistance, is now promised substantial aid. Dr. Jerdon, who has undertaken the very arduous task of preparing a set of Mammals of the Natural History of the Vertebrate Animals, specially adapted for India, is, as we learn from the preface of the portion relating to the Birds, now complete, permitted to draw his full pay as Surgeon-Major while engaged in editing his work. So that we must allow that what with the advancing position occupied by Science of late years, and, perhaps we should add, under the influence of the hitherto unheard of event of a surplus in the Indian Exchequer, things are looking a little more bright for the Naturalist in British India.

It is indeed with no small satisfaction we are able to call the attention of our readers at one time to three different publications on the Zoology of India—one relating to the Mammals, a second to the Birds, and a third to the Reptiles; which, although of very different orders of merit as regards the information they contain and the labour bestowed upon them, will each alike serve as a basis for some general remarks upon those parts of the Fauna of British India of which they treat.

To begin with the Mammals—Mr. Blyth's recently issued catalogue, of which the title stands at the head of our list, does not relate solely to the Mammals of India, but is, in fact, a list only of those of which specimens are contained in the Museum of the Asiatic Society of Bengal at Calcutta. This well known Institution, which has done so much for the progress of the Natural Sciences in our Eastern possessions, acquired the services of Mr. Blyth as its Curator in 1841. At that time, as may be seen by reference to the 10th volume of the Society's Journal,* the collection of Mammals in the Society's Museum was meagre indeed, consisting only of some thirty specimens. How laboriously the new Curator set to work to develope the collections under his care—how the civil and military officials of every part of our Indian Empire were pressed into the service of Natural History, and induced to contribute specimens to the Museum and facts to the Journal of the Society—is well known to every Naturalist, who has paid attention to the Zoology of the East. The value of the contributions made by Mr. Blyth to our knowledge of the Natural History of India, during the twenty-four years of his

* Catalogue of Mammalia in the Museum of the Asiatic Society. By T. C. Pearson. Journ. A. S. B. x. p. 660.

curatorship of the Asiatic Society's Museum is a matter of history, and we believe few occurrences have given greater satisfaction amongst the friends of science than the well-earned pension bestowed upon him by the Indian Government, upon his recent return in broken health and with shattered constitution to this country.

When Mr. Blyth arrived at Calcutta, the Society's collection of Mammals consisted, as we have already said, of some 30 or 40 specimens, which might, as we have been told, have been all arranged on a moderate sized table. Before his departure, as the present catalogue tells us, the collection embraced 585 species of Mammals—many of them represented by large and well-selected series of specimens of different sexes and ages, and from different localities. The fault of the collection now is, we believe, that it is *too crowded*, and that the proper care of it weighs too heavily upon the finances of the Society. This evil, as we learn from the recent numbers of the Society's Journal, is proposed to be remedied by the transfer of the whole of the Museum to the Government upon certain conditions, whereby a new building will be obtained, and the collection will form the nucleus of a Public Museum of Natural History for British India. For this purpose the Society's collection will be of the utmost value, as containing a very large number of typical specimens of every class. The series of Indian Mammals, to which our catalogue refers, although not quite complete, is very nearly so. As we turn over its pages we propose to call our readers' attention to the principal features of the Mammal-fauna of the Indian Peninsula, as they are thus brought before us, neglecting, for the present, the specimens from other parts of the world.

The typical Quadrumana are represented in India by species of three different types—namely, the genera *Hylobates*, *Macacus* and *Semnopithecus*. Of the Gibbons (*Hylobates*) no species occurs in the Peninsula of India proper. On the eastern side of the bay of Bengal, however, two of this genus are found—the *H. hoolook* and the *H. lar*. The former is the prevalent species in Arracan, and "extends thence over all the hill-ranges of Sylhet and Assam," whilst the White-handed Gibbon (*H. lar*), also found in Assam, ranges southwards down the Malayan Peninsula to Malacca.

Of the Macaques, the well known "Toque," or Bonnet-Monkey (*M. radiatus*) is a common inhabitant of the forests of Southern India, ranging on the Coromandel side as far north as the Godavery. In Ceylon this species is replaced by the nearly allied *M. pileatus*, commonly, but incorrectly, called the "Chinese" Bonnet-monkey. In Southern India also, we find the singular "Lion-Monkey" (*Macacus silenus*), often said to be from Ceylon, but of which the true home is "Travancore and Cochin, and the Malabar ghâts as high as Goa." In Central India and Bengal the Rhesus-monkey (*M. rhesus*), so common in European menageries is the only species of this form, unless the varieties distinguished by Hodgson* be deemed worthy of a higher rank than what is generally accorded to them.

The genus *Semnopithecus* or *Presbytes* is better represented in Continental India, if we accept the claims of the various "distinguishable races" of the *S. entellus* to be considered as specifically distinct. The true Hoonuman or Sacred Monkey, *S. entellus* (*verus*) of Mr. Blyth's writings, is found only in Bengal and Upper India. In Southern India it is replaced by *S. priamus* of the Coromandel coast, and *S. hypoleucus* of the Malabar ghâts, in the Subhimalayan region by *S. schistaceus*. In Southern India is also found the distinct species *S. cucullatus* of the Nilgiris, Pulneys and Malabar ghâts. On the eastern side of the bay of Bengal, Mr. Blyth's *S. pileatus* appears to be a northern outlier of the *S. cristatus* of Sumatra. In Ceylon, besides the continental *S. priamus*, which is common in the north and east, we meet with *S. thersites*, *S. ursinus*, and *S. cephalopterus*. The former of these belongs to the true *entellus* group, the two latter are quite distinct, and more nearly allied to *S. maurus*. So that in British India we have some seven or eight representatives (belonging to two sections) of this group of Quadrumana.

The Lemuridæ are represented in India by two outlying stragglers of this Æthiopian group, quite distinct in their geographical range, and although often united under one generic head, equally so in organization. The slender Loris (*Loris gracilis*) is found in Ceylon and Southern continental India. In Bengal, however, the only representative of this family is the *Nyticebus tardigradus*, or Slow Loris, which, like so many other animals of this district, is little more than a northern form of the scarcely separable *N. javanicus*.

The next great group of Mammals, following the arrangement of Mr. Blyth's catalogue, is very extensively diffused in our Indian dominions, as in most other parts of the world. But the Chiroptera

* J. A. S. B. ix. 1213.

are at present in such a state of confusion both as regards genera and species—that we shall content ourselves by merely stating that Mr. Blyth records the existence of three Frugivorous* Bats in Continental India, and enumerates the names of about thirty-five others belonging to the Insectivorous families of the group.

Of the Carnivora of India, although many of the genera are still in a state of confusion, almost rivalling that of the Bats, and little creditable to Naturalists, we can speak rather more at length. The Indian Canidæ consist, according to Mr. Blyth's catalogue, of the *Cuon rutilans*—the "Dhob" or "Wild Dog," as it is commonly called, the *Canis pallipes*, or Indian Wolf, the Jackal (*C. aureus*) and a fox, *Vulpes bengalensis*. Four other species of the latter genus are also recorded as inhabiting the Subhimalayan and north-western districts, but some of these require further examination. One species only of Hyena is found in India—namely, the widely diffused *H. striata*, which appears to have diffused itself from the true focus of this group in Africa throughout South-western Asia, and though not general in Lower Bengal, to extend its wanderings occasionally even to the gates of Calcutta. The more typical Viverridæ of India consist of the *Viverra zibetha*, or Indian Civet—still kept in cages in many parts of the country for the supply of the drug whence it obtains its name—as is likewise the Rasse *Viverricula malaccensis*, a smaller animal of the same type, and several species of *Paradoxurus*. In the same group, Mr. Blyth arranges the Subhimalayan representative of the genus *Prionodon;* a small, but very bold and rapacious quadruped resembling *Herpestes* and *Viverra* in many particulars, but in its short close fur and other characters showing an affinity to the true Felidæ. The very singular Binturong (*Artictis*) likewise ranges from Sumatra along the hills of the Indian peninsula into Assam, and even as far north as Nepal, according to Mr. Blyth, while some seven species of *Herpestes* complete the list of Indian Viverridæ. The typical Felidæ which follow next in Mr. Blyth's catalogue are well represented in British India, at least 10 or 11 species of *Felis* being more or less common in various parts of the country—amongst which are the largest and finest forms of the genus, such as the Lion, now nearly extinct except in the

* *Pteropus medius*, Temm. (generally called erroneously *P. edwardsii*) *Pt. leschenaultii* and *Cynopterus marginatus*.

province of Kattywar in Guzerat—the Tiger, the Leopard, and the Cheetah. The members of the succeeding family, Mustelidæ are mostly more northern in their range, but the Indian list includes at least one Martin (*Martes flavigula*), a species of wide distribution, and two *Mustelæ* belonging to the Subhimalayan region. The Ratel (*Mellivora indica*), which, judging from the living specimens now in the Zoological Society's Gardens, seems separable from its African brother (*M. capensis*), a species of the Eastern-Asiatic genus *Helictis*, and two of the peculiar Indian form *Arctonyx* likewise belong to this family of the Carnivora, which seems altogether to number about nine Indian representatives. Of the remaining family of this Order—the Ursidæ—four very distinct species occur in various parts of the same country. The "Wáh" (*Ailurus fulgens*) is a somewhat abnormal form, confined to the slopes of the Himalayas, and not descending below the level of 7000 feet. The *Ursus isabellinus* is probably nothing more than a variety of the widely distributed *Ursus arctos*, and is also confined to the higher ranges of the Himalayas, while the lower forest-districts of the same region are tenanted by the *Ursus tibetanus* or Black Bear of the Indian sportsmen, and the Sloth Bear (*Prochilus labiatus*) is generally distributed over the Indian peninsula and Ceylon.

The Insectivora, which follow next the Carnivora in Mr. Blyth's list, are also numerous in India, particularly the Shrews of the genus *Sorex* and its allied forms, of which nearly twenty species have been recorded as belonging to this Fauna,* although the whole of this difficult group requires a searching revision. Of the Hedgehogs (*Erinaceus*), at least two species are found in India, and of the Banxrings (*Tupaia*), one well-marked species inhabits the Eastern ghâts of the peninsula,† while a second runs up the Malayan peninsula, as far north as the Khasya hills, and perhaps even to Sikhim. The Talpidæ are only represented in India, as far as we know at present, by two species of the typical genus *Talpa*.

The Cetaceans of the Indian seas, according to Mr. Blyth's catalogue, consist of seven species of Delphinidæ, the Sperm-whale,

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* See an article by Messrs. Blyth and Tomes, Ann. N. H. ser. 2, xvii. p. 11, (1856.)

† *Tupaia elliotti*, Waterhouse, P. Z. S. 1849, pl. xiii. p. 106.

and a single species of Whalebone whale of the genus *Balænoptera*,* which occasionally even enters the Persian gulf. Not the least remarkable of these is the freshwater Dolphin, *Platanista gangetica*, which is only found in the freshwaters of the Ganges and neighbouring rivers. It is said to be common in the Brahmaputra in the valley of Assam, and to ascend that stream probably up to the foot of the mountains. In the Indus and its tributaries this Dolphin appears to be replaced by an allied, but distinct species, recently described by Mr. Blyth as *Platanista indi*,† of which, we believe, no specimens have yet reached this country.

Mr. Blyth now enters upon the most formidable order of Mammals, as regards their classification, both from their varying forms and from the numbers of the species. The Order Rodentia in India as elsewhere in the world (except always those lands of exceptions, Australia and Madagascar) comprises a greater number of specific forms than any other of the great divisions of the Mammalia. The Squirrels, Sciuridæ, of which we have only one species in this country, are very numerous in the extensive forests of India, both in those of high and of low elevation. Many of the former pass into well-marked geographical varieties in different regions, and have been distinguished as species by Mr. Blyth, who has devoted much attention to this group of Mammals. Of the Flying Squirrels (*Pteromys* and *Sciuropterus*) our catalogue enumerates some thirteen Indian species, and of true *Sciuri* about fifteen, besides many others of the adjoining Malayan provinces and great Asiatic Islands. The Myoxidæ or Dormice on the other hand, a group, it is true, not very numerous in species, have only one representative in India. This is a singular and very little known form, allied to the African *Graphiuri*, but with sharp flat spines on the back. It is only found on the Malabar coast, and was described by Mr. Blyth a few years ago as *Platacanthomys lasiurus*.‡ The Spalacidæ in like manner have but one or perhaps two representatives within the area of India proper, in the shape of the Bamboo-rats of the genus *Rhizomys*, of which one species occurs in the north-eastern parts of the country. The Muridæ or true Mice are numerous. Mr. Blyth's

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* *B. indica*, Blyth, J. A. S. B. xxviii. 488.

† Ibid. p. 493.

‡ J. A. S. B. xxviii. p. 288.

list gives us the names of nearly twenty species of *Mus* and its subdivisions, besides a species of *Gerbillus*, and at least two Voles, which occur at some elevation on the slope of the Himalayas, and are perhaps rather to be regarded as stragglers from the great stronghold of this group in Europe and Central Asia. There is much, however, to be done before this very difficult group of Mammals can be said to be anything like satisfactorily worked out, and future investigation will, no doubt, augment the present list, while at the same time it may get rid of many merely nominal species.

Of the Porcupines (*Hystricidæ*) there are two well-marked Indian species—*Hystrix hirsutirostris*, scarçely distinguishable externally from the European *H. cristata*, and the crestless *H. hodgsoni* of the Subhimalayas. But a recent writer speaks of a third, specimens of which have not yet reached Europe.* The long catalogue of Rodents closes with the Hares (*Leporidæ*), three of which seem to have good claims for admission into the Indian Fauna. These are all true hares (*Lepus*), as distinguished from the Piping-hares (*Lagomys*) of the Steppes of Central Asia, which only descend just far enough to look over the edge of the Himalayas, and are quite foreign to the true Mammal-fauna of India.

As, in spite of what Professor Schlegel has advanced, we agree with Dr. Falconer† in considering the specific difference of the Indian-peninsular and Ceylonese Elephants as not yet proven, we shall only allow one Proboscidean to count in the Indian list. The Equidæ, which follow next in Mr. Blyth's catalogue, have also but one living representative in the Indian Fauna. This is the *Equus onager*, or wild Ass of the deserts of Western Asia, extending from Syria through Persia and Beloochistan to the run of Cutch, upon the left bank of the Indus. Judging from specimens now living in the Zoological Society's Gardens, examples from all these countries are indistinguishable, whereas they are strongly contrasted with the true *Equus hemionus* of Pallas, which is spread over the high plains of Central Asia, and is often encountered by Indian sportsmen in the eastern parts of Ladakh. On the subject of the Indian Rhinoceroses, we confess we do not quite understand Mr. Blyth's views, although he has lately put them

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* *Hystrix malabarica*, Day (Land of the Permauls, p. 446)—the "Orange Porcupine" of the Western Ghauts.

† See Nat. Hist. Rev. 1862, p. 144, and 1863, p. 43.

forward at considerable length.* They appear, however, to be that the true *R. unicornis* sive *indicus* is confined to the Tarai regions at the base of the Eastern Himalayas, inclusive of the valley of the upper Brahmaputra and province of Assam; and that the *R. sondaicus*, generally heretofore supposed to be confined to the islands of Java and Borneo, extends right up the Malay peninsula into the Sundarbans of Bengal, and even to the Rajmahal hills north of Calcutta. There seems to be no doubt that the two-horned Rhinoceros of Sumatra (*R. sumatranus*) likewise ranges along the Malay peninsula into the Tenasserim provinces, but though Mr. Blyth says it is "rare in Assam," he does not furnish us with any precise evidence as to its occurrence so far north. It is interesting to the student of geographical distribution to notice that the Sumatran Rhinoceros, although *two*-horned, belongs strictly to the Asiatic section of the genus with lower incisors, and has nothing to do with the African type with deciduous lower incisors, in which two horns are always present.† The Suidæ are represented in India by various "distinguishable" races of wild *Sus*, which Mr. Blyth groups together under the specific name of our European *Sus scropha*, and by the little Pigmy Hog of the Tarai forests of Nepal and Gorruckpore, which Mr. Hodgson described as *Porcula salvania* in 1847,‡ but of which no satisfactory account has yet been published, although, we believe, skin and skull are in our National collection.

Of the marine order of Sirenia, the Dugong (*Halicore indica*) occurs in the Bay of Bengal—the specimens in the Society's Museum being from the Andaman islands, where it seems the natives occasionally use its flesh for food.

The Cervidæ of the Old World are divisible into two sections—the sub-families, Cervinæ and Rusinæ of Mr. Blyth, although we should doubt even the generic distinctness of these two groups. The Cervinæ or typical *Cervi* can hardly be said to enter strictly into the Fauna Indica—this form being characteristic of the northern regions of the two Hemispheres. But the *Cervus wallichii*, which is distributed from the shores of the Caspian throughout the mountain-ranges of Caucasia and Persia, certainly occurs abundantly in the

* See Mr. Blyth's article "On the living Asiatic Species of Rhinoceros," J. A. S. B. xxxi. p. 151, (1862.)

† Cf. De Blainville's Ortéographie, Rhinoceros, p. 209.

‡ J. A. S. B. xvi. 423.

forests of Cashmir, and probably in those of the Nepalese Terai; while we suspect that the *Cervus affinis* of Hodgson, although it has been called "the *Saul* forest Stag,"* is confined to the northern slopes of the Himalayan range. It is certainly quite contrary to the laws of distribution that these two large, nearly-allied species should co-exist in the same area. The Rusine *Cervi*, on the other hand, are the characteristic group of the Indian region, to which indeed they are peculiar. In India proper we have four distinct species of this form—the *Cervus duvaucelii* of Upper Bengal, Nepal, and Assam—the *C. aristotelis* or Sambur, which is generally distributed over the peninsula and Ceylon—the *Cervus axis* with the same wide distribution, and the *Cervus porcinus* confined to the eastern parts of India and Ceylon, but according to Mr. Blyth "unknown in the peninsula of India generally." On the opposite side of the Bay of Bengal the very distinct *Cervus eldii* occurs, which ranges from Pegu northward to the valley of Munipur. The four first-named species of Indian Deer have already been introduced into this country and bred in the Gardens of the Zoological Society of London, and we hear that the last-named species, so conspicuous for its curiously lengthened brow-antlers may be shortly expected as a new addition to the Society's celebrated Menagerie. The only remaining member of the family Cervidæ is the Muntjac (the Barking Deer or Jungle Sheep of the Indian sportsmen), very incorrectly, as we believe, placed by Mr. Blyth in the family of Moschidæ. It is certainly not a Musk, although its exserted canines give it a superficial resemblance to those animals, and together, with the elongated pedicils on which the horns are mounted, distinguish it from the typical Cervidæ. Mr. Blyth does not separate the Indian *Cervulus* from the true *C. vaginalis* of Java and Sumatra, although, judging from the living specimens seen in this country, the latter would appear to be the larger and finer animals, and quite as different as many similarly allied representative forms.

The Tragulidæ as, in accordance with M. A. Milne-Edwards'† views, we suppose we must call the next group, appear to have only one representative in India—the *Tragulus meminna*. The *T. kanchil* occurs in the southern Tenasserim provinces, but the locality of

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* Gray, Cat. of Ungulata, p. 199.

† See Nat. Hist. Rev. 1864, p. 495.

"Ceylon" usually attributed to *T. Stanleyanus* is without doubt erroneous.

We now come to the Bovidæ, the last and most important family of Ruminantia, both as regards the number of its species, the size of many of them, and their importance to carnivorous Man, as affording him his principal sustenance. The Zebu or *Bos indicus* of Linnæus is a theoretical name for the species whence the numerous races of the humped cattle of Southern Asia and Africa were derived. Mr. Blyth considers it may have been originally derived from Africa. However this may be, certain it is that it is now unknown in the originally wild state, just as is the case with *Bos taurus* and *Equus caballus*, though "feral herds" of the Zebu are said to exist in Ceylon and in many parts of India. On the other hand, the Indian peninsula possesses a fine wild *Bos* in the Gaour or "Bison" of Indian sportsmen, (*B. gaurus*) which is found in suitable districts throughout the country, extending into Burmah and the Indo-Chinese region. The Gayal (*Bos frontalis*) is a second distinct Indian species, confined, however, to the hill-regions east of the Brahmaputra, and extending thence northwards to the Subhimalayan districts and southwards into the Tenasserim provinces. Unlike the Gaour the Gayal has become a quasi-domestic animal, although it appears only occasionally to breed in captivity. The Buffalo (*Bubalus buffalus*) is also a primeval inhabitant of the Subhimalayan forests, but although met with in a wild state in other suitable localities—the great swampy jungles of India—is considered by Mr. Blyth to have been introduced there.

The Antelopine series which we next encounter is, as is well known, African *par excellence*, some 60 or 70 species of this group being met with in various parts of the Æthiopian Region. In India, however, there are several animals, which, though mostly distinct from the African types, clearly belong to different parts of the same series. These are the Nylghai (*Portax picta*)—the Four-horned Antelope, *Tetracerus quadricornis*, and the Sasin (*Antilope bezartica*) all inhabitants of the peninsula of India—as is likewise the *Gazella bennettii*—the "Ravine Deer" of Indian sportsmen, a straggling outlier of the African genus *Gazella*. The Mountain-Antelopes, which form the transition between the Antelopinæ and the goats and sheep are, on the other hand, a group distributed over the northern regions of the two Hemispheres of which the well-known Chamois (*Rupicapra tragus*) is a somewhat aberrant European representative. Of this group two species of the genus *Nemorhædus* (*N. goral* and *N. bubalinus*) inhabit the southern slopes of the Himalayas, whilst a third, *N. sumatrensis*,* extends up the Malayan peninsula as far north as the Tenasserim hills. Closely allied to *Nemorhædus* is the *Budorcas taxicolor* of Hodgson, a singular form of gnu-like aspect, which inhabits the Mishmi hills at the head of the valley of Assam.

Of the Goats the *Capra hylocria* of Ogilby (the so-called "Ibex" of the Nilgiris) is alone found in the peninsula of India. In the Himalayas we meet with *C. jemlaica* and *C. sibirica*, and in the Punjab salt-range and Kashmir with *Capra megaceros*. The Sheep (*Ovis*) can hardly be considered strict members of the Indian Fauna, although one species (*O. cycloceros*) occurs in the Sulimani salt-range of the Punjab, and two if not three others† upon the heights of the Himalayas. Excluding, therefore, the extreme mountain-forms, which only occur on the highest ranges of the Himalayas, we shall have about fifteen species of the family Bovidæ, strictly appertinent to the Indian Fauna.

The Edentata are only represented in the peninsula of India by a single species of the genus *Manis* — the *M. pentadactyla*, replaced, however, in Sikhim and the Himalayas by *M. aurita*, Hodgson, which Mr. Blyth states to be conspicuously distinct from the preceding. As Marsupials are unknown to the recent Fauna of the Old World, except in Australia, we have now arrived at the termination of the Mammalian series, and can sum up the Mammals of the Indian Fauna in the subjoined table.

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* The *Ant. goral* of Hardwicke and *A. bubalina* Hodgson, have been made by Ogilby (P. Z. S. 1836, p. 138) the types of two distinct genera, *Kemas* and *Capricornis*, which have been adopted by subsequent systematists, but, as Mr. Turner remarks, (P. Z. S. 1850, p. 173), the genus is too well-marked in nature to admit of sub-division, and the oldest name for it is *Nemorhædus*, established by Hamilton Smith in 1827, (Griffith's edition of Cuvier's Animal Kingdom, Vol. v.) with *A. sumatrensis* as its type. Other species of the group are *N. swinhoii*, Gray, of Formosa, (figured P. Z. S. 1862, pl. xxxv.) *N. rubidus*, Blyth, of Aracan, (if distinct from *N. bubalinus*), and the species described by Radde (Reisen in Ost-Siberien I. p. 262), which is probably different from the India *N. goral*, as well as from the Japanese *N. crispus*.

† *Ovis argali*, *O. nahoor* and *O. vignei*.

APPROXIMATE ESTIMATE OF INDIAN MAMMALS.

Order.	*Family.*	*Number of Species.*	
QUADRUMANA	Simiidæ	15	
	Lemuridæ	2	
		—	17
CHIROPTERA	Pteropodidæ	3	
	(Fam. Insectivoræ)	35	
		—	38
INSECTIVORA	Erinaceidæ	2	
	Soreeidæ	20	
	Tupaiidæ	2	
	Talpidæ	2	
		—	26
FERÆ	Canidæ	8	
	Viverridæ	16	
	Felidæ	11	
	Mustelidæ	9	
	Ursidæ	4	
		—	48
RODENTIA	Sciuridæ	28	
	Myoxidæ	1	
	Muridæ	21	
	Hystricidæ	3	
	Leporidæ	3	
	Spalacidæ	2	
		—	58
PROBOSCIDEA	Elephantidæ		1
ARTIODACTYLA	Tragulidæ	1	
	Cervidæ	6	
	Bovidæ	15	
	Suidæ	2	
		—	24
PERISSODACTYLA	Equidæ	1	
	Rhinocerotidæ	2	
		—	3
SIRENIA	Halicoridæ		1
CETACEA	Balænopteridæ	1	
	Physeteridæ	1	
	Delphinidæ	7	
		—	9
EDENTATA	Manidæ		2
			227

It would thus appear that within the area of India and Ceylon, including the lower and middle ranges of the Himalayas up to the point where the great Palæarctic Fauna which pervades Europe and

Northern Asia meets that of the Indian Region in its wide sense, and excluding the Malayan provinces on the eastern side of the Bay of Bengal, about 227 species of Mammals are met with. Amongst these are representatives of every one of the great orders of Mammals, except the Seals and Marsupials. The beasts of prey are very fully developed, and amongst them are the two largest and finest species of the typical genus *Felis*. The important order of Ruminants is also well represented, although not to the extent that it is in Africa, where the Antelope-group is very numerous.

But it is hardly fair to compare the country we have been speaking of with the huge continent of Africa. India, we must recollect, is but a portion of a great Zoological Region, which embraces not only the Indian peninsula and adjoining lands up to the Himalayas, but also the whole of South-eastern Asia, together with the great Islands of Java, Sumatra and Borneo and other islands up to the line through the Strait of Macassar, which Mr. Wallace has shown* to be the boundary between this and the Australian Region. In any comparison with Africa this region should be taken in its entirety, and it is not our present purpose to enter upon such a wide field of discussion. It may suffice to say that the Indian Region, in its wide sense, is richly endowed with representatives of all the most highly organized forms of Mammals, and that whether we look at it as regards variety of forms and species or perfection of type, it is but little if at all inferior to the Æthiopian Region.

So much for the Mammals of our Indian dominions. The subject is a fertile one, and we have occupied so much space in discussing it that we are constrained to reserve our account of Dr. Jerdon's volumes on the Birds of India, and Dr. Günther's elaborate work on the Reptiles of the same country for another number.

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* Journ. Roy. Geograph. Soc. Vol. xxxiii. p 217.

II.—Nordmann on Steller's Manatee.

Beiträge zur Kenntniss des Knochen-baues der Rhytina Stelleri, von Dr. Alex. v. Nordmann. Acta Soc. Sc. Fennicæ, Vol. vii. Helsingfors, 1861.

The publications of the Finnish Society of Sciences are so little known in this country that we are sure our readers will thank us for some notice of the paper of which the title is above given, although it appears to have been published several years ago. The communication referred to contains an account of a newly discovered skeleton of the remarkable Sirenian *Rhytina Stelleri*, from the pen of Dr. Alexander v. Nordmann, the learned Professor of Zoology in the Imperial University of Helsingfors.

This large marine animal, formerly so abundant on the coasts of Bering's Island has, as is well known, now quite disappeared from the surface of the globe as a living animal, and even the date of the destruction of the last individual of the race has been ascertained with exactness.*

The original account of the Northern Sea-cow by Steller, which was published at Petersburg in 1751,† long remained our only authority on the subject, and for many years subsequently no specimen, nor even any portion of a specimen, of the *Rhytina* was known to exist in any collection. In 1832, Professor Brandt found among the

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* The last *Rhytina* was killed in 1768, according to Sauer, the Secretary of Captain Billings' expedition. We may remark, that Professor Owen (Paleontology, p. 400), states that the extinction of this animal "does not appear to have been due to any special quest and persecution by man." This is, however, directly contrary to the conclusions arrived at by v. Baer in his learned article upon this subject, (Untersuchungen über den Nordischen Seekuh—Mém. Acad. S. Pet. vi. Ser. 1840, iii. p. 53, et seq.) Steller, who first discovered the *Rhytina* during Bering's second expedition in 1741, when ten months were passed upon Bering's Island, the only spot where this remarkable animal is known to have existed in recent times, estimated its numbers as then so large as to be sufficient to feed the whole population of Kamtschatka. But the hunters and adventurers following in Steller's track along the chain of the Aleutian Islands, who were in the habit of wintering in Bering's Island, and of provisioning their ships with these animals, made such havoc with them, that, as we are informed by Sauer, in his narrative of Billing's expedition, which remained five years in these seas, from 1789 to 1793, they were at that time totally extinct, the last known individual having been killed in 1768.

† De Bestiis marinis, auctore G. W. Steller, Nov. Comm. Petr. xi. p. 294, (1751).

treasures of the St. Petersburg Museum, one of the singular horny palatine plates of the *Rhytina*, and described and figured it as a molar tooth,* supposing it to be a modification of that organ. This discovery induced the learned Professor to take every means in his power to have the former habitat of the *Rhytina* ransacked, in order to obtain further portions of its remains. Baron Wrangel, who was then commencing his celebrated explorations in North-eastern Asia, and whose ardent zeal in favour of the Natural Sciences is well known, only succeeded in obtaining some fragments of the ribs of the missing animal, together with the information that the huge beast was certainly utterly extinct. But a few years later, Mr. Wosnessenski, who was sent out to the Russo-American colonies in 1839, to collect specimens of Natural History for the Zoological Museum, succeeded in disinterring portions of a cranium of the *Rhytina* from the soil of Bering's Island. This precious fragment served as the material for Professor Brandt's learned treatise, published in Memoirs of the Academy of St. Petersburg in 1849,† in which a complete history of the *Rhytina*, including all that was then known of its structure and habits, and a full discussion of its place in the Natural System is given. The conclusions arrived at by Professor Brandt, correspond nearly to those of De Blainville‡ and Owen§—namely, that the Sirenia constitute an order of Mammals, quite distinct from the Cetacea, and in some characters more nearly allied to the Pachyderms. As regards the subdivisions of the Sirenia, Professor Brandt clearly points out the remarkable characters which divide the *Rhytina* from *Halicore* and *Manatus*. These he considers necessitate the subdivision of the Sirenia into two tribes—the first of which, embracing the two latter genera, he calls "Sirenia Dentigera seu Halicorea." The latter, containing only the toothless *Rhytina*, he names "Sirenia Edentata seu Rhytinea."

Shortly after the publication of this Essay, as we learn from a notice in the Bulletin of the Academy of St. Petersburg,‖ the

* Ueber den Zahnbau der Stellerschen Seekuh. Mem. Acad. St. Pet. vi. Ser. Sc. Math. ii. p. 103.

† Symbolæ Sirenologicæ quibus præcipue Rhytinæ historia naturalis illustratur. Mém. Acad. St. Pet. Sc. Nat. v. (1849).

‡ Osteographie, Vol. iii. Genus Manatus.

§ Proc. Zool. Soc. 1838, p. 45, et aliis locis.

‖ Bull. Acad. Imp. Sc. St. Pet. iv. p. 305.

Imperial Museum received further specimens of the *Rhytina*. These consisted of a complete cranium as well as of several occipital bones, ribs, and other parts of the skeleton. A few years later, Professor Brandt was so fortunate as to obtain through the Russo-American Company, a nearly complete skeleton, and a second not quite so perfect was procured through the same agency by M. Simachko. These materials have served as a basis for Professor Brandt's second Memoir on the Sirenia, which, if published, appears not yet to have been received in this country.

In the meanwhile, however, we have Dr. Alexander von Nordmann's Essay, describing a nearly complete skeleton of the *Rhytina*, received by the Zoological Museum of Helsingfors under the following circumstances. Dr. Nordmann's fellow-countryman, Captain Furuhjelm, having been appointed Governor of Russian-America, was earnestly besought to try to obtain a skeleton of the *Rhytina* for the Museum of his National University. In 1861, Captain Furuhjelm succeeded in accomplishing this—a specimen of the much desired object having been dug up in Bering's Island by two Aleutians—and wrote home to his friend that he had forwarded the same by water "along with other trifles." The skeleton thus received is described as being that of an immature individual—measuring 16½ feet in length.* The only parts deficient are the hand-bones, some of the caudal vertebræ, and the epiphyses of the shoulder blade, humerus, ulna, and radius. There seems no question that the rest of the skeleton must all have belonged to the same individual. All the bones were obtained in the same spot from the earth, and show no trace of *Balanus*, *Serpulæ*, or other marine product. As Professor v. Nordmann observes, had an expert been present he would probably have found the missing portions likewise.

Professor von Nordmann gives in his paper an elaborate account of every portion of these precious relics, and illustrates his descriptions with five lithographic plates, which represent all the more characteristic parts, as also the whole skeleton reduced to one fifteenth of its natural size.†

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* Steller gives the length of the adult *Rhytina* as 296 English inches = 24 ft. 8 inches.

† Professor v. Nordmann, states (p. 17 of his Paper), that "*Rhytina*, as Steller rightly remarks, possesses only *six* cervical vertebræ." Brandt in his paper referred to by Mr. Flower, (Nat. Hist. Rev. 1864, p. 259), says there can be no doubt

In conclusion, we venture to make the impertinent suggestion to the Lords of Her Majesty's Admiralty that the crew of one of the vessels of war on the Pacific Station might be very usefully employed in visiting Bering's Island, and obtaining for our National Collection a skeleton of this very singular mammal. At present we have not a fragment of it in this country, except two ribs purchased by the British Museum some two years since from St. Petersburg. A cruise up to Bering's Island in the summer months, and a little digging would involve neither hardship nor risk to the vessel selected for this service, and might be the means of much increasing our knowledge of this curious animal.

III.—Günther's Catalogue of Fishes.

Catalogue of the Fishes in the British Museum. By Albert Günther, M.A., M.D., Ph.D., &c. 5 vols. London: 1859-64.

Half a century ago our National Collection of Zoology was one of the most indifferent of the larger Museums of Europe, and certainly not to be compared either in value or in extent with the sister institutions of Paris, Leyden, Berlin, or Vienna. Now-a-days, thanks to the untiring zeal of the naturalist, who has so long presided over this department of the British Museum, it has become, taken altogether, the largest in existence, although as regards par-

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whatever of the necessity of ascribing to it *seven*, and certainly the figures and description in Nordmann's paper show distinctly that the anterior part of the head of the first rib is received into an articular fossa on the *posterior* edge of the body of the seventh vertebra, as in the mammalia generally, proving without any doubt that this is the last cervical and not the first dorsal vertebra. Brandt's description is therefore perfectly correct, and Nordmann is in error on this point.

It is rather surprising that the circumstance of the broad tubercle of the first rib being brought by the excessive antero-posterior compression of the neck bones into relation with the hinder edge of the transverse process of the seventh vertebra, should have caused Nordmann to have overlooked the far more important relation of its head to the bodies of the vertebræ.

Since the publication of the note above referred to, we are informed by Mr. Flower, that the skeleton of a West African Manatee (*Manatus senegalensis*) has been received at the Royal College of Surgeons, with the cervical vertebræ still united by their ligaments. There are certainly not more than six of them; so that it may now be affirmed with perfect confidence that the normal number of the cervical vertebræ in the genera *Halicore* and *Rhytina* is seven, and in *Manatus* only six.

ticular branches it may be rivalled, and perhaps even excelled by some of the Continental and American collections.

In the year 1843 Dr. Gray obtained the sanction of the Trustees of the British Museum to the publication of catalogues of certain portions of the Zoological collection. These were at first merely systematic lists of the specimens of animals belonging to the different species of the groups to which they referred, with indications of the locality from which they had been obtained, and of the mode in which they had been acquired for the collection. But the plan has been gradually extended, until from mere lists of the specimens in the Museum many of these catalogues have become elaborate treatises on different groups of animals, including not only the species represented in the Museum collection, but also all others known to science, and constituting in fact what are termed complete Monographs of the subject. Some of the lately issued catalogues, such as that of the Tortoises, by Dr. Gray himself, and that of the Lantern-flies (Phasmidæ), by Professor Westwood, are elaborately illustrated, and form the most recent and generally-referred-to standard works on the subjects to which they relate.

Dr. Günther's above-named contribution to this series, of which five volumes are now complete, is of a still more important nature than those we have last mentioned. Although commenced simply as a catalogue of the "Acanthopterygian" Fishes in the British Museum, the limits of this great division of the class Pisces have already been passed, and, if the author is permitted to complete his work, we believe it is intended that the whole of this numerous and imperfectly known division of the Vertebrates shall be treated of in the same manner. And although the simple term "catalogue" is used in its title, Dr. Günther's work would be more fairly described by a much more important name. So far from confining himself to a mere enumeration of the specimens of fishes in the collection of the British Museum, Dr. Günther follows the lead of Dr. Gray and the other authors of the more extended catalogues, and gives descriptions of all the known species of each genus, whether they are found in the British Museum or are known to exist in some other collection. Diagnoses of the genera and higher groups are also included, so as to render the so-called "Catalogue," a complete treatise on general Ichthyology. In relation to this Dr. Günther well remarks in the preface to his first volume, that the number of known species of fishes having been considerably increased of late years, and the descriptions of the new species being scattered through a great many Journals, Voyages and Reports, such a general synopsis as the present in which all the species of which descriptions are accessible are contained, will meet a real want in Ichthyology.

Dr. Günther has commenced his labours, as we have already said, with the Teleostian Fishes of the great order "Acanthopterygii," as defined by Johannes Müller in his celebrated modification of Cuvier's System. Frequent, he says, as have been the objections against these modifications, "no one has yet proposed any arrange-"ment which would give a more satisfactory result if put to the test "of carrying it out to a detailed subdivision." Under these circumstances our author, who was, we believe, in former years a pupil of the great anatomist, has been satisfied to adopt, nearly without alteration, his master's views as a basis, and to distribute the species into natural minor divisions according to Müller's *ordinal* arrangement. As regards the points mostly to be attended to in subdividing the orders, Dr. Günther is of opinion that there is no character equal in importance to the structure and position of the fins, as these organs stand in immediate connection with the entire habit of fishes and their mode of life, and therefore supply the best indication of their natural affinities, although isolated exceptions are occasionally met with. Another character of great importance for the distinction of the families is, according to Dr. Günther, the number of the vertebræ, but whether this has any bearing of still greater import cannot exactly be determined at present, as the osteological portion of the collection has not been yet completely examined.

The first three volumes of Dr. Günther's work are entirely taken up with the order "Acanthopterygii," of which no less than 3481 species are given, and 2811 of these are considered to be well characterized. In Cuvier and Valenciennes, Histoire Naturelle des Poissons (1828-1849)—the last published general work upon this class of Vertebrates—only 2146 species of the same group are enumerated, and upwards of 600 of these are considered by Dr. Günther to have been merely nominal species, so that we see at a glance what large additions have lately been made to our knowledge of this class.

In a synopsis of the Acanthopterygian Fishes at the end of the third volume, Dr. Günther furnishes the following scheme for the primary division of this Order:—

1. A soft dorsal and an anal fin. Vent remote from the extremity of the tail, and behind the ventral fins, if they are present.	36 families separated into 16 divisions, and comprising all the typical forms.
2. Dorsal and anal fins developed. Vent in front of the ventrals.	1 fam. Aphredoderidæ.
3. Body riband-shaped, with the vent near its extremity; a short anal behind the vent; dorsal as long as the body.	1 fam. Lophotidæ.
4. Anal absent; caudal rudimentary, or not in the longitudinal axis of the fish. Skeleton soft.	1 fam. Trachypteridæ.
5. Soft dorsal absent or rudimentary; ventrals abdominal, composed of several unarticulated and articulated rays.	1 fam. Notacanthi.

Leaving out the four strongly aberrant groups placed at the end of the series, the mass of the typical Acanthopterygians, it will be observed, are divided into 16 divisions, containing altogether 43 families, the greater number of which are newly defined. These "divisions" are mostly named from the title of the most typical or best known genus, to which the termination-*formis* is added, and consist of one or more "families," as the case may be. The arrangement thus given is completely new, and in fact has only been perfected since the termination of the working out of the whole group, as it will be noticed that the species as given in the text of the three volumes, do not follow this consecutive order.

Dr. Günther's fourth volume contains the two orders *Pharyngognathi acanthopterygii* and *Anacanthini*, of Müller. In dealing with the former of these orders Dr. Günther has deviated from Müller's arrangement—changing the name into *Acanthopterygii pharyngognathi*—as he considers the structure of the fins a more important character than that of the pharyngeal bones. He also omits altogether the soft-finned Pharyngognaths of Müller (Scomberesocidæ), not considering the coalesced pharyngeal bones as a character of sufficient importance to unite acanthopterous and malacopterous fishes in the same order. The *Anacanthini* on the other hand (which coincide essentially with the *Malacoptorygii* *jugulares* of the old authors) appear to Dr. Günther to be a very natural order, although the want of symmetry in the Pleuronectidæ would at first sight induce one to distinguish them rather strongly from the symmetrical Gadidæ and their allies. But, as Dr. Günther reminds us, the absence of symmetry in the latter is the only constant character upon which such a distinction can be made, and in the more highly organized Pleuronectidæ (such as *Psettodes*) this character is but little developed. On the other hand the Gadidæ and Pleuronectidæ agree in other important characters, such as the great development of the dorsal and anal fins, the position of the ventrals, and the increased number of the caudal vertebræ.

Dr. Günther gives 1090 species of Acanthopterygii Pharyngognathi and Anacanthini, of which he considers 890 to be well characterized. There are a great number of new species described in these two orders, particularly in the families Chromidæ and Pleuronectidæ. In the former groups the freshwater lakes of Guatemala, lately explored for the first time by Messrs. Salvin and Godman, have yielded an abundant harvest, and we believe a special communication of Dr. Günther on this subject, with figures of many of the new species, will shortly appear in the Zoological Society's "Transactions."

Dr. Günther's fifth volume commences the series of those families of Fishes, which Müller called *Physostomi*, from the air bladder being connected with the pharynx by an air-duct. The extensive family of Siluroids is taken first, of which nearly 700 species are known, and the details of which take up the greater portion of the volume. These are followed by the Characinoids and several other smaller families. Amongst these perhaps the most noticeable in the way of novelty is a new genus of Australian freshwater fish called *Prototroctes*—the representative of the Salmonoids of the Northern Hemisphere in the Antipodes. The genus is of greater interest as being naturally associated in one family with the genus *Haplochiton* of Jenyns, discovered by Mr. Darwin, during the voyage of the Beagle, in the freshwaters of the temperate parts of South America, and thus giving us a new link between the Fauna of Australia and that of South America.

Dr. Günther's fifth volume is also of great importance in making such extensive additions to our knowledge of the fishes of the Nile basin—the Siluridæ and Characini, being as is well known very fully developed in the freshwaters of the Æthiopian as well as in those of the Neotropical region.

The whole of Dr. Günther's fifth volume contains 1005 species, against 492 in the corresponding portions of Cuvier and Valenciennes' work. Of these 849 are considered to be undoubtedly valid specimens.

In conclusion we heartily wish Dr. Günther health and strength sufficient to carry his great and important labours to completion—of his industry, and of his ability (in other ways) to finish what he has begun we have no doubt. It is no small task, as our readers must acknowledge, that has already been accomplished—that of naming, cataloguing, and describing some five or six thousand species; and those who know the energetic author of the "Catalogue of Fishes" are well aware, that these volumes are by no means the only products of Dr. Günther's laborious industry during the last six years. The work, however, is now more than half accomplished, and we trust that another five years will see the "Catalogue of Fishes" complete. Its effect upon the study of Ichthyology will in all probability be very remarkable. We cannot suppose that more than a fourth part of the fishes now in existence are yet known to science, nay, perhaps, not more than a tenth part, for of many parts of the world the Pisci-fauna is almost unknown. The fact is that the study of these creatures has been hitherto greatly obstructed by the want of a convenient book of reference, wherein what is at present known is summarized and brought together. The publication of Dr. Günther's Catalogue will therefore, no doubt, give a great and immediate impetus to the study of fishes—indeed we may say in relation to the published portions that it has already done so. Its *immediate* effect will be in all probability an increase of at least ten per cent. in the number of described species of this class of Vertebrates. It has already operated well for our National Collection in inciting the accession of a very large number of valuable additions to this department, as will be seen by reference to the long lists of donations and purchases given at the commencement of each volume of the catalogue. It has also been of the greatest service to the collection in another way—we mean in enabling selections to be made out of series offered for sale. Until a collection has been properly named and catalogued there is of course perpetual risk of acquiring duplicates when new purchases are made, or of rejecting new specimens. As the catalogue advances this risk diminishes, and the means for acquiring serviceable additions proportionately increase. At the completion of Dr. Günther's labours, therefore, he may fairly look forward to having under his care the largest as well as the most perfectly catalogued series of Fishes in existence.

IV.—Siebold's European Freshwater-fishes.

Die Süsswasserfische von Mitteleuropa. Bearbeitet von C. Th. E. v. Siebold. Leipzig, 1863. 8vo.

We believe that a feeling of some surprise, mixed with no little curiosity, was excited among zoologists, when it became known that one of the editors of the "Journal für Wissenschaftliche Zoologie," had descended to the level of *ordinary* Zoology—we mean the Zoology of the old school, which considers an animal worth examining, even when this can be done without the aid of the microscope and the dissecting needle. Would one of the founders of the modern German school of "scientific zoology" treat his subject in a new style? Would he discover new ways of distinguishing species, and put forward hitherto unknown views leading to a more perfect systematic arrangement? Would he teach us, as we have been taught in the case of the North American Tortoises, that to study the adult animal is useless, and that to understand specific and generic affinities, we must examine embryonic and subembryonic conditions? How far conjectures of this kind were verified by the result we shall shortly see.

When Bloch, the celebrated German Ichthyologist of the last century, humbly requested Frederic the Great to order certain officials to aid him in collecting the fishes of the Mark of Brandenburg, he received the reply: "I am glad to hear that you occupy yourself with fishes, but what you ask of me is nonsense; for I know all the fishes in the Mark myself. There are carp, sander, perch, and eels. Are you going to count their bones?" We need hardly say that Dr. v. Siebold found his Government more enlightened than this. In fact, the present work owes its origin to the order he received from it to prepare a report on the fishes of Bavaria—and as by degrees he extended his researches far beyond the limits first assigned to it, he not only enjoyed material assistance from his own rulers, but also obtained aid from the governments of neighbouring countries. Having devoted nine years to a study which he found infinitely more difficult and time-absorbing than he had anticipated, he presents us with the results of his labours in an octavo volume of 430 pages, illustrated by 64 woodcuts, and 2 coloured plates.

The somewhat lengthy introduction to Dr. von Siebold's volume is evidently written for that part of the public which does not care much about the information which they might gather from the work itself. In this the author describes the ordinary ways and means of collecting materials and information, which are familiar to every one who has studied any portion of a particular fauna. The introduction is followed by a complete and excellent review of the literature bearing upon the fishes of Germany, whereby the author evades the usual practice of quoting in the synonymy of each species every author who has ever noticed it. This is a method far superior to the one in which valueless works and names of would-be naturalists are promiscuously quoted along with original descriptions and scientific authors. From the author's own assertions in his introductory remarks and especially from the synonymy itself, it is evident that he places himself on the side of those Zoologists who would counteract the mischief done by Agassiz, Valenciennes, Bonaparte, and Heckel, in introducing into ichthyology the custom of splitting up species and genera on the slightest and most insufficient grounds. "The catalogue of our freshwater-fishes," says Dr. v. Siebold, "abounds with untenable species. This nuisance has been partly caused by systematists who have carried the multiplication of the genera so far, and who have defined the characters of these genera so indistinctly, that in consequence of their insufficient examinations they were obliged not only to separate fishes which must be referred to the same species by every unbiassed observer, but even to place them in two distinct genera, in obedience to the principles of their unnatural system." Of the authors mentioned none fares worse than Heckel, and although Dr. v. Siebold pays him all those compliments which celebrated savants usually pay to one another, the synonymy of almost every species shows, that he has no great opinion of the discriminating powers of the man who endeavoured to make Vienna the head-quarters of our knowledge of European freshwater-fishes. For although out of Austria there never was much doubt as to the scientific value of Heckel's genera and species, it required a publication like the present to entirely supersede the "Süsswasserfische der Oesterreichischen Monarchie," and to thoroughly expose the fallaciousness of the principles upon which that work was based. Dr. v. Siebold has done much and well to reduce the number of German freshwater-fishes. We recommend a glance over the synonymy of the Dace (*Squalius leuciscus*) p. 203, to those whose tendencies carry them the other way—our author may have gone too far in a few cases. Thus, for instance, nobody who has seen our Chub and its representative of the Continent, will agree with him, that both are of the same species. But there is no fear that other Ichthyologists will allow such questions as these to remain unsettled for long.

Dr. v. Siebold gives detailed descriptions of those species only which are not perfectly known, whilst the commoner kinds, like the Perch, Pike, etc. are sufficiently characterized in a short diagnosis. His method of examining and describing a fish does not differ from that of previous writers, but whatever species is referred to, the account given of it will be found evidently to have been drawn from the author's own original researches, and shows that he has lost no opportunity of thoroughly acquainting himself with his subject. The history of each species is given as completely as possible. Our author fairly acknowledges where observations previously made, are only confirmed by him, and details the reasons which induce him to entertain different views from his predecessors. Even where he does not add any new fact, as for instance in the history of the Eel, his account will be read with pleasure for its perspicuity, and for the honesty with which he confesses where his own knowledge is incomplete.

No other Ichthyological work has dealt in an equally prominent manner with two facts which, if only one half of the observations relating to them shall turn out correct, are of the greatest importance in distinguishing the different species, viz, *hybridism*, and *sterility*. The author gives it as his opinion that *hybridism* is by no means of rare occurrence among fishes, although the cases which he considers as more or less established, belong to one family only, that of the Cyprinoids. They are five in number:

	Hybrid between
1. Carpio kollarii, Heck.	Cyprinus carpio, L. and Carassius vulgaris Nilss.
2. Abramis leuckartii, Heck.	Abramis, sp ? Leuciscus, sp ?
3. Abramis abramo-rutilus, Holandre	Abramis sp? Scardinius erythrophthalmus, L.

4. Leuciscus dolabratus, Holandre	{ Alburnus lucidus Squalius cephalus
5. Chondrostoma rysela, Agassiz	{ Chondrostoma nasus Telestes agassizii.

The least doubtful is the first, but then we must not forget that this *Carpio kollarii* is the produce of two domesticated species, viz. the Carp and Crucian Carp, and therefore that this instance *per se* only proves that hybridism is *possible* in this class of vertebrate animals. The other instances certainly need confirmation: and nobody who looks over the list given above, will fail to remark that in every case, the fishes said to be the parents of these hybrids, are referred to two different genera, and are thus not the offspring of closely allied species of the same genus, as we should expect *a priori.** Surely there is something wrong here! Either the genera are based upon merely specific characters, and not entitled to that rank in our system, or the explanation of the origin of those hybrids, and even their hybrid nature itself becomes a matter of great difficulty. Dr. v. Siebold himself is evidently wavering: for whilst he asserts his conviction that the fishes are hybrids, he not only prefixes to their descriptions the heading "characters of the species," but actually forms two new genera, viz. *Abramidopsis* for *A. leuckartii*, and *Bliccopsis* for *A. abramo-rutilus!* Not even Heckel or Bonaparte would have been guilty of such an inconsistency as this, and we can only partly account for it from the author's former studies of the lower classes of the animal kingdom, where many genera are founded upon larval forms.

The question whether these hybrids are fertile, is not solved; but their sexual organs were found to be fully developed.

The discovery of the author, that there are individuals of certain species, especially of the Salmonoids, but perhaps of all other families, which remain sterile throughout their life, assuming with age a form very different from that of individuals with the sexual organs normally developed, is scientifically of the greatest importance, and will engage Ichthyologists for some time to come. A speedy confirmation of it is the more wanted, as should these barren fish occur in considerable numbers, the question would assume a practical

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* Ornithologists who call to mind the hybrids between different species of ducks, will, perhaps, not find any thing surprising in this, but a genus in Ichthyology is generally more comprehensive than one in Ornithology.

bearing; for normally developed fishes feed little during the time of propagation, and consequently are lean and unfit for the table immediately afterwards, whilst a sterile individual continues to feed, and therefore remains in season throughout the year.

A systematic index with short diagnoses, and three synoptical tables showing the horizontal and vertical geographical distribution of the eighty species described, and their spawning seasons, conclude a work which has done a great deal to expiate the sins of its predecessors, and which we particularly recommend to the Ichthyologists of this country—not to be copied from, but to be imitated.

V.—Huxley and Hawkins' Osteological Atlas.

An Elementary Atlas of Comparative Osteology. By Professor Huxley, F.R.S. and B. Waterhouse Hawkins. Williams and Norgate, 1864.

The object of this work, as stated in the introductory note, is to aid students in comprehending the general arrangement, and some of the most important modifications of the bony framework of the Vertebrata. The drawings are executed by Mr. Waterhouse Hawkins: the very important task of selecting, arranging, and naming the parts of the objects figured is Professor Huxley's share in the work.

There are twelve plates, folio size, drawn on stone, containing on the average about twenty figures in each plate. The first shows the structure of the skull of four of our commonest domestic animals, belonging to as many different orders of mammals—viz., the dog, pig, horse, and sheep, illustrated by views of the upper, under and lateral surface, as well as by a median longitudinal vertical section. Comparison of the different objects both in this plate and in most of the others in the work is greatly facilitated by the figures being all drawn of the same absolute size, and also by the names of the different elements being marked on the plate, so that no turning-over-pages to refer to a description is required. The second plate shows in the same manner the most characteristic differences between the skull of man, and of the several species of apes, both of the Old and New World. In the third and fourth plates are figured the crania of some of the lower mammals, of birds and of reptiles; the fifth is devoted to the skulls of fishes; the vertebræ of the different regions of the spinal column of a mammal (wolf), a bird (ostrich), and a reptile (crocodile) are compared and contrasted in the sixth and seventh plates. The illustrations of the structure of the vertebræ are continued in the eighth plate, together with views of some of the principal modifications of the hyoidean apparatus in the mammal, bird, reptile, and fish. The remaining four plates are devoted to the osteology of the extremities. Two of these contain views of the terminal division of the fore and hind limb of various mammals reduced to the same absolute size, and showing in a very instructive manner the changes in the carpal and tarsal bones, and in the number and structure of the digits.

From this summary of the contents of the different plates, an idea may be gained of the large amount of information to be derived from this Atlas, the production of which at a comparatively moderate price does great credit to the publishers. The drawings are executed in a very artistic style, and with the great advantage of the supervision and nomenclature added by Professor Huxley, they cannot fail to prove a great boon to the student in comparative anatomy.

VI.—Peters, Carus and Gerstaecker's Handbook of Zoology.

Handbuch der Zoologie, von W. C. H. Peters, Jul. Victor Carus, und C. E. Adolph Gerstaecker. Zweiter Band. Leipzig, Engelmann, 1863. 8vo. pp. 842.

It is not quite a century since the twelfth edition of the Systema Naturæ of Linnæus made its appearance, and it would be neither uninteresting nor uninstructive if we could have a detailed history of the Manuals of Zoology that have been produced since that day. The fortunate zoologists who witnessed the publication of the Systema Naturæ, could take that immortal work as the guide of their first steps in the investigation of the mysteries of their science, and continue to walk by its light for the greater part of their course; but the very progress initiated by the publication of a good system soon did away with at least one portion of its value, and its importance as a "Species Animalium" was not of long duration. Within little more than twenty years after the appearance of Linné's twelfth edition the gigantic compilation of Gmelin showed the world that Natural History, in its rapid progress, had already outgrown the limits of any single book, and that thereafter the elaboration of a general system of Nature, with descriptions of all the species, was to be regarded as an impossibility. Blumenbach's Manual is an example of an elementary systematic work, giving the general outline of the Linnæan classification; but within ten years of the publication of Gmelin's edition of the Systema Naturæ, Cuvier commenced the work of innovation by the production of his *Tableau élémentaire*, in which he indicated the division of the Animal Kingdom into four groups, a system afterwards fully developed by him in the two editions of his *Règne Animale.*

In all these works, as also in Lamarck's *Histoire Naturelle des Animaux sass Vertèbres*, an effort was made to give the characters not only of the larger groups, but of the genera, with descriptions of illustrative species, and many of us can recollect a time when the works of Cuvier and Lamarck formed the chief standards to which all newly established generic groups were referred. That time, however, has long since passed away, and from the rapid progress of Zoology during the last thirty years, the number of genera has increased so greatly, that, at the present day, any attempt to include short characters of all the genera of animals within a single book of moderate compass, is almost as impossible as it would have been for Cuvier and Latreille to have described all the species known to them in the five volumes of their *Règne Animale.* Many of our writers of Manuals have, accordingly, abandoned the description of genera altogether, contenting themselves with carrying their classification as low as the family groups, and indicating, or briefly describing, typical examples of each family. Others, again, and amongst them are the authors of the Handbook now before us, have endeavoured to give a selection of genera, a course of which we cannot altogether approve,—as, although a certain number of types may, by this means, be ascertained by the student, it is a question whether a much greater amount of usefulness might not be attained by omitting these partial generic details, and by devoting the space thus gained to the fuller elaboration of the structure and life-history of the more prominent members of the larger groups. Thus, in the work now under consideration, the generalities upon the organisation, functions, &c., of the Classes and Orders are reduced within the smallest compass, whilst some of the most important questions of modern Zoology, such as those relating to the geographical and geological distribution of animals, scarcely receive more than a passing mention.

The volume before us, which constitutes the second volume of the book, includes those animals which formed the sub-kingdoms, Annulosa and Radiata, in the Cuvierian system; the Vertebrata and Mollusca being postponed until the publication of the first volume. The authors of this present volume, Dr. Gerstaecker and Professor J. V. Carus, divide these animals into five groups, of which the first alone, that of the Arthropoda, has been consigned to the treatment of the former gentleman. This group is divided into the usual four classes, Insecta, Myriapoda, Arachnida, and Crustacea, and the description of the characters of these and of their subordinate groups occupies considerably more than half the volume.

The classification of the Insecta will present some appearance of novelty to the English Entomologist, as it is in accordance with the views generally entertained by the more advanced German school. The Apterous, or so-called Ametabolous orders are got rid of altogether, being amalgamated, as originally proposed by Burmeister, with other recognised groups; the Strepsiptera are referred to the order Neuroptera, and the whole series of insects is thus made to consist of seven orders. But the most striking change to our insular prejudices consists in the peculiar limitation of the first two orders in Dr. Gerstaecker's classification,—the Orthoptera and Neuroptera. The former group includes the whole of the Insecta with an imperfect metamorphosis and biting oral organs; so that besides the ordinary Orthoptera, in Latreille's sense, we have as members of this great order the *Termites*, *Psoci*, *Perlidæ*, *Ephemeridæ*, Dragon-flies, and Physopoda among winged insects, and the Thysanura among the apterous forms. The latter ought certainly to have been accompanied by the Mallophaga, or Mandibulate Lice, but the author has chosen to place them with the true Lice under the Hemipterous order, being induced to take this course by the supposed near alliance existing between the two groups, and because, as he says, by "their reversion to the Orthoptera, they close the circle of the Insect-Orders" (p. 287). It seems to us that the latter purpose would have been equally well served by placing these curious parasites in their natural position among the Orthoptera, and their alliance to the Pediculina appears to be one chiefly of general appearance and mode of life.

The order Neuroptera, deprived of all the groups with an imperfect metamorphosis, appears sadly diminished in importance—it includes only the Planipennia of Latreille, and the Trichoptera of English authors, with the addition, as already stated, of the singular Strepsipterous Bee-parasites. The latter are regarded by Dr. Gerstaecker as most nearly allied to the Phryganidæ, with which, he says, they "agree in the structure of the prothorax, the free, elongated anterior and middle coxæ, the rudimentary oral organs, of which the maxillæ are amalgamated in a similar manner with the labium, and likewise in the radiate venation of the posterior wings," and he cites, as a further proof of this relationship, "the branchiiform respiratory organs detected by Newport on the abdominal segments of the larvæ of the Strepsiptera" (p. 79). It does not appear to us, however, that Dr. Gerstaecker has by any means made out his case in favour of the Neuropterous nature of the Strepsiptera,—the characters adduced by him in proof of their relationship to the Trichoptera are for the most part non-essential, and the peculiar organs noticed by Newport, upon which Dr. Gerstaecker lays so much stress, are only supposititiously regarded by him "as imperfect respiratory organs of the nature of branchiæ." The balance of evidence, especially that derived from the life-history of these curious parasites, seems to preponderate greatly, as shown by Dr. Schaum in a recent paper in Wiegmann's Archiv, in favour of their Coleopterous nature, almost all their most striking peculiarities being paralleled among the Coleoptera by the Meloidæ.

The division of the Coleoptera into characterisable groups higher than the natural families is certainly one of the greatest difficulties with which Entomologists have to contend, and Dr. Gerstaecker has been unable to get over it. He accordingly adopts the old Latreillian divisions in accordance with the number of joints of the tarsi, although he admits that it is liable to many exceptions in the Pentamerous group, and brings together, under the common term Heteromera, the most "heterogeneous elements." In other respects the author has been most fortunate in his elaboration of the analysis of the Coleoptera, and especially in his selection of characteristic genera, which must have been a work of no small labour in a group so extensive.

Passing over the order Hymenoptera, our author's treatment of which presents no peculiarity calling for special notice, we must object strongly to his primary division of the Lepidoptera into two groups, denominated from the general size of the species in each, *Macro-* and *Micro-lepidoptera.* It may be true that certain characters exist of sufficient value to justify the division of the Heterocerous Lepidoptera into two sections, but in any classification professing to show the natural affinities of these Insects, the Butterflies (Rhopalocera) may certainly claim to form a group of higher rank than that of a family. The Diptera also are divided into sections on an unusual principle,—the true Diptera (*Diptera genuina*, Gerst.), after the deduction of the Pupipara and Aphaniptera, being formed into two groups, according as the pupa is coarctate or not. The group with an obtected pupa includes the Tipuliform and Culiciform families, with the *Tabani*, *Asili*, *Empidæ*, *Bombylii*, and some other families,—that with a coarctate pupa only the *Muscidæ*, *Syrphidæ*, and *Stratiomyidæ*. The propriety of this mode of division seems rather questionable; the pupa in both sections is essentially the same, and the circumstance of its being retained within the dried larva-skin in the one set of forms and not in the other can hardly be regarded as of equal importance with the structural differences by which the Nemocerous and Brachycerous Diptera are distinguished.

Dr. Gerstaecker's seventh and last order of Insects, to which he gives the name of Hemiptera, includes the Rhynchota of Burmeister, with the addition, as stated above, of the Mallophaga. The author refers the Ploteres to the Hydrocores, which is certainly incorrect, but in other respects the classification adopted by him, although not satisfactory, furnishes a good general view of the insects composing this little known order.

The treatment of the small class of Myriapoda presents nothing to call for special notice, but in the classification of the Arachnoidea, Dr. Gerstaecker departs widely from the principles ordinarily adopted in the division of this class into groups. The old sections of Pulmonary and Tracheary Arachnoids are entirely ignored by him, and in place of them he adopts groups founded upon certain peculiarities in the external structure. Thus his first order is denominated Arthrogastra, and includes all the Arachnoidea with "a sessile and distinctly segmented abdomen," whether they respire by means of lungs or by tracheæ. The groups thus brought together into a single order are very heterogeneous in their character, including, as they do, the Scorpions, Phrynidiæ, Pseudoscorpiones (*Chelifer*), Phalangidæ, and Solifugæ (*Solpuga*),—nay, Dr. Gerstaecker even interpolates the Chelifers between the true Scorpions and the Phrynidæ in his first section of the order which he designates Didactyla, from the presence of didactyle nippers on the first maxillary palpi. We cannot but think that Dr. Gerstaecker would have done better had he allowed more weight to those "many essential differences" which he admits to exist between the forms thus grouped together within the limits of a single order, of which the nature of the respiratory organs is the most striking, especially as these differences are reflected, or at least accompanied, by corresponding peculiarities even in the external structure. His order Arthrogastra consists of essentially incongruous elements, and we cannot expect ever to see it generally adopted. Of the remaining orders of Arachnoidea little need be said,—the Araneina and Acarina constitute well-marked groups, as to the limits, of which there can be little difference of opinion, and the only change adopted by Dr. Gerstaecker consists in the separation from the latter of the Tardigrada and Linguatulina, of which he makes distinct orders. The Pycnogonidæ are also justly regarded by Dr. Gerstaecker as Arachnoidea,—he places them in a distinct order, to which he gives the name of Pantopoda, in allusion to their being apparently composed only of legs.

In his general arrangement of the Crustacea, Dr. Gerstaecker seems to us to have been particularly successful, and as this class, from the multitude of forms which it includes, and the marvellously varied life-history of its members, is perhaps the most important and interesting to the experienced Naturalist of all the Arthropod classes, and at the same time the most difficult for the student to obtain a clear notion of, we cannot but regard it as a fortunate circumstance that, in this Manual of Zoology, it has been treated in so philosophical a spirit.

The orders of Crustacea recognised by Dr. Gerstaecker are seven in number. In the first and highest of these, under the name of Decapoda, he includes the whole of the Podophthalmous Crustacea, justly considering that the Stomapoda, whilst still constituting a subordinate group, form an essentially uninterrupted series with the other Decapoda, from which they are distinguished by characters of less than ordinal value. Following the example of Kröyer and Spence Bate, Dr. Gerstaecker unites the Whale-lice to the Amphipoda, and thus gets rid of the Latreillian order Læmodipoda,—the family Pranizidæ, including the single genus *Anceus* (of which the researches of M. Hesse have shown *Praniza* to be only a larval and female form), is placed in an appendix to the Isopoda, the author remarking justly upon the singular resemblance of these curious Crustacea to the Decapoda, which, with other peculiarities, renders it somewhat difficult to settle accurately their systematic position.

The King-Crabs constitute a fourth order, leading naturally from the Malacostracous to the Entomostracous Crustacea, and for this Dr. Gerstaecker adopts the name of Pœcilopoda, applied by Latreille to a heterogeneous assemblage, in which these animals figure together with *Argulus*, *Caligus*, *Anthosoma*, and several other parasitic genera. Why he has rejected Latreille's term *Xyphosura* for the King-Crabs, or rather sunk it into a family name does not appear; it is certainly the most characteristic name for the order, and the change is by no means an advantageous one.

The fifth order, Branchiopoda, receives from our author a wider extension than is given to it by Milne-Edwards, embracing the Fossil Trilobites and the Cypridiform Crustacea, in addition to the Phyllopoda and Cladocera of Latreille. With regard to the precise sytematic station of the Trilobites (which Dr. Gerstaecker erroneously describes (p. 395) as "the oldest representatives not only of the Anthropoda, but of all animal organisms") we certainly possess no positive evidence, and although Burmeister's investigations have shown that their nearest allies in existing nature are the Phyllopoda, they nevertheless present characters which, taken in conjunction with their limited distribution in time, would seem to justify our regarding them as a distinct order. The difficulty of placing the Trilobites in a definite position is, however, only a negative one, arising from our ignorance of those parts from which the essential characters of the orders are derived, but the Ostracoda have evidently presented our author with a positive difficulty, which has interfered materially with his definition of the order Branchiopoda—a difficulty which he has but imperfectly got over, by assuming that the two pairs of branchiferous footjaws in these Crustacea are in reality to be regarded as belonging to the series of abdominal feet. This is a point which may be cleared up by future researches,—in the meanwhile it is certainly better to place the Ostracoda in the same order with the very *analogous* Daphnidæ, than to adopt the only other course, that of establishing a distinct order for this small group. This indeed is the only alternative open to us, for Dr. Gerstaecker's sixth order, to which he restricts the term Entomostraca, must be regarded as a perfectly natural group. In it he includes, besides the Copepoda, the whole of the parasitic Entomostraca of authors, forming a group which it is perhaps difficult to characterise satisfactorily, but which, from the close similarity in the young animals, and the agreement in many important points of the life-history of its members, presents all the essential marks of homogeneity. The chief character by which the Cirripedia are distinguished from the Entomostraca consists in their hermaphroditism, and Dr. Gerstaecker seems to entertain some doubt as to the accuracy of Mr. Darwin's observations of the occurrence of "complemental males" in some species. He adopts the opinion of Lilljeborg as to the Cirripedian nature of the curious parasitic *Sacculina* and its allies, and admits them into the system as forming a family, to which he gives the name of Suctoria, proposed for them by that author.

The Crustacea conclude Dr. Gerstaecker's portion of this Manual of Zoology, which, notwithstanding some minor defects, such as those which we have briefly indicated, has evidently been executed with great care and with a most conscientious desire to do full justice to his subject. It is of course easy to cavil at some portions of his system, but we must at the same time admit that he has produced a most successful general view of the vast series of Arthropod animals, while the generic types described as examples of the families are generally judiciously selected, and the chief facts in the life-history of the animals, especially those bearing upon systematic Zoology, are clearly, although of course very briefly depicted.

Dr. Carus' section of the work, occupying just one-third of the volume, strikes us as being rather slighter in its general execution; but when we consider the vast extent of systematic ground that he has had to run over in so short a space, and that the great extension of the Arthropod section has evidently necessitated a correspondingly increased compression of that devoted to the lower Invertebrata, we may excuse some little shortcomings.

Dr. Carus commences his work with the Rotatoria, which he regards as a class forming a sort of appendix to the Arthropoda, and under any circumstances they must be looked upon as constituting a sort of transition between those animals and the true Vermes. The author divides the Rotatoria into eight families, out of which he claims five as newly defined by himself, although three of them were certainly recognised and named long since, and admitted with very little difference of contents in Van der Hoeven's "Handbook."

The Vermes, although treated here as a primary section of the Animal Kingdom, are not regarded by Dr. Carus as constituting a distinct type, but only "as forms of that great series (Annulosa) which attains its climax in the Arthropoda." In this respect he differs from Vogt, who even allows the Mollusca to intervene between his Vermes and Arthropoda. In his general view of the members of the group, however, he agrees pretty closely with Vogt, except that he excludes the Rotatoria and Gregarinæ and includes *Sagitta.*

The Vermes, according to Dr. Carus, form five classes—namely, Annulata, Gephyrea, Chætognatha, Nematelminthes, and Platyelminthes. With regard to the first of these groups we need only say that the author closely follows Grube in his classificatiou, and that he has given a most careful analysis of the families and genera of the Ringed-worms. Here and there we find new family groups defined, and on p. 447 Dr. Carus proposes a new provisional section, Haloscolecina, with two families for the reception of the problematical genera *Dero* and *Capitella* and their allies.

The Gephyrea (*Sipunculus* and its allies) placed by many authors with the Holothuroidea among the Echinodermata form the second class of the Vermes in the system of Dr. Carus, who gives as his reason for referring them to this position that "although their organisation is not exhaustively known, the deficiency of calcification in the skin, the absence of the aquiferous system with its dilatable appendages, the decided bilateral symmetry, the bristles and other characters indicate their proper position to be amongst the Worms."—(p. 452.) At the same time these curious creatures present many characters incompatible with their occupying a place even among the multifarious types of the Annelides, and perhaps the best course that can be adopted at present, is that followed by our author, of placing them in a distinct (provisional) group in the immediate vicinity of the Ringed-worms. Dr. Carus divides them into four families—namely, the Sternaspidea, Echiuridea, Sipunculidea and Priapulidea.

The *Sagittæ*, which have the somewhat questionable honour of having been referred by different writers to no less than three of the great primary divisions of the animal kingdom, constitute Dr. Carus' third class of Vermes, the Chætognatha. It is hardly fair of the author, however, to ascribe to the late Edward Forbes the establishment of the Molluscous order Nucleobranchiata for the reception of these puzzling creatures, considering that that group was founded many years ago by De Blainville for the genera *Carinaria* and *Firola*, and that those Zoologists who referred *Sagitta* to such a position were led to do so by a very laudable desire to avoid establishing a new group for animals of which they knew next to nothing. In the present day Zoologists are, as stated by Dr. Carus, pretty well agreed that the

Sagittæ must occupy a place among the Vermes, but their precise position is still open to discussion. It is a question, however, whether Dr. Carus might not have done better towards producing a clear picture of this difficult branch of Zoology, had he divided his Vermes only into three great classes, of which the first might include the three groups to which we have already adverted. The differences between his Annulata, Gephyrea, and Chætognatha are hardly of the value of those upon which classes of animals are generally founded, and by including the constituents of the three groups as orders of a single class, their stronger mutual affinity as compared with that existing between them and the parasitic Nematelminthes and Platyelminthes would be better expressed.

Of the former of these parasitic classes we need say but little,—the author adopts the generally received classification of the Nematoid worms and follows Diesing for the most part in the subordinate groups. But in regard to the Platyelminthes he reverts to the old, and it seems to us erroneous, plan of including the Turbellaria in the same class with the parasitic Trematode and Cestoid worms, a proceeding from which we should have thought he might have been restrained even by the difficulty which he has evidently experienced in framing his definition of the class. The Turbellaria are manifestly of a higher type than the Trematode worms with which they are here associated, and approach in many respects to the lower forms of the Hirudinea, most of which, like the majority of the Turbellaria, are hermaphrodite. Moreover, in the Turbellaria we find no trace of that complicated system of digenesis which prevails, as far as we know, almost throughout the Trematode and Cestoid worms,—the so-called alternation of generations in the Nemertina being of a very dissimilar nature.

The classification of the Turbellaria here adopted is founded upon the systems proposed by Keferstein, Max Schultze, and Schmarda, with the introduction of some groups established by Mr. Stimpson in his "Prodromus," published in the Proceedings of the Philadelphian Academy for 1857. The Trematoda and Cestodea are arranged in accordance with the latest systematic views of Van Beneden.

It is unfortunate with respect to furnishing the student with a clear view of the primary grouping of the animal kingdom, that the five main sections described in this volume are represented *typographically* as of equal value, although three of them are regarded by the authors as going to make up the great division of the Annulosa.

This circumstance may be of little consequence to the advanced student, who forms his own conclusions upon classification, and views such books as this by the light of an intelligent criticism, but to the beginner it must be not a little puzzling to find that groups treated apparently as equivalent are really of very different value, and that what is spoken of as a class in one page is subsequently divided into classes. Thus the Arthropoda and Vermes which stand as primary heads in this book, are regarded by Dr. Carus as sections of the Annulosa, to which great division of the animal kingdom he likewise refers the third main section (Echinodermata); and both the Vermes and Echinodermata are mentioned as *classes* (pp. 422 and 485) whilst their subdivisions are also described as classes. And again these groups appear as if equivalent to the Cœlenterata and Protozoa which follow them, but which are universally allowed to be of higher systematic rank. It may be thought that such remarks savour of hypercriticism, but let any one look back to the period of his first steps in science and he will hardly be inclined to make light of such a fault as want of method in a student's manual. It is to be hoped in the interests of a sound zoological system, that when the first volume of this "Handbook" makes its appearance a table of classification showing the true relations and subordinations of the groups may form part of its contents. The Echinodermata are divided by Dr. Carus into the usual four orders—viz., Holothurioidea, Echinoidea, Asterioidea, and Crinoidea.

With regard to the classification of the Cœlenterata, which are adopted here as constituting a primary division, our author differs somewhat from the views advocated by Huxley. Recognizing the two types of structure represented by the Actinozoa and Hydrozoa of that distinguished zoologist, he yet divides the Cœlenterata into three classes, considering the characters presented by the Ctenophora to be of sufficient value to entitle them to rank as a distinct class. In this he is probably right, as, notwithstanding the unmistakeable resemblance of some of the Ctenophora to such Actinian forms as *Ilyanthus* and *Philomedusa*, the bilateral symmetry of the body, the nature of the tentacles when present, the peculiarities of the canal-system, the degree of development of the nervous system, and the ciliated paddles by which the free movements of the animals are effected, would seem to entitle them to rank as a group apart from the Anthozoa. The latter are described by Dr. Carus under the name of Polypi, and his classification of them is founded upon that established by Milne-Edwards in the well-known "Histoire Naturelle des Coralliaires" except that he has removed the Tabulata and Rugosa of Milne-Edwards, chiefly formed of Fossil corals, to the place assigned to them among the Hydrozoa by the researches of Agassiz.

In his treatment of the complicated phenomena of the life-history of the Hydrozoa and his appreciation of their bearing upon the system, Dr. Carus seems to us to have been very happy. His first order consists of the Medusæ (the Steganophthalmata of Forbes, the Lucernaridæ of Huxley, less *Lucernaria*), his second of the *Lucernariæ*, the Calycozoa of Leuckart. For his third and last order he adopts Vogt's name of Hydromedusæ, giving it, however, a sense very different from that in which its author used it. The Hydromedusæ of Dr. Carus include two groups, the Siphonophora and the Hydroidea; the former described in general accordance with Professor Huxley's views, except that the main division into Calycophoridæ and Physophoridæ is rejected; the latter including the whole of the Hydroid Polypes and Naked-eyed Medusæ of former authors. Of the sexual Medusoids, whether set free from fixed Polype-forms or produced directly from the ova of similar creatures, an analysis is given in accordance with Gegenbaur's "System der Medusen," but this is only preliminary to the systematic résumé, in which the author endeavours to represent the multifarious relations of these perplexing creatures. In this the Hydroidea are divided into two sections, *Haplomorpha* and *Diplomorpha*, the former including those Medusoid forms (Geryonidæ, Trachynemidæ, Æquoreidæ, and Aeginidæ) which are developed directly from the ovum *without metagenesis*,—and the latter, the Polypoid forms which produce either free sexual zooids, or attached and usually more or less Medusoid buds. To the latter group Dr. Carus refers the Tabulate and Rugose Corals, of course provisionally, forming with them a section to which he gives the name of *Lithydrodea;* his other sections of Diplomorpha are called *Skenotoka* (Sertularian and Campanularian polypes) and *Gymnotoka* (Tubularidæ, Corynidæ, with *Hydra*).

That there may be defects in this system can hardly be denied, but it seems to us to approach more nearly towards the production of a true picture of the natural relations of the Hydrozoa than any of its predecessors.

Indeed as we approach the lower confines of the Animal Kingdom, or of any of its great divisions, a certain difficulty of satisfactorily classifying the objects under consideration seems always to meet us, due no doubt to a comparative multiplicity of forms with a greater simplicity of organisation. Hence among these lower groups, nearly every writer has his own system, and although none of these efforts may lead to a classification at all comparable for clearness of definition with the well established groupings of the higher forms, we may generally find some justification for them. Nevertheless we are rapidly approaching to a uniformity of opinion even as to the classification of the lowest forms of animal life, such as the Cœlenterata and Protozoa, and although each successive author may show us some slight change of the kaleidoscopic picture, its broad and general features remain pretty much the same.

Dr. Carus indeed in his systematic arrangement of the Protozoa establishes one new class for the reception of *Noctiluca*, to which he gives the name of Myxocystodea,—and in the classification of the other forms he introduces some new groupings. His second and third classes, consisting of the Gregarinæ and Spongiæ, present no peculiarity calling for remark, but in his classes of Rhizopoda and Infusoria we find some new views. Thus the Rhizopoda form three orders, of which the first, under the new name of Homogenea, includes only the Foraminifera, distributed in accordance with a combination of the systems of Carpenter and Max Schultze; the second, Phlœophora, is established for the Actinophryna, and the third, Cytophora (Häckel), contains the whole of the Radiolaria of J. Müller. The latter are arranged in accordance with Häckel's distribution, and Dr. Carus has gone so far as to give a complete analysis of the multitudinous genera proposed by that author. Whatever may be the value hereafter attached to Häckel's work, this analysis cannot but prove welcome to the working naturalist.

The presence of a nucleus and contractile vesicle in *Amœba* and its allies induces Dr. Carus to remove these singular creatures from the class of Rhizopoda, of which they have generally been regarded as typical examples; they constitute the first order, Atricha, of his Infusoria. His second order, Suctoria (Clap. and Lachm.) includes only the Acinetina, the right of which to a distinct place in the system is, however, still disputed by Stein. The true Infusoria constitute a third order, to which Ehrenberg's name Ciliata is appropriated, and a fourth group the Flagellata (Ehrenb.), includes several families such as the Peridima, Volvocicea, and Monadina, the animal nature of which is, to say the least of it, very doubtful. The last mentioned order is, however, inserted only provisionally.

We have thus, not without some labour, endeavoured to analyse the general classification put forward in the work before us, chiefly with the purpose of indicating to our readers those particulars in which it departs more or less from what we believe to be the generally received views of Zoologists. That the system adopted is open to certain objections there can be no doubt, and the more prominent of these have been indicated to the best of our power in the preceding pages, but on the whole the work appears to be the best and most complete Manual of Systematic Zoology that has yet appeared. As a guide to classification it is superior to the excellent Handbook of Vander Hoeven, although it is inferior to that work in copiousness of detail as to the general organisation and developmental phenomena of the various groups. The great space devoted to the generic analysis has necessarily compelled the authors to compress what they had to say upon these subjects into a comparatively small compass, but what they do give is exceedingly good, and has evidently been prepared with a thorough appreciation of the most recent investigations into the various departments of Zoology.

VII.—Phipson's Phosphorescence.

Phosphorescence; or, the Emission of Light by Minerals, Plants, and Animals. By T. L. Phipson, Ph.D., F.C.S. London: Lovell Reeve, and Co. 1862.

Towards the close of the eighteenth century, in a narrow winding street of the old town of Bologna, a cobbler—Vincenzo Cascariolo by name—might have been found, more intent on the pursuit of alchemy than in making or repairing boots. While enjoying a walk one Sunday evening, near the Monte Paterno, not far from the city, he picked up a stone, which, from its great weight, struck him as peculiar, and from which he fancied he could extract gold. This stone was sulphate of Baryta, which Cascariolo, heating in his crucible with charcoal, converted into a sulphuret of Barium, and produced a body well known for its strange property of giving out light after it has been exposed for some time to the Sun's rays. Since then, other substances have been discovered endowed with this strange property, and from the most remarkable of them, phosphorus, the name of phosphorescence, is derived. This phosphorescence is not, however, confined to the mineral kingdom; but, on the contrary, some of the most remarkable instances of this phenomenon are found in many of the species of the animal and vegetable kingdoms; and we could conceive a most interesting volume being written on the various creatures, organic and inorganic, in which this peculiar property is found. Phosphorescence is a phenomenon familiar to all students of nature. Even in this country, the naturalist by the sea-side recollects the long flashes that come pouring in on the sands, as on some warm summer's evening he watches the waves gently breaking on the shore, or the drops of fire that fall on the feathering of an oar. The naturalist in this country brings to mind the glowworm, with its ineffectual fire, or the centipede that leaves behind it a luminous trail. He who has travelled in other lands, remembers how these phenomena become intensified—Lucciola flying among the bushes, and Tunicates and Hydrozoa rolling like globes of molten metal through the waves.

The little volume, the name of which heads this notice, is an attempt to handle this subject in a popular-scientific manner. The first portion of the volume speaks of mineral phosphorescence; the second, of the phosphorescence of vegetables; the third, of the phosphorescence of animals; and the concluding part is devoted to some historical and practical considerations about phosphorescence. The whole of these subjects are treated of in a very general, and, we may as well at once say, in a very unsatisfactory manner; and, though many of the accounts collected together are curious and interesting, yet there is among them but little that strike us as new; while there are many things that show a strange amount of ignorance, mixed up, it is true, with a certain small amount of knowledge.

The observations of Linneus's daughter on the common garden Nasturtium, of Prof. Haggern on the Marigold and Orange Lilies, of Fries on the Poppies, are all quoted as examples of phosphorescence in flowering plants; while the species of Rhizomorpha, the *Agaricus olearius*, and others, are mentioned as instances of the same among Cryptogams. In the chapter on the emission of light by dead animal matter, the author alludes to a "peculiar mucus, sometimes seen about spring, on the damp ground, near rivulets, which, from the circumstance of its being occasionally phosphorescent at night, has been regarded, since the middle ages, as having some connection with the shooting-stars. This substance appears to be the "peculiar mucus" which envelopes the ova of the frog. It swells to an enormous volume when it has free access to water. It is swallowed by some large crows, or other birds, and afterwards vomited, from its peculiar property of swelling to an immense size in their bodies." The whole of this account is so strange, that we confess we should have liked a few more details, especially when we are told that the history of this curious substance is given in the Medical Journal of Brussels for 1855.

The chapter on the phosphorescence of the sea is perhaps the worst in the book. Instead of giving ample details of this subject, the author contents himself with giving a most meagre and imperfect list of such marine animals as are known to be luminous; and we have the history of the *Noctiluca miliaris* repeated twice. Figures of some of the animals are given—one of *Pyrosoma atlanticum*, just one inch and a quarter long, and scarcely one quarter of an inch wide is said to represent "the entire animal magnified!" while a representation of two or three of the zooids—about the size of life, and very badly represented—is said to be "the phosphorescent surface of the body, magnified about 300 diameters." We recollect not long since hearing a popular lecturer on Zoology confounding *Noctiluca*, *Pyrosoma*, and *Salpa* together; the creature described was made up of thousands of *Noctilucæ;* it had the shape and form of *Pyrosoma*, and the strange development of *Salpa*. We wondered, at the time, where he could have got the idea, not believing it possible it could have been hazarded on chance. We now think that Dr. Phipson is, perhaps, to blame for the lecturer's errors; because, while talking of the *Noctiluca miliaris*, he proceeds to allude to and figures *Pyrosoma*, and says "it belongs to the tribe of Tunicata; each *individual* resembles a *minute* cylinder of glowing phosphorus. Sometimes they are seen *adhering together* in such prodigious numbers, that the ocean appears as if covered with an enormous layer of molten lava." Then comes a brief account of *Salpa cristata*, wherein it is stated that they also swim adhering together in vast numbers, with a figure of *Salpa cristata*, "an isolated individual," and of five Salpæ "united as they swim." Phosphoric Infusoria are referred to, and bad figures of *Peridiniæa fusca* (?) and *Prorocentrum micans* are given. Appended to the description of this latter is a foot-note, which, as it appears to show that the author does know something about these creatures he writes of, we quote: "It is exceedingly probable that this animalcule will be placed among the Rhizopodes; and the same remark may apply to many now called Infusoria. In this microscopic class of animals, as it undergoes fresh investigations, the species are continually being removed and placed in higher genera, families, or classes. Thus the Rotifera are now classed among the Annelides." If the author really knows as much of these creatures as this footnote would appear to indicate, how are we to account for the many blunders made in the portion of this volume which treats about them? We are so far inclined to agree with him, that we would remove all the non-ciliated animalcula from the group of the true Infusoria; but as they do not possess pseudopodia in any form, we would not be inclined to place them among the Rhizopodes. They will probably turn out to be either larval forms of other animals, or vegetable zoospores. Many marine phosphorescent animals are not even alluded to by name in this chapter. The brilliant emerald green phosphorescence of several of the species of *Nereis*, that of many of the Sertularian Hydrozoa, and several others, are passed by without a word. Some details are given in reference to the phosphoric light of the earth-worms, and of the two species, *electrica* and *phosphorica* of the genus *Scolependra*. Macartney's curious observations on *S. electrica* have been lately confirmed by Dr. Stokes, who has found this species in some numbers on the Hill of Howth, near Dublin. A short account follows of phosphoric insects, chief among which are enumerated the glow-worm of Northern, and the Lucciola, or fire-fly, of Southern Europe, the females of the first apterous, and of the second winged. We have observed that the male of our common species—*Lampyris noctiluca*—shows a much more brilliant light in Italy than what we have seen it exhibit in England or Northern Germany; but the light exhibited by the female is twofold more brilliant than that of the male, or than that exhibited by either sex of the *L. Italica*. There are few sights more beautiful than, when driving along some bye-road on the plains of Lombardy, to see the countless thousands of Lucciola flying about like wandering stars—now here, now there, causing the hedgerows quite to rival the heavens. On plunging several of these Fire-flies into weak spirits, we noticed that their light shone forth with vivid intensity, but faded away in a few minutes. Nothing satisfactory is as yet known as to the why and the wherefore of the luminosity of these insects. The author includes the species of the genus *Fulgora* among the phosphorescent insects; we believe that as yet all the evidence goes to prove that this genus is not luminous. The case, pro and con, will be found detailed in a manner very pleasant to read, in the third volume of the "Entomological Magazine," for 1836; and we are not aware that much information has since been obtained. The author says that Mr. F. Smith, of the British Museum, has related to him the following anecdote, which *confirms* the opinion that *Fulgora* is certainly luminous: "Whilst shewing these insects to two young middys, one of them exclaimed, 'Why, look here! these are the *Candle-flies* that we used to knock down with our caps in China.'" If our friend, Mr. F. Smith, were to tell us that he had seen a *Fulgora* emitting light, we would at once believe him; but we do not think the reader will believe in the fact on such evidence as appears decisive to Dr. Phipson. In addition, he urges that the fact must be so, as Dr. Donovan has carefully figured these insects, and his figures show them in the act of emitting light from the points of their peculiar proboscis. If he had only known it, he might have also referred to the title pages of the "Entomological Magazine" for *Fulgora* showing a wondrous luminosity, 'sine me dare lumina terris.' But we doubt if, in the discussion above referred to, Mr. Newman brought this fact forward as conclusive.

Into the historical, theoretical, and practical considerations which form the fourth and concluding portion of this volume, we do not propose to enter. We cannot recommend this volume as a complete, or even a tolerably complete, treatise on Phosphorescence. But it nevertheless contains a compendium of facts of great interest, many of which may be new to some of our readers.

VIII.—New Colonial Floras.

Flora of the British West Indian Islands. By A. H. R. Grisebach, M.D., F.L.S., Professor of Botany in the University of Göttingen. London: Reeve and Co. 1864. 8vo. pp. 789.

Enumeratio Plantarum Zeylaniæ; an Enumeration of Ceylon Plants, with Descriptions of the new and little known Genera and Species, Observations on their Habits, Uses, Native Names, etc. By G. H. K. Thwaites, F.L.S., Director of the Royal Botanic Gardens, Peradenia, Ceylon; assisted in the identification of the species and synonymy, by J. D. Hooker, M.D., F.R.S., &c. London: Dulau and Co., Soho Square. 1864. 8vo. pp. 483.

Dr. Grisebach's "Flora of the British West Indian Islands," is the only work containing a complete account of the plants of any considerable tropical area that has ever been brought to a termination, and as such it marks an epoch in the history of descriptive Botany. It is the first of the Colonial Floras, published by Government, the origin and progress of which are detailed in the vols. for 1861 and 1863 of the present work. It includes all that is known of the Floras of Jamaica, the Bahama and Turk Islands, Virgin Isles, St. Kitts, Nevis, Montserrat, Dominica, St. Vincent, Grenada, Antigua, Barbadoes, Tobago, Trinidad, and other smaller islands. Of these by far the largest and best explored is Jamaica, containing 5470 square miles,* and mountains of 8000 feet elevation. The Bahamas rank next, with 5400 miles in all. They lie chiefly beyond the Tropic (between 27° and 21° N. Lat.), present no elevation of any importance, and their Flora, which has not been well explored, is probably neither rich nor varied. Trinidad has been pretty well botanized, it presents an area of nearly 2000 square miles, and points of elevation of 3000 feet. In its climate, geographical features, and Flora, it partakes of the characters of the neighbouring coast of Cumana, and should perhaps rank botanically rather with Venezuela, than with the West India Islands proper. Of the other Islands, Dominica has been the best explored, but all want a careful botanical investigation. It may not be the case that they will add many species to the Flora, but they will certainly extend the known range of the species very materially.

The main botanical features of the West Indies are of course tropical American, and with the exception of the slight approximation of the Flora of the most northern islands to that of the South-Eastern American States, and the more evident affinity of that of the southern islands with the Venezuelan, there seems to be no very marked or contrasting subdivisions of the Flora. Still peculiarities occur, which lead Dr. Grisebach to recognise five botanical divisions in the Archipelago. He says in his preface:—

"Though reaching beyond the Tropics (N. Lat. 10° to 27°), the West Indian Islands present an entirely tropical character in their vegetable productions, and the Northern Bahamas in this respect are quite distinct from the opposite continental shore of Florida, from which they are separated by the Gulf stream, while Trinidad, lying almost contiguous to the delta of the Orinoco, partakes of the

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* According to the American authority which Dr. Grisebach has followed; but 4256 square miles, according to British maps.

Flora of Venezuela and Guiana. Jamaica again, from its mountainous character, and more distant position,—most of the Leeward Islands, from being wooded volcanos,—and the majority of the Windward ones, with a dry climate and a low calcareous soil, form three divisions of this tropical archipelago, which show as many peculiarities. Thus the whole of the British West Indies, as comprised in this Flora, may be divided into five natural sections, each with a distinct botanical character, and including the following islands, the geographical area of which is added according to the American almanac for 1858, and other sources.

			English Square miles.
I.	27°—21° N.L.	Bahamas	5420
	21°	Turk Islands	400
II.	19°—18°	Jamaica	5470
III.	Western Caribbean Islands (most Leeward, and including some of the Windward Islands).		
	18°	Virgin Islands	140
	17°	St. Kitts	70
	,,	Nevis	30
	16°	Montserrat	50
	15°	Dominica	290
	14°—13°	St. Lucia	225
	13°	St. Vincent	130
	12°	Grenada and Grenadillos	155
IV.	Eastern Caribbean Islands (most Windward, and some Leeward Islands).		
	18°	Anguilla	30
	17°	Barbuda	90
	,,	Antigua	100
	13°	Barbadoes	170
	11°	Tobago	190
V.	10°	Trinidad	2000

"Thus the territory comprised may be estimated as amounting to about 15,000 English square miles, or nearly twice as much as the area of Wales. Haiti alone is nearly twice as large as the whole of the British West Indies; Cuba surpasses them almost three times, and this will account for the fact, that, considerable as were the materials at my disposition, and great the exertions of so many excellent collectors, the number of novelties in my Flora is, comparatively speaking, small, while Cuba affords a daily increasing number of unpublished species. Considering, at the same time, how neglected by botanists Cuba has been, if we compare it with the standard works of men like Jacquin and Swartz, the publications of whom, with regard to the West Indies, were almost confined to the British possessions, it will appear probable, that by far the greatest part of the plants of our territory consists of old species; these indeed being the foundation of our scientific knowledge of the Flora of tropical America.

"To study these primary species and their varieties (which have so often been misunderstood that their synonyms are far more numerous than their numbers) to show that many of them range through the whole of tropical America, and some even beyond its limits, and that a considerable number of so-called geographical species must be reduced, is an object of great systematic importance, and this has been the aim which, during my labour, I have constantly had in view."

The first remark we must make on the West Indian Flora is the apparent absence of temperate American species or types on the loftier mountains. These, as stated above, rise in Jamaica to 8000 feet, and yet, with the exception of a few naturalized plants, as *Fragaria vesca*, *Ranunculus repens*, &c., we find scarcely any European or North American temperate genera or species, and very few Andean either. Indeed, of nearly 1100 West Indian genera, less than 100 (exclusive of aquatic genera) are decidedly northern, and of this number the majority are tropical genera represented in Europe. The more decidedly temperate genera represented in the West Indies amount to only thirty. Of these, the most remarkable are *Cakile* (*C. æqualis*, a species closely allied to our *C. maritima*, and which has indeed been reduced to it by A. Richard and others); *Drosera* (*D. longifolia β.*, an American form of the European plant which ranges from Canada to South Brazil, but which, in the West Indies, has hitherto been found only in Trinidad); various American species belonging to *Salix*, *Vaccinium*, *Prunus*, *Rubus*, *Galium*, *Lactuca*, *Sonchus*, *Pinguicula*, *Plantago*, and other genera which are found in the Cordilleras; and lastly, a species of *Allium*, which ranges from the United States to Chili. The actually European and North American species, exclusive of water plants and sub-tropical grasses, believed to be indigenous in the Islands, are.

Cardamine hirsuta,	Leonurus Sibiricus,
Nasturtium officinale,	Drosera intermedia, β.,
Sonchus asper,	Juncus tenuis,
——— oleraceus,	Oxalis corniculata,
Plantago major, β.,	

of which several are possibly introduced, and most of the rest are weeds of wide dispersion.

Whether the lofty mountains of Cuba and Haiti present a larger assemblage of Northern forms, we do not know; the Mexican Alps certainly do, and as there is a marked affinity between the more peculiar vegetation of the Blue Mountains of Jamaica and the Mexican Alps, on the one hand, and the New Grenada ranges on the other, it may prove that there has been an ancient geological connection between these regions, previous to that cold epoch which favoured the migration of Northern forms across the Tropics which Mr. Darwin so plausibly advocates. Be this as it may, the almost total absence of typical North American plants in the West Indies, is perhaps the most singular feature in the whole Flora, one that is incompatible with their having shared in the effects of a glacial migration.

On the other hand, it may be argued that the difference between the temperature of the islands, and of even the warmest of the North American States, is so great, that this alone may have expelled what Northern plants once inhabited the islands. In favour of this view, it must be stated, that it is difficult to conceive greater contrasts of climate within equally small distances than obtain between the Bahamas and Florida. This, as is well known, is due to the influence of the Gulf stream, which, where it impinges on the American Coast, does not raise its winter temperature much, but which, bathing even the northernmost Bahama Islands off the Floridan coast, raises their winter temperature to that of the tropics.

As to the extent to which this induced climate may have affected the Northern plants, we can only judge by observing its effects upon such as have been introduced by the agency of man. Of these, a small proportion have run wild, or become naturalized; and it may be worth while to devote a short space to the consideration of them. Fortunately Dr. Grisebach has most carefully discriminated between the truly naturalized species and occasional escapes, and thus enables us to extract the following information from the body of his work:—

In the British West Indies the naturalised species amount to less than 150 out of the 3055 flowering plants; a very small proportion considering how long the Islands have been not only colonised, but under cultivation, and how extensive and of how long duration the intercourse between these Islands and both Europe and Africa has been. If we arrange these under the Continents to which they are severally indigenous, another remarkable fact appears, viz., that the numbers contributed by each Continent are almost exactly in an inverse ratio to what would *a priori* have been assumed. They are as follows:—

African	13 species.
American	17 ,,
European	31 ,,
Asiatic	85 ,,

Over and above these, there are some 250 species which are common to the three tropical Continents of America, Africa, and Asia, and some of which may have been introduced, but being chiefly littoral plants, or annual weeds, that have with equal probability been diffused by natural agencies over them all, they have been regarded as indigenous in all. With these we have here nothing to do at present.

To begin with the African species, the most important are those which have been introduced for food or commercial purposes. They are

Coffee . . .	Coffea Arabica.
Oil-Palm . . .	Elaeis Guineensis.
Tamarind . . .	Tamarindus Indica.*
Akee	Blighia sapida.
Ground nuts . . .	Arachis hypogæa.
Calabash, or American nutmeg	Monodora Myristica.
Henna . . .	Lawsonia inermis.

The others are an *Aloe*, *Capparis*, *Cassia*, *Tephrosia*, and two species of *Acacia*.

The American naturalised plants of Economic value are

Cherimolia . . .	Anona Cherimolia.
Tobacco . . .	Nicotiana Tabacum.
Sweet potato . . .	Ipomea Batatas.
Coco-nut . . .	Cocos nucifera.
Maize	Zea Mays.
Pine Apple . . .	Ananassa sativa.

* Which is indigenous nowhere in Asia.

The others are, almost without exception, garden plants that have been introduced for ornament.

Asia supplies

Nutmeg	Myristica moschata.
Ben-oil	Moringa pterygosperma.
Castor-oil	Ricinus Palma-Christi.
Jews' Mallow	Corchorus olitorius.
Orange	Citrus Aurantium.
Lemon	Citrus Medica var.
Citron	Citrus Medica var.
Shaddock	Citrus decumana.
Lime	Citrus Aurantium var.
Bread fruit	Artocarpus incisa.
Club Wood	Casuarina equisetifolia.
Mango	Mangifera Indica.
Cassia pod	Cassia Fistula.
Senna	Cassia obovata.
Native Almond	Terminalia Catappa.
Indigo	Indigofera tinctoria.
Dhal or Pigeon Pea	Cajanus Indicus.
Jute	Crotalaria juncea.
Clove	Caryophyllus aromaticus.
Otaheite Apple	Jambosa Malaccensis.
Malay or Rose Apple	Jambosa vulgaris.
Jambolana	Sizygium jambolanum.
Cinnamon	Cinnamomum zeylanicum.
Mankuda	Morinda citrifolia.
Kauki	Mimusops Kauki.
Sesamum	Sesamum orientale.
Cocoe, or Eddoes, or Bleeding Heart	Colocasia esculenta.
Bamboo	Bambusa vulgaris.
Chinese corn	Setaria italica.
Sugar cane	Saccharum officinarum.
Job's Tears	Coix Lachryma.
Balsam Apple	Momordica charantia.*
Cerasee	Momordica Balsamina.
Bottle Gourd	Lagenaria vulgaris.*
Towel Gourd	Luffa acutangula.*
Yams	Dioscorea alata and triphylla.
Plantains and Bananas	Musa Sapientum and Paradisiaca.
Ginger	Zingiber officinarum.

* Those marked with an asterisk are undoubtedly of Asiatic origin, though not so stated in the Flora.

The remaining Asiatic naturalized plants are chiefly garden shrubs, as Jasmines and Ixoras, together with a very few weeds.

Of the European naturalized plants, the great majority are escapes from gardens, that have established themselves here and there, very few being generally diffused. As, however, they are almost without exception British species, it may be interesting to enumerate them, which we shall do under two heads.

1. Plants introduced for food or pasture, or other economic purposes.

Cress . . .	Lepidium sativum.
Furze . . .	Ulex Europæus.
White Clover . .	Trifolium repens.
Creeping do. . .	T. filiforme.
Vetches . .	Vicia sativa.
Lentils . .	Ervum hirsutum.
Strawberry . .	Fragaria vesca
Parsley . .	Petroselinum sativum.
Parsnip . .	Pastinaca sativa.
Carrot . .	Daucus Carota.
Pomegranate . .	Punica Granatum.

2. Introduced accidentally, or for ornament.

Creeping Crowfoot .	Ranunculus repens.
Small flowered ditto .	——— parviflorus.
Hedge Mustard .	Sisymbrium officinale.
Shepherd's Purse .	Capsella Bursa.
Hearts' Ease .	Viola tricolor.
Purple Spurge .	Euphorbia Peplus.
French Catch-fly .	Silene gallica.
Mouse-ear Chickweed .	Cerastium viscosum.
Nettle-leaved Goosefoot	Chenopodium murale.
White ditto	——— album.
Mountain Crane's bill .	Geranium Pyrenaicum.
Nipple-wort . .	Lapsana communis.
Dandelion . .	Taraxacum dens-leonis.
Centaury . .	Erythræa ramosissima.
Thyme-leaved Speedwell	Veronica serpyllifolia.
Yellow Toad-flax .	Linaria vulgaris.
Corn Wound-wort .	Stachys arvensis.
Prunella . .	Prunella vulgaris.
Donax Cane . .	Arundo Donax.
Brome Grass . .	Bromus sterilis.

The European list is certainly a remarkable one for a thoroughly tropical climate, showing as it does that many of the common weeds of our own country have the power of establishing themselves under climatic conditions so very different from our own. Some of the species are, it is true, confined to the upland districts of Jamaica; but even here the mean annual temperature is high compared with any part of Northern Europe, and the extreme temperatures very feebly contrasted.

Turning to the elements of the indigenous British West Indian Flora (exclusive of Cryptogams), these may be roughly classed into the Endemic and non-Endemic, the former being quite one-third of the whole; about 1030 out of 3050 being hitherto found only in the West Indian Islands (British and others). No doubt a certain number of them will yet be discovered on the main land of America; but, on the other hand, probably a more than counterbalancing number of Endemic species remain to be discovered in the Islands. Whether this proportion represents the Endemic character of the whole West Indian Flora or no, it is impossible to say. Cuba and Haiti will no doubt add enormously to the number of peculiar plants; but on the other hand, such islands as Curacoa and Tobago must contain a large proportion of continental species not found in any of the other Islands. Meanwhile, we are glad to learn, that Dr. Grisebach promises us a work on the distribution of the whole Flora of the West Indies, as far as is known, which will, no doubt, throw great light on the precise relation between the Floras of the several Islands and between these and the neighbouring parts of the Continent.

Let us now briefly consider this Flora, and compare it with that of other tropical countries. Of the above 2000 indigenous species (or thereabouts), which are common to the West Indies and other countries, 1750 are American exclusively, and about 250 are also natives of the Old World. The latter is a surprisingly small number, considering the great similarity that pervades the vegetation of most tropical littoral climates, and observing how readily so many Asiatic and African trees and shrubs have become naturalized in the islands after being introduced by man.

When again these 250 extra-American plants are divided into African and Asiatic, another curious fact appears, viz., that notwithstanding the proximity of the West Indies to Africa, and the constant traffic between these countries for upwards of three centuries, there are actually fewer plants common to the West Indies and Africa than there are to the West Indies and Asia; the approximate numbers being, of the former 210, and of the latter 220. Of the aggregate number, upwards of 200 are common to Africa and Asia, leaving a very few common to Africa and the West Indies, and not hitherto found in Asia. Of these the following are, as being large trees, the plants of most interest in this inquiry:—

American trees that have migrated to Africa; or vice versa.

Carapa Guianensis.
Paullinia pinnata.
Lonchocarpus sericeus.
Drepanocarpus lunatus.
Hecastophyllum Brownii.
Andina inermis.
Chrysobalanus Icaco.

Of these seven, four belong to one Natural Order, *Leguminosæ*, and most of these, together with probably all the rest, are more or less littoral plants.

Under whatever light we regard this fact, it appears a very strong argument against their being much oceanic and aereal transport of seeds between the tropics of the Eastern and Western worlds; and, coupled with the no less remarkable counter-fact, that there are many more marked points of affinity between the Floras of the extra-tropical regions of America and Africa (though these are so very much more distant geographically), than between the tropical Floras of these countries, it would at first-sight appear to throw us back upon ancient continental extension, to account for much of the community of vegetation, which we do find to exist between the tropics of the Old and New Worlds. But sufficient ancient continental extension demands incalculable time to account for; and one effect of this, if granted, must be great specific and even generic change on the descendants of the species that lived on the common continent. The question, therefore, next to be asked is, whether there is greater generic affinity between the West Indies and Africa, than between the West Indies and Asia? Here again we are baffled, there being only 50 genera common to the former case, but 53 in the latter!; besides which, there are a considerable number of large and important Natural Orders common to the West Indies and Asia, that are almost wanting, or comparatively very rare, in tropical Africa; such are *Laurineæ*, *Magnoliaceæ*, *Myristiceæ*, *Ilicineæ*, *Guttiferæ*, *Rutaceæ*, *Gesneriaceæ*, *Vaccinieæ*, *Coniferæ*, *Orchideæ*, *Palmeæ*, *Piperaceæ*.

It is evident from these considerations, that tropical Africa and America have borrowed little of one another within the period of the creation of the forms of plants now inhabiting each,—that the differences between these Floras are so great, that it is doubtful whether at any time there has been much community of vegetation,—and that the hypothetical modern Atlantic continent, which Heer assumes to have existed in the North Atlantic, and to have connected Europe and North America, cannot have extended to the south of the Tropic of Cancer.

If, on the other hand, we compare tropical Africa with tropical Asia, we find, 1, a vast amount of specific and generic identity; 2, an absence in Africa of any great or peculiar group, that is not also Asiatic; and 3, an absence in Africa of many of the great groups that are characteristic of Asia. The sum of these facts amounts to fair evidence, that tropical Africa was peopled by plants from tropical Asia, and that within a comparatively modern epoch. Up to the present time we have no sufficient data for comparing tropical Africa, generically even, with America beyond the West Indies, and until this is done, it would be rash to speculate upon the means whereby the few plants common to tropical Africa and the West Indies have been transported from the one to the other; or why it is that there should be so many Orders common to America and Asia, that are scantily represented, or totally absent in tropical Africa.

Turning now from these points of difference between the Floras of the Old and New Worlds to those of similarity, a comparison of the contents of Dr. Grisebach's Flora with those of Mr. Thwaites' enumeration, gives some curious results.

In the first place, the number of Natural Orders is almost precisely the same in both areas, viz., 156 in Ceylon, and 152 in the West Indies; and the Orders† themselves are to a great extent the same; the Orders not represented in both being, with the exception of six, either small or feebly represented. These are the following:—

Present in the West Indies, but absent in Ceylon.			*Present in Ceylon, but absent in the West Indies.*		
ORDERS.	GEN.	SPEC.	ORDERS.	GEN.	SPEC.
Papaveraceæ . .	2	2	Berberideæ . .	1	1
Sauvagesiaceæ .	1	1	*Tamariscineæ .	1	1

† The respective authors have slightly different opinions as to the limits of some of the Orders, but these are here reduced to the same standard.

*Canellaceæ	2	2	Elatineæ	1	2
*Marcgraviaceæ	3	4	Lineæ	2	3
Chrysobalaneæ	4	10	*Dipterocarpeæ	8	10
*Papayaceæ	1	3	*Aurantiaceæ	12	19
*Turneraceæ	1	6	Geraniaceæ	1	1
Loaseæ	1	1	*Balsamineæ	2	22
*Cyrilleæ	1	1	*Pittosporeæ	1	2
Myoporineæ	1	1	Corneæ	1	2
Juglandeæ	1	1	Valerianeæ	1	1
Myriceæ	1	1	Dipsaceæ	1	1
*Garryaceæ	1	1	*Stylidieæ	1	1
Lacistemeæ	1	1	*Salvadoreæ	1	1
Saliceæ	1	1	*Jasmineæ	1	7
Coniferæ	3	5	Orobancheæ	2	6
Irideæ	1	3	Santalaceæ	3	2
Hæmodoraceæ	1	1	Elæagneæ	1	1
*Bromeliaceæ	13	37	*Nepenthaceæ	1	1
			Triurideæ	1	1
			*Apostasiaceæ	1	1

Therefore the sum of the *Ordinal* differences between two spots in the tropics of the Old and New World respectively, and containing together upwards of 2000 genera and 5000 species is represented by only about 82 genera and 200 species.

If again we seek to ascertain the extent to which the dominant Orders are represented in each, we find a further great and remarkable uniformity. More than half the Flowering plants belong to eleven Orders in the case of the West Indies, and to ten in that of Ceylon, whilst with but one exception the Ceylon Orders are the same as the West Indian, and they follow in nearly the same sequence in each country.

West Indies. (Of total 3500 species.)		Ceylon. (Of total 2400 species.)	
1. Leguminosæ	262	1. Leguminosæ	196
2. Orchideæ	226	2. Gramineæ	168
3. Rubiaceæ	173	3. Orchideæ	146
4. Gramineæ	160	4. Rubiaceæ	168
5. Compositæ	160	5. Cyperaceæ	133
6. Euphorbiaceæ	118	6. Euphorbiaceæ	121
7. Cyperaceæ	107	7. Acanthaceæ	82
8. Melastomaceæ	103	8. Compositæ	70
9. Urticeæ	69	9. Urticeæ	59
10. Solaneæ	67	10. Melastomaceæ	52
11. Convolvulaceæ	64		

* The species in each column marked with an asterisk, are confined (in the tropics) to the Old and New Worlds respectively.

Tropical Africa, according to the data published twenty years ago, in the Niger Flora, differs little in its ten dominant Orders, and their sequence from Ceylon; and lastly, to show that this uniformity is not accidental, we have taken the figures from Miquel's Flora of the Dutch East Indian Islands, which also includes a good many Continental Asiatic plants.

TROPICAL AFRICA.		MIQUEL'S FLORA.	
1. Leguminosæ	264	1. Leguminosæ	632
2. Rubiaceæ	159	2. Orchideæ	616
3. Gramineæ	152	3. Rubiaceæ	594
4. Compositæ	82	4. Gramineæ	430
5. Cyperaceæ	74	5. Urticeæ	412
6. Acanthaceæ	61	6. Euphorbiaceæ	268
7. Euphorbiaceæ	55	7. Cyperaceæ	262
8. Convolvulaceæ	45	8. Acanthaceæ	257
9. Malvaceæ	55	9. Compositæ	250
10. Urticeæ	35	10. Melastomaceæ	224

Again, of the 110 Orders, common to Ceylon and the British West Indies, only 37 are so unequally represented as to contain in one country double the number of species which the other contains. They are the following :—

Majority in West Indies.		*Majority in Ceylon.*
Samydeæ.	Boragineæ.	Dilleniaceæ.
Malvaceæ.	Solaneæ.	Anonaceæ.
Buttneriaceæ.	Begoniaceæ.	Menispermeæ.
Malpighiaceæ.	Gesneriaceæ.	Bixineæ.
Rutaceæ.	Verbenaceæ.	Olacineæ.
Melastomaceæ.	Nyctagineæ.	Ampelideæ.
Onagrarieæ.	Begoniaceæ.	Rosaceæ.
Passifloreæ.	Piperaceæ.	Rhizophoreæ.
Cacteæ.	Palmeæ.	Styraceæ.
Compositæ.	Amaryllideæ.	Ebenaceæ.
Lobeliaceæ.	Musaceæ.	Acanthaceæ.
Ericeæ.		Restiaceæ.
Myrsineæ.		Liliaceæ.

The following Orders are singularly equally represented in each :—

	WEST INDIES.	CEYLON.
Magnoliaceæ	1	1
Nymphæaceæ	3	3
Cruciferæ	5	4
Tiliaceæ	19	21
Ternstrœmiaceæ	7	6
Guttiferæ	14	18

Erythroxyleæ	6	4
Sapindaceæ	31	25
Meliaceæ	13	14
Oxalideæ	5	5
Ochnaceæ	5	5
Hippocrateaceæ	6	7
Chailletiaceæ	1	1
Rhamneæ	9	12
Terebinthaceæ	17	22
Connaraceæ	4	4
Lythrarieæ	9	12
Homalinieæ	1	1
Araliaceæ	7	5
Umbelliferæ	6	9
Loranthaceæ	22	19
Caprifoliaceæ	2	3
Lentibularineæ	10	8
Sapotaceæ	23	17
Oleineæ	6	7
Asclepiadeæ	28	33
Gentianeæ	20	19
Labiatæ	33	39
Amarantaceæ	25	26
Laurineæ	28	30
Thymeleæ	5	5
Euphorbiaceæ	118	121
Cycadeæ	2	2
Aroideæ	29	25
Xyrideæ	4	4
Scitamineæ	26	32
	550	569

It would be worth inquiring to what longitudes this similarity of vegetation is confined within the tropics. We know that no such Ordinal uniformity exists between the vegetation of extratropical Africa and South America, nor between that of either of these countries and extratropical Australia ; and we also know that the Floras of the Mediterranean Region and the Southern American States, and those of middle Europe and the Northern American States, differ more than those of Ceylon and the West Indies in their Ordinal relations. This is a most interesting subject in relation to the hypothesis of an intertropical cold epoch, such as Mr. Darwin demands for the migration of the Northern Flora to the Southern hemisphere, and which epoch, occurring (as it must have occurred) since the creation of most of the existing temperate species, must have destroyed a great part of the pre-existent vegetation of the Tropics, obliging us to regard the majority of existing tropical plants as modern creations compared with the temperate. With ourselves it is a matter of doubt whether the vegetation of the Tropics (exclusive of the temperate regions of its mountains) is richer generically and specifically than that of the Temperate zones. If it should prove to be richer, it presents a grave difficulty in the way of Mr. Darwin's hypothesis, and one which he may perhaps best obviate by showing that, owing to the struggle of life being greater in intertropical regions, and the greater activity of the subsidiary agencies (such as rapid development of vegetable life, insects and the elements that tend to hasten change), there has been a more rapid process of differentiation and selection. There will still, however, be the difficulty of accounting for the uniform distribution of Genera and Orders over the Tropics of the Old and New World, without any obvious means of transoceanic migration between them.

The last point to which we shall allude in the West Indian Flora is the astonishing number of Ferns it contains. Dr. Grisebach adopts Sir W. Hooker's moderate estimate of the value of specific characters, and according to it enumerates no less than 340 species (exclusive of 23 *Lycopodiaceæ*). Considering the area of the two islands which contain almost the whole of them, viz. Jamaica and Trinidad, this number is enormous. Ceylon, a very rich country, contains 205 species and 14 *Lycopodiaceæ*. Jamaica alone contains 290 Ferns and 17 *Lycopodiaceæ*.

In Mr. Thwaites' Enumeratio Plantarum Zeylaniæ, we have a work whose modest title covers a great amount of most accurate botanical matter, which will prove of the greatest use to the Indian as well as to the Cingalese Botanist. It comprises the Flowering plants and Ferns of one of the richest tropical islands in the world, perhaps the very richest, considering its area and elevation; and one which derives an additional interest from being the first the Flora of which was published in a systematic form, and this too by the great Linnæus.

The number of species described by Linnæus in 1757 as indigenous to Ceylon was 657. Mr. Thwaites enumerates no less than 2832, which might be considerably enlarged by those who take a narrower view of specific limits than he does. On this subject the author says in his preface, "Care has been taken not to multiply species unnecessarily, for observation has shown that the amount of variation is often considerable in plants, affecting a large range of station, and consequently of climate. Instances occur, as in the genera *Hortonia, Mappia, Turpinia, Euonymus, Elæodendron,* in which a more elevated locality produces a form or variety possessing a stouter habit and larger flower than are observed in the same species when growing only a little above the level of the sea. These forms or varieties would probably be viewed by some botanists in the light of distinct though closely allied species, and they occupy, in fact, that debatable ground the difficulties and perplexities of which the practical naturalist alone knows, and which, in the opinion of many (and I may include myself among the number), are only to be got rid of by the adoption of the views enunciated by Mr. Darwin as regards the relationship of allied forms or species by descent from a common ancestor."

Owing partly to our ignorance of the extent of the Floras of other tropical islands, and partly to the different estimates of specific limits entertained by different authors, it is not possible to compare the Ceylon Flora accurately with that of any other tropical island, except that of Jamaica, which, as we gather from Grisebach's Flora of the British West Indies, contains about 1092 species of flowering plants. The latitudes, areas, and elevations of these islands respectively are—

	Latitude.	Area.	Elevation.	Gen.	Sp.
Jamaica	18° N.	4256 miles	8000 ft.	735	1840
Ceylon	6—10° N.	24,600 ,,	8300 ,,	933	2832

This comparison would not be, however, a good one, for Jamaica presents little variation of climate beyond what the elevation of the Blue Mountains afford. In Ceylon, on the other hand, Mr. Thwaites tells us that much of the variety of its vegetation is due to the great difference of climate which the island presents. The southern part possesses a humid very hot climate, equable temperature, and considerable rainfall. The northern portion is hot and dry, being screened by the hilly interior from the rainy south-west monsoon, and enjoys but a short rainy season. The mountainous interior again presents a considerable tract of cool very rainy districts. Hence, as Mr. Thwaites remarks, the vegetation of the humid south is akin to that of Sumatra and the Malay Archipelago. That of the dry northern districts is identical with that of the Coromandel Coasts, and of the hilly interior with the Neilgherrie Mountains.

It is to be hoped that on some future occasion Mr. Thwaites will enter fully into the subject of the relations of the vegetation to the climate, and tell us how far he thinks the presence in Ceylon of the plants of the several countries he cites as having analogous climates, may be accounted for by favouring climate alone. With regard to the peopling of the northern districts by Coromandel plants, few naturalists would, in the present state of geological belief, deny that the immigration of these may have taken place before the severance of Ceylon from the great Western Peninsula of India; and as the large Indian mammals of the island could only thus have found their way across, it is reasonable to suppose that the plants did so too. To account thus, however, for the generic and almost specific identity of the mountain temperate Flora of Ceylon with that of the Neilgherries, 400 miles distant, is not so easy, and, except a great lowering of temperature be assumed, demands not only continuous land, but a continuous mountain chain. In this case the small size of many of the seeds of the plants, common to both mountain-ranges, and other circumstances connected with their facility of transport, (direct by currents, or indirect by birds, &c.) must also be taken into account.

Far more curious and suggestive, however, than the similarity of the northern and mountain Floras of Ceylon, with those of Coromandel and the Neilgherries, is the relation of the Southern Ceylon Flora with the Malayan. This which alone would furnish materials for a most interesting discussion is evidenced by the presence of gigantic trees of *Dipterocarpeæ*, of which Order Ceylon contains 8 genera and 42 species, while in continental India there are probably not one-sixth of that number; by the presence of *Cycas Rumphii*,* and by a great many representative and identical species, scattered through many Natural Orders. There is also a most curious relation established between Madagascar and tropical Africa and Ceylon by means of a species of Cacteæ, *Rhipsalis Cassytha*, the only plant of its Order found beyond the limits of America, by *Angræcum* and sundry other plants; to which must be added, by way of negative evidence the absence of Conifers and Cupuliferæ in both countries.

Our limits prevent us going further into detail as to the contents of Mr. Thwaites' volume, which we the less regret, from believing it to be only a precursor to a general Flora of the island, in which he will doubtless expatiate upon these and kindred topics.

We should like too to have carried out our comparison between Ceylon and the West Indies, and show all the points in which they

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* Discovered by Mr. Thwaites whilst the last part of his work was passing through the press

contrast, but we must confine ourselves to the most prominent, and that is the very intimate relationship subsisting between the Cingalese vegetation and that of the temperate zone to the northward of it. The West Indies, as we showed, have not on their mountains any temperate North American types; Ceylon, on the other hand, though its mountains are no higher and are situated much nearer the Equator, presents many Northern and even European plants. Of these the most remarkable are

Of Genera.

Thalictrum.
Anemone.
Ranunculus.
Berberis.
Sinapis.
Cardamine.
Nasturtium.
Viola.
Drosera.
Stellaria.
Cerastium.
Linum.
Hypericum.
Geraniaceæ.
Rubus.
Potentilla.
Poterium.
Helosciadium.
Pimpinella.
Heracleum.
Viburnum.
Galium.
Valeriana.
Dipsacus.
Bidens.
Sonchus.
Doronicum.
Campanula.
Vaccinum.
Gaultheria.
Rhododendron.
Lysimachia.
Ligustrum.
Gentiana.
Pedicularis.
Scutellaria.
Teucrium.
Elæagnus.
Arum.
Asparagus.
Allium.
Avena.

Of Species.

Stellaria media.
Tamarix gallica.
Oxalis corniculata.
Agrimonia Eupatoria.
Alchemilla vulgaris.
Sanicula Europæa.
Bupleurum falcatum.
Artemisia vulgaris.
Mentha arvensis.
Calamintha Clinopodium.
Plantago major β.
Chenopodium murale.
Juncus glaucus.
Brachypodium sylvaticum.
Triticum repens.

Here then we have in Ceylon no less than 57 genera (out of 933) which are all European, in contrast to 30 (out of 1094) in the West Indies; and 15 Northern species in Ceylon, in contrast to 9 in the West Indian highlands.

IX.—Report on Sexuality in the Lower Cryptogamia.

It was at first intended in this Report to have recapitulated the principal discoveries with regard to sexuality in the Cryptogamia generally; but two reasons suggested themselves against the adoption of this course:—one was the great length to which the report must have been extended; but the other and principal reason was, that the main facts with regard to the sexuality of the Higher Cryptogamia are already accessible to the English reader in the Report of the late Professor Henfrey to the British Association in the year 1851, and in the translation of Dr. Hofmeister's Treatise on the Higher Cryptogamia, published by the Ray Society in 1862.

This Report has, therefore, been limited to what are usually styled the Lower Cryptogamia, viz., the Lichens, Fungi and Algæ.

The Lichens may be disposed of in a few words—for our knowledge as to their sexuality may really be said to be *nil*. The function of the small bodies called "*spermatia*," (which are so very generally present in special conceptacles on the thalli of Lichens), does not appear to be fecundative as has been supposed by some botanists; and the notion of their being male organs is now, we believe, very generally abandoned, although Dr. Stitzenberger, in the Ratisbon Flora for 1862, speaks of them as "männliche Befruchtungsorgane." We must, however, mention Karsten's recent statements with regard to *Cœnogonium Andini*.

At the end of his essay on Parthenogenesisare to be found some observations on the development of the apothecia in that Lichen, which, if correct, would show that the latter originate in a free central cell, contained in an organ similar to the archegonia of the higher cryptogams. This central cell he states to be impregnated in a manner almost exactly similar to what occurs in *Coleochæte* and *Saprolegnia* amongst the Algæ. If Karsten's observations were to be relied upon, the problem of sexuality in the Lichens would have been solved, for it could hardly be doubted that what was alleged to have been seen in *Cœnogonium* would speedily have been discovered in other Lichens, when observers were put upon the track. Karsten's observations, however, have not been confirmed by any other botanist; and Dr. Schwendener, in the Flora for 1862, meets them with a positive contradiction. We have not space to give more than Dr. Schwendener's concluding remarks; but he says: "Whether the "mother-cells of the spores or some other cells are impregnated, is a "question still unsettled, and which will probably occupy many an "observer until the right solution is arrived at. As matters stand "at present, however, the assumption of an impregnation of the "young asci is the most probable one. It is easily seen that in many "apothecia, tolerably wide canals lead down from the upper surface "of the *lamina proligera* to the apex of the asci; and moreover, "that the membrane of the older asci exhibits at this spot (which is "usually thickened and gelatinous), a pore, which traverses the inner "layers, extending often as far as the so-called primary membrane. "May it not be suspected that these circumstances have some con- "nexion with the impregnation?"

We cannot venture to say yes or no to this inquiry: the question remains an enigma for Lichenologists, and we now pass on to the consideration of the Fungi.

The speculations as to the existence and nature of the sexual organs of Fungi have been numerous, and of the most various kind. It would be merely a matter of historical curiosity to follow out the different suggestions which have from time to time been made, and we would refer those who wish to acquaint themselves with the literature of the subject to the 9th chapter of Tulasne's "Selecta Fungorum Carpologia." Of all the speculations above referred to, that which held its ground the longest, and which is as old as the time of Micheli, is the theory which attributed sexual functions to the so-called "cystidia," which are large overgrown vesicles occurring upon the gills of many of the Agaricini, as well as upon *Boletus*. The idea of the sexuality of these organs has been supported by Bulliard, and (long after him) by Klotzsch; but of recent writers, Corda has been the most decisive in its favour. He called the organs in question *antheridia* or *pollinaria*, and considered each of them equivalent to a pollen-grain: he thought that a granular fluid emerged from their apices, the diffusion of which stimulated the formation of spores. He was of opinion that the antheridia differed so much in their structure and partial distribution from the paraphyses of the Ascomycetes that the two could not have the same function. Phœbus,* on the other hand, alleges that the cystidia are a peculiar kind of altered paraphyses or basidia, and that although they are more often absent from the Agaricini than paraphyses are from the ascophorous stratum

* Nova Acta, vol. xix. and Deutschland's Kryptogamische, Gift-gewächse.

of the Discomycetes, still that they serve the same purpose of protecting the shorter fertile basidia with which they are mixed. M. de Seynes, in his recent work, "Essai d'une Flore mycologique de la region de Montpellier et du Gard," has some remarks upon the nature of the cystidia which deserve careful consideration. He describes the cystidium as a cell generally larger than the basidium, and which varies much in its form: growing from the parenchyma at the same level, as, or rather below, the other elements of the hymenium, it protrudes sometimes as a simple barren cell of somewhat larger size than the others, sometimes in the shape of a more or less elongated cone, sometimes bearing a small sphere at its extremity, sometimes becoming lageniform. After stating that it is not found in all the Hymenomycetes, nor even in all Agarics, he alludes to Corda's notion of its being a male organ, and then gives his own views as follows. He says: "It is difficult to accept this (Corda's) interpre-"tation. Numerous observations upon these organs, some made "even before I was aware of Corda's hypothesis, lead me to quite "a different conclusion, and I consider these cystidia to be nothing "more than organs remitted to vegetative functions by a sort of "hypertrophy of the basidium. Corda asserts that impregnation is "effected by means of a viscous fluid issuing from these organs; but "if we remark that the instances of this sort of impregnation are "taken from fungi (*Ag. rutilus*, Schæff. *viscidus* Fr., *mucosus*, Bull.), "in which all the vegetative portions are viscous, or have a tendency "to become so in wet weather, we shall see nothing surprising in "the fact of one of their cells having the same property, and thus "becoming attached to the spores: on the contrary, we shall be "rather led to suppose that the cystidia are simple vegetative organs. "In the milky Mycenæ (*Ag. galopus*), which have the organs of "reproduction very different from those of the Lactarii, the cystidia "are identical with those of the Lactarii; in the division Pluteus "they are so like the basidia that but for their size they would be "taken for the latter; being divided at the apex into short horns "they even seem to have retained the sterigmata. In other cases "their form is like that of the cells of the parenchyna; in a new "Agaric (*Ag. sulcatus*, Dun,) I have observed the cystidia forming "small cylinders with a swollen spherical extremity, and this is pre-"cisely the form which the vegetative cells assume in the pileus and "gills. These observations have led me to consider these organs, "which are scattered over the gills, or frequently crowded near the

" margin, as basidia which have become hypertrophied and resumed " the character of vegetative organs, as one sees abnormally a carpel " become a leaf. We are thus brought back to Micheli's first con-" ception, who called them barren flowers, using the terms, however, " in a sense diametrically opposite to his. The cystidia seem to me to " fulfil, with regard to the gills, the same function as the ring does " with the pileus and stipes; these two organs send out prolonga-" tions which bind them together: the gills, organs of the same " nature and contiguous, have a tendency to send out prolongations " to bind one another together. A certain number of basidia obey-" ing this law elongate and are diverted from their primitive function, " but in like manner as the ring may be very much developed, or so " fugacious and rudimentary that its existence may be only just " ascertainable, and may seem to be altogether wanting; in like man-" ner the cystidia may be wanting, or may be so well-developed as to " be visible to the naked eye. In some cases they fulfil this function " of 'ties' so well that in separating the lamellæ of a partially " expanded specimen of *Ag. atramentarius*, Bull., the gills separate " into two longitudinal portions instead of the corresponding faces of " two different gills parting from one another. This phenomenon is " so apparent that Delile, who was ignorant of the cystidia, had " noted the existence of fibrous prolongations binding together the " gills of this Agaric."

In the "Botanische Zeitung" (Vol. xiv. p. 153), Hoffman noticed the occurrence of small corpuscles scattered about the mycelium of certain Agarics. They were said not to germinate, and to be like the spermatia of the Discomycetes and Lichens. They do not, however, appear to be male organs. Tulasne says of them:* "Fecunda si qua vis eis impertitur, saltem in sporis priusquam germinent sicuti docuerunt experimenta ad hoc instituta non exercetur; utrum vero mycelio recenti quodammodo prosint, hactenus prorsus ignoratur."

In the "Botanische Zeitung" for April 5th, 1861, (Vol. xix. p. 89), Dr. De Bary states that he has observed in *Peronospora 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 one-spored oogonia,

* Sel. Fung. Carp. Vol. i. p. 168.

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. He then describes the production of the outer membrane of the oospore of *P. alsinearum*, which is formed from the surrounding plasma within the oogonium.

Pringsheim's Jahrbücher für wissenschaftliche Botanik, Vol. ii., contains some observations by Hofmeister, with regard to what he considers indications of sexuality in *Tuber*. He noticed that the terminal cell of the delicate threads which surround the ascus in *Tuber*, and which appeared to him to spring from the stalk of the ascus, became firmly united to the outer membrane of the ascus itself. At the point of junction, and sometimes at other points also, he observed a depression in the membrane of the ascus; and he suggests the possibility of the terminal cell being, in fact, an antheridium. In the Selecta Fungorum Carpologia,* the MM. Tulasne, in noticing these observations of Hofmeister, say, "We "remember, whilst studying the Truffles, having often observed "very delicate filaments which adhered so pertinaciously to the asci "that it was difficult to detach them . . . . what these fila-"ments were, we did not then understand, we now agree with "Hofmeister in looking to *Saprolegnia*† for an explanation of the "phenomenon." De Bary, in his recent work—"Ueber die Fruchtentwickelung der Ascomyceten"—suggests doubts as to the sexual nature of the threads in *Tuber;* but although his doubts may be valid, his reasons for them have not been considered conclusive.‡

Further indications of sexuality have also been suggested by De Bary as occurring in *Erysiphe cichoracearum*, DC. In his work just mentioned—"Ueber die Fruchtentwickelung der Ascomyceten"—he traces the origin of the perithecium of *Erysiphe cichoracearum*,

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* Vol. i. p. 176, 177.

† As to *Saprolegnia*, see the latter part of this Report.

‡ See Nat. Hist. Rev. Vol. iv. p. 231.

DC., from its earliest state up to the formation of the single ascus and spores. In this process he notices two cells as being always present and visible from the earliest period, one of which he calls the "Ei-zelle," and the other the "Antheridium." The former afterwards divides, and the ascus is the result of this division. De Bary admits that the evidence of the sexuality of these organs is not strong. "However," he says, "it is certain that the cell by "the division of which the ascus and its coating are formed, only "develops itself when it has been in contact, and therefore probably "in some sort of intercommunication with the antheridium, which "latter organ is never wanting, is always of the same form and size, "and originates in the same manner." He adduces the Phænogams as showing that impregnation may take place by mere contact, and concludes that it may be assumed as very probable that the "Ei-zelle" is impregnated by the antheridium, and that the perithecium of *Erysiphe* (excepting the outer wall) is the product of sexual impregnation.

We are not aware of any other recent observations with regard to the sexuality of the Fungi; and we pass, therefore, to the consideration of the Algæ, in which family the greatest discoveries in relation to impregnation have been made.

Dr. Cohn, writing in the year 1855, says, "Until last year, few botanists believed in the sexuality of the Algæ;" and although this remark went rather too far, when we consider that Thuret's observations were made in the year 1845, it tends to show how little was known ten years ago in comparison with our present knowledge.

We will notice, in the first place, M. Thuret's observations on the Fucaceæ. It is to him that botanists are principally indebted for a knowledge of the facts relative to sexuality and fecundation in that tribe.* The organs of fructification of the Fucaceæ are enclosed in cavities under the epidermis of the frond, and which open on the surface of the latter by a little pore or ostiolum. These cavities contain two different kinds of organs. The one kind consists of large bodies of an oval form, and an olive colour, attached to the walls of the cavities by a short pedicel. These bodies are in some genera simple, in others are divided into two, four, or eight spores.

* See Comptes Rendus, t. xxvi. p. 745; Memoires de la Société des Sciences naturelles de Cherbourg, t. i. p. 161; Annales des Sc. Nat. 4 Ser. Vol. ii. p. 197, and Vol. vii. p. 35.

The other organs are small sacs inserted on the hairs which line the walls of the cavities. The sacs contain a number of hyaline corpuscles, enclosing a red granule, which, after their escape from the sac, move rapidly in the water by means of two vibratile cilia. Some Fucaceæ are diæcious, others hermaphrodite. For instance, *Fucus serratus*, L., *Fucus vesiculosus*, L., and *Fucus nodosus*, L. are diæcious, *Fucus platycarpus*, Thur., *Fucus canaliculatus*, L. and *Fucus tuberculatus*, Huds. are hermaphrodite. *Fucus vesiculosus*, L. is the species to which M. Thuret has devoted the most attention, and his account of his observations and experiments is shortly as follows :—An examination of the young female conceptacles of this species shows that the sporangia originate in small protuberances forming the wall of the cavity. These mamillæ, which are at first unicellular, become bi-cellular by the formation of a transverse septum, the upper one of the two cells thus formed becomes the sporangium, the lower one the pedicel. The dark coloured contents of the sporangium at length divide into eight segments, and by the rupture of the sporangium the divided body or "octospore," escapes, enclosed in a hyaline membrane (epispore) which keeps the eight segments closely pressed together. Within the epispore is another extremely delicate membrane extending over the octospore. By the dissolution of the upper portion of the octospore and the rupture of the delicate membrane just mentioned, the octospore becomes free, and separates into eight spherical spores which have no integument. Thus far the observations have reference to the female organs. The process which takes place in the male fronds is very similar. The small sacs or antheridia become detached from the walls of the conceptacle and escape in vast quantities through the orifice of the latter. Shortly after their escape they burst and emit swarms of spermatozoa, which move about in sea water with great rapidity, their motion lasting sometimes for upwards of two days.

When the spores and spermatozoa, are placed in water together, the latter attach themselves to the former in great numbers, and by means of their vibratile cilia communicate a motion of rotation sometimes extremely rapid.* After lasting for a time, but rarely

* M. Thuret does not consider this rotation to be of much importance, for although seen plainly enough under the microscope he thinks it never occurs in nature, and that it is in no way necessary for impregnation. The fact of its

more than half an hour, the rotation ceases: the motion of the spermatozoa lasts somewhat longer, but is less active, and they also eventually become quiescent.

After the spores have been in contact with the spermatozoa the former become clothed with a plainly visible membrane,* and shortly afterwards septa are formed and germination commences. Those spores which have not been in contact with spermatozoa remain unchanged for some days and ultimately decompose. Sometimes a membrane is formed over them, and a kind of imperfect germination commences, but this only lasts for a few days, after which the spores decay in the same way as those in which no membrane was formed.

Fucus serratus, L. and *Fucus nodosus*, L. (*Ozothallia vulgaris*, Dene and Thur.) yielded M. Thuret the same results, except that in the latter species the contents of the sporangium form four, not eight spores as in *F. vesiculosus.*

The intermixture of the spores of *F. nodosus* with the spermatozoa of *F. serratus* and *vesiculosus*, and of the spores of the two latter with the spermatozoa of the former yielded no results, although the spermatozoa attached themselves to the spores and produced the ordinary movement of rotation. Neither could the spores of *Himanthelia lorea* be impregnated by the spermatozoa of *Fucus nodosus* or *F. serratus.* The spores of *F. serratus*, could not be fertilized by the spermatozoa of *F. vesiculosus*, but strange to say, on the inverse operation, *i. e.*, when the spores of *F. vesiculosus* were mixed with the spermatozoa of *F. serratus*, the spores germinated. Upon these facts, M. Thuret observes, that *F. nodosus*, *Himanthelia lorea*, and *F. serratus*, are very constant in their form, whilst *F. vesiculosus* is extremely variable, and he thinks it not improbable that the great variability is owing to the facility with which the latter species is

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occurring when spores are examined under the microscope he explains by attributing it to the concentration of a much greater number of spermatozoa than could ever be found in the same space in nature. At the same time he considers the rotation as not altogther accidental, for he found that the spermatozoa of *Fucus* communicated no rotation to some spores of Florideæ, which were small enough, and round enough to have been easily set in motion, and as a matter of precaution in experiments he recommends the application of a sufficient number of spermatozoa, to render the rotation manifest.

* The formation of this membrane, is said to commence six or eight minutes after the contact of the spore with the spermatozoa. See *Deuxième note sur la fecondation des Fucacées.* A. S. N. 4. Ser. Vol. vii. p. 35.

hybridized by its congeners. *F. platycarpus* and *F. ceranoides* exhibit the same variability.

M. Thuret remarks, that he finds nothing to support the supposition of those observers who believe that the spermatozoa effect an entrance into the spore: he has always seen them on the surface, never within the substance of the spore.*

We have next to consider the division of the Chlorospermeæ or Zoosporeæ, in which very important results have been arrived at, principally from the observations of Dr. Pringsheim.

The plant upon which some of his earliest observations were made, was the well-known *Vaucheria sessilis*,† which from the simplicity of its structure offers peculiar facilities for observations of this nature. From the tubular filament of which this plant is composed, two papillæ in close proximity are produced. One of these becomes ultimately developed into a horn-like organ, more or less spirally twisted, in the middle of which, but at no very definite point, a septum is formed, cutting off the apex from the base. The other papilla forms a lateral protuberance, at first symmetrical, but which afterwards throws out a beak-like process (*rostrum*), on the side turned towards the horn. A septum is then formed at the base of this protuberance, cutting it off from the parent tube. After the formation of the septum in the hornlet, minute rod-like bodies are seen imbedded in its colourless mucous contents. In the meantime an internal layer of colourless substance, called by Pringsheim the cutaneous layer, increases to such an extent, especially in the fore-part of the rostrum, that at last the membrane of the latter is ruptured, and a portion of the cutaneous layer escapes.

Just at this period the horn opens at it apex, and the contents escape in the form of very minute rod-like corpuscles, which enter the orifice of the sporangium, and penetrate the portion of the cutaneous layer which remains. After this a membrane is formed around the contents of the sporangium (which were previously bare), and thus a *cell* is formed, which completely fills the sporangium—the embryonic cell of the plant. This embryonic cell, which is at first green, becomes colourless, with one or more dark-brown bodies

* See Ann. des Sc. Nat. Vol. vii. p. 43.

† A summary of these observations was given in the Quarterly Journal of Microscopical Science, Vol. iv. p 63, and 124.

On the same subject, see Schenk on *Vaucheria*, Würz. N. Z. Vol. ii. p. 201 and Nachtrag zur Kritik, &c. (Pringsheim) in "Jahrbücher für wiss. Bot." Vol. ii. p. 470.

in its interior. It then becomes detached from the parent plant by the decay of the membrane of the sporangium, and after some time suddenly resumes its green colour and grows into a young *Vaucheria*, exactly resembling the parent plant.

Before dismissing *Vaucheria*, we may mention that fifty years before Pringsheim's publication, Vaucher had suggested the sexual nature of the horns, which he considered to be the anthers of the plant through which the pollen was discharged.

Dr. Pringsheim's observations on *Vaucheria*, were shortly afterwards followed by those of Cohn upon *Sphæroplea annulina*.* This somewhat rare Conferva was found by Dr. Cohn, covering a field of potatoes which had been overflowed by the river Oder. It forms long filaments, composed of more or less elongated cellules placed end to end. The endochrome of some of these cellules becomes transformed into a number of small spherical bodies, consisting of a green substance, with some grains of starch. Each of these bodies is clothed with a delicate smooth layer of plastic matter, but not with a cellulose membrane. They are called by Cohn *primordial-spores*. During, or before the formation of these primordial-spores, the membrane of the cellules, in which they are contained has become perforated with minute apertures. At the same time the colour of the contents of other cellules of the same filament changes from green to a reddish-brown, and the contents themselves become transformed into an innumerable multitude of cylindrico-elongated corpuscles, which escape through small apertures in the membrane of the cellules. These corpuscles, which are in fact the spermatozoa of the plant, enter the cellules, which contain the primordial spores, by means of the apertures existing in the membrane of the latter cellules. One or two of the corpuscles attach themselves by their cilia and beak to the end of the primordial spores and remain attached, after which the latter speedily assume a true cellular membrane. Thus, as Dr. Cohn remarks, we distinguish in the component cellular tissue of *Sphæroplea* male cellules and female cellules, which may be called antheridia and sporangia, and we recognize the fact, that in the impregnation, if not of the Algæ generally, at least in that of the Fucaceæ, Vaucheriæ, and *Sphæroplea*, the one essential circumstance, viz. the direct contact of spermatozoids with a primordial cell as yet devoid of

* See Ann. des Sc. Nat. xx. 4, Ser. Vol. v. p. 188.

any investing membrane. There is also in *Sphæroplea*, the very remarkable fact, that whilst in *Fucus*, the unimpregnated spores are dispersed over the surface of their thallus where the spermatozoa must come in contact with them, and whilst in *Vaucheria* the orifice of the antheridium almost joins that of the sporangium, the *Sphæroplea* have to search out a female cellule, sufficiently developed, and often at a distance, and have then to effect an entrance through narrow apertures designed for the purpose. What the force may be which guides them to their destination, Dr. Cohn pronounces to be a veritable physiological enigma.

In *Œdogonium* and *Bulbochæte** impregnation is also effected by the action of spermatozoa upon the contents of the female cells or sporangia. The contents of these female cells (*Oogonia* of Pringsheim) shortly before impregnation part from the wall of the cell and become contracted into a globular mass, called by Pringsheim the "*Befruchtungskugel*," which is a membraneless rudimentary spore. An opening is formed in the wall of the oogonium, and the nature of this opening as well as the form of the rudimentary spore varies in different species. The simplest and most frequent opening is by a small oval hole in the membrane of the oogonium, formed at the same time as the rudimentary spore. The portion of the latter which adjoins the opening is covered with a colourless protoplasm, which projects as a papilla. The spermatozoon touches and becomes intermixed with the papilla, which then retracts itself into the oogonium and the impregnation of the spore is effected.

The most remarkable point in the impregnation of the Œdogenieæ is the different mode in which the spermatozoa originate in different species. In some species of *Œdogonium* they are produced directly from certain cells which are true antheridia—the antheridia and oogonia occurring in most cases upon separate plants, but in some instances upon the same plants. This is quite similar to what occurs in other Algæ. But in other species of *Œdogonium*, and in most, if not all, of *Bulbochæte*, the antheridia are produced by certain bodies to which M. Pringsheim has given the name of *androspores.* These androspores are produced in cells differing from the ordinary vegetative cells only in their small size. The androspores differ hardly at all from the ordinary zoospores of the plant except in being of smaller size, and after their escape from the parent cell they

* See Jahrbücher für wiss. Bot. Vol. i. p. 1.

swim about freely in the water. They are oval, nearly filled with a green substance, but having a transparent beak surrounded by cilia. After some time the androspores attach themselves by the beak to the oogonia, the cilia fall off, and they then commence a true vegetative growth and become transformed into an organ which produces spermatozoa. In some cases the cavity of the androspore gives immediate birth to two spermatozoa; in other cases a septum is formed dividing the androspore into two cells, the upper one of which produces two spermatozoa: in other cases again several septa are formed giving rise to several cells in each of which cells two spermatozoa are produced.*

The point to which we have alluded in speaking of the Fucaceæ—viz., whether impregnation is effected by contact merely, or whether the spermatozoa are absorbed in the rudimentary spore has been much discussed in the case of the Œdogonieæ. Pringsheim, De Bary, and Petrowski being ranged on the one side, and Vaupell on the other.

In the Jahrbücher für wissenschaftliche Botanik, Vol. ii. p. 1-36, Dr. Pringsheim gives the results of his observations on the genus *Coleochæte*. Here again we meet with oogonia and spermatozoa, the former being impregnated by the latter so that the sexuality of these plants also may be considered to be established.†

With regard to the nature of the Saprolegnieæ much difference of opinion has existed and still exists, some botanists considering them to belong to the Fungi, others to the Algæ. Mr. Berkeley's opinion (and none could be more valuable) was, and we believe still is, in favour of their being submerged conditions of mucedinous Fungi, but we think the majority of botanists still rank them as Algæ.‡ However this may be, the observations of Pringsheim and De Bary show that impregnation is effected by the operation of active spermatozoa upon membraneless "primordial spores," a process precisely analogous to what we have already stated to take place in *Fucus*, *Œdogonium*, and *Sphæroplea*. We have not space to enter into details with regard to the structure of the oogonia and antheridia, but it is worthy of remark that in all the three genera of the family—viz., *Saprolegnia*, *Achlya*, and *Pythium*, the spermatozoa reach the contents of the oogonia (*i.e.*, the so-called *primordial spore*)

* In *Œdogonium curvum*, Pr. it appears that only one spermatozoon is produced in each antheridial cell.

† On the peculiarity of the fructification of the Coleochæteæ and their relations to the Mosses and Characeæ, see the papers above cited, pp. 24-29.

‡ See Jahrb. für wiss. Bot. Vol. i., p. 284, Vol. ii. pp. 169 and 205.

by passing through holes in the membrane of the oogonium, a mode of access which we have already seen to occur in *Sphæroplea.*

We must not part with the Zoosporeæ without mentioning the observations of M. Cohn and Mr. H. J. Carter* on reproduction in the Volvocineæ. Although these two writers are at variance with regard to the monæcious or diæcious nature of *Volvox globator* (the species which has received the greatest amount of attention) there seems no reason to doubt that the sexual process corresponds exactly with that which has been observed in other Algæ—viz., That it consists in the impregnation by spermatozoa of a previously membraneless "primordial spore."

In the Florideæ the knowledge of the phenomena of impregnation is far less advanced than in the other two divisions. The organs of fructification are of three kinds, 1st, the tetraspores consisting of an oblong or globular external cell enclosing four spores, each of which is capable of germination and of reproducing the plant directly; 2nd, antheridia, containing corpuscles which have been regarded as spermatozoa, but the nature of which is as yet extremely doubtful.

It is stated in Mr. Berkeley's Introduction to Cryptogamic Botany, that the plants of this division produce antheridia filled with active spermatozoa; but although some observations to this effect have been recorded by Derbès and Solier, they have not been confirmed by other botanists. Dr. Pringsheim, at the meeting of German Naturalists at Bonn, in the year 1857 (a report of which is to be found in the Botanische Zeitung for 1857, p. 784), unhesitatingly denies the existence of spiral or motile filaments. Since that time Dr. Gustav Venturi has described† certain organs occurring in *Wrangelia penicillata*, *Polysiphonia elongata*, and *Callithamnion vesicolor*, which have the appearance of being antheridia. He did not, however, find true spermatozoa, although in *Callithamnion versicolor* the upper cells of the so-called antheridia contained minute cellules in which slight movements were observed, but which movements might possibly have been only molecular.

"Thirdly, besides the tetraspores and the so-called antheridia, the Florideæ produce spores grouped in definite masses, and usually, but

* See Annales Sc. Nat. 4 Ser., Vol. v. p. 323. Ann. and Mag. of Nat. Hist. Jan. 1859.

† See "Beobachtungen über die Fructifications-organe der Florideen." Wien Z. B. V. Vol. x. p. 583.

not always, enclosed in special cells or conceptacles. M. Pringsheim long since suggested* that these conceptacular spores, called cystocarps by Nägeli, are either true female sexual organs, or that they produce, like the spores of ferns, an organ which performs in some way the female sexual functions. It would seem, however, that he has since seen reasons for changing this opinion, for in the Botanische Zeitung (*loc. cit.*) he is reported to say that the conceptacular fruit does not differ essentially from the tetraspores; that it is, in fact, only a more divided form of the latter; that in *Ptilota plumosa* the transition from one to the other may be followed out; and that the spores often germinate within the capsule, in which case impregnation is out of the question. In a paper on the Ceramiaceæ in the Reports of the Bavarian Academy,† Nägeli has some observations on the nature of the fruit of the Florideæ. They occur in the course of some comments upon a proposed subdivision of the Order by J. Agardh, who separated two groups, viz. the Spyridieæ and the Wrangelieæ, on the ground of the different formation of their cystocarps. Nägeli says: "In most Florideæ both cystocarps and tetra-"spores are found; in some, however, the one or the other kind "of fruit is wanting. Their physiological import is still uncertain. "I have expressed the opinion that the tetraspores are the "female fruit, and that they are impregnated by the antheridia; "the cystocarps, on the other hand, are the asexual germs. Up "to this time, I find no reason to give up this opinion, and until "it is confirmed or set aside, it is for many reasons the most "probable. Irrespective of the striking resemblance between "the cystocarps, and the gemmæ and receptacles of the mosses "and liverworts, two points relative to the Ceramiaceæ may be "mentioned. In the first place, the tetraspores and the antheridia "are constant in their relative position, and therefore agree in their "morphological signification, whilst the cystocarps vary. The "second circumstance to be noted is the distribution of the three "reproductive organs upon different individuals. Triæciousness is "most usual, so that one plant bears only antheridia, another only "tetraspores, a third only cystocarps. Exceptionally, however,

* See Ann. des Sc. Nat. 4 Ser. Vol. iii. p. 376.

† Beiträge zur Morphologie und Systematik der Ceramiaceæ. Sitzungsberichte der konigl. Bayerischen Acad. der Wiss. zu München; Jahrgang 1861. Band ii. p. 297.

"tetraspores and cystocarps occur upon the same plant, as has been "seen by the MM. Crouan in a species of *Callithamnion;* antheridia "and cystocarps have been seen by Bornet upon *Lejolisia;* and "antheridia and cystocarps have also been seen by myself upon "*Callithamnion bipinnatum*, Crouan, and *Herpothamnion hermaphroditum*, Nägeli. These observations point to the fact that the Florideæ "are normally diæcious, and that the plants with cystocarps may "really be male and female individuals, in which, for the support of "the neutral organ, the formation of the sexual organs (antheridia "and tetraspores) has been suppressed.

"If my opinion as to the nature of the cystocarps is correct, "they might possibly be wanting in certain Florideæ, whilst the tetra-"spores must occur in all. It might be objected that there are "probably more Florideæ, in which the tetraspores are unknown than "in which the cystocarps are unknown. This, however, is not con-"clusive, inasmuch as the former are usually invisible to the naked "eye, whilst the latter are easily seen and collected. There are some "Ceramiaceæ very generally distributed, and occurring in places "where indefatigable algologists reside, in which tetraspores have "been found, but no cystocarps have yet been observed, e.g. *Rhodochorton Rothii* and *R. floridulum* and *Antithamnion cruciatum*."

The result at which Professor Nägeli arrives is that the cystocarps ought not, in the classification of the Cerämiaceæ, to be used even for subordinate divisions; and if he is right in his views they must be considered as asexual organs of very little importance. Whether botanists will accept this conclusion time alone can show. At present we can only say, as M. Vaillant has remarked in his recent work,* that the notions of botanists as to the Florideæ are very undefined, and that although the nature of their organs may lead to the supposition of sexuality, further observations are indispensable before the existence of male and female Florideæ can be looked upon as anything more than a vague supposition.

We must not close this report without referring to the disputed question as to the nature of the conjugation which takes place in the Zygnemaceæ and other allied Algæ. As far as we are aware it is not yet settled whether this conjugation is a sexual process. We cannot here discuss the point, and must refer those who are interested in the question to Dr. De Bary's Essay, "Untersuchungen über die

* "De la fecondation dans les Cryptogames," p. 53.

Familie der Conjugaten," and particularly to the second chapter "Ueber die Bedeutung der Copulation und ihre Verbreitung."

Note.

Since this report went to press we have seen a paper by Sollman in the Botanische Zeitung for September 2, 1864, in which that author professes to have discovered a true process of impregnation in *Nectria Lamyi*, De Not. Without venturing any opinion as to the correctness of his observations, we append the conclusions with which he sums them up. He says:—

1. *Nectria Lamyi* has a manifest mycelium, out of which the stroma is formed, and upon the latter the perithecia are developed.
2. The perithecia consist of three layers of cells. The innermost layer is the fructifying layer.
3. Upon this layer, in young perithecia, are situated the processes which bear the spermatia, and which, after the spermatia are separated from them, become developed into paraphyses.
4. The spermatia penetrate the fructifying layer, and reach the cavity of the rudimentary asci, which are in process of development.
5. In the double-walled asci eight cytoblasts originate, into which the spermatia penetrate and amalgamate with their contents, so as to form a uniform mass.
6. After the penetration of the spermatia the cytoblast assumes a visible smooth membrane, and becomes a spore capable of reproducing the plant.
7. The species of *Nectria* are hermaphrodite.
8. The bodies supposed to be granules of protoplasm in the young asci of Sphæriæ, are the particles of disintegrated spermatia.
9. They effect the impregnation of the spores.

Original Articles.

X.—On the Dentition of Hyæna spelæa, and its varieties, with Notes on the recent Species. By W. Boyd Dawkins, B.A. Oxon. F.G.S. Geological Survey of Great Britain.

In the course of the determination of the vast quantity of organic remains from Wookey Hole Hyæna-den,* upwards of 200 jaws and 500 teeth of *Hyæna spelæa* of all ages, and showing considerable variations from the typical form, passed through my hands. My only excuse for adding the following notes about them, to a literature already so bulky, is that they clear up some of the doubtful points in the researches of MM. Croizet and Jobert, Marcel de Serres, De Blainville, and others, relative to the value of certain differences assumed to be specific in the milk and permanent dentition of the Spelæan Hyæna. Before, however, I can enter upon these, I must briefly run over the differences which obtain in the dentition of the three existing species of the Genus.

§ 1. The genus *Hyæna* is characterized by a dental formula, intermediate between the Canidæ on the one hand, and the Felidæ on the other, the deciduous series consisting of $\frac{\text{I. 3. C. 1. Dm. 3.}}{\text{I. 3. C. 1. Dm. 3.}}$, and the permanent of $\frac{\text{I. 3. C. 1. Pm. 4. M. 1.}}{\text{I. 3. C. 1. Pm. 3. M. 1.}}$

A. Of the three species into which it is divided, the most common, ranging through North Africa, Asia Minor, Arabia and Persia, and extending down to the Cape, *H. striata,* Zimmer. (*H. vulgaris,* Cuv.),

* See two papers by the Author. Quart. Journal Geol. vol. xvii. p. 115. vol. xix. p. 260.

differs from the other two in the small size of its teeth. In the upper jaw, Premolar 2 is characterized by the presence of the anterior accessory cusp, and by the large development of the posterior one; Premolar 3, by the presence of both these, which are absent or rudimentary in the other two species; Premolar 4, by the division of its sectorial edge into three subequal lobes. But the oblong transverse tubercular upper true molar exhibits the maximum differences, in its implantation by three fangs. According to M. De Blainville,* it possesses but one fang ("na' qu'une racine"), on the authority of Frederic Cuvier† ("elle a plus de deux racines") more than two, while all those that I have examined in the British, Hunterian, and Oxford Museums, without exception, possess three, situated very nearly in the same transverse line. Its crown is composed of three tubercles, inter-connected by a ridge, the stouter on the inner side, and each supported by a fang.

In the lower jaw, the accessory cusps are much more strongly marked in the Premolar series, than in the other species, while the true molar exhibits considerable differences of size and form. The tubercular portion is developed largely at the expense of the carnassial, the blades of which are subequal in antero-posterior extent. On the inner side, and springing from the posterior of these, is a stout cusp or tubercle, the analogue of that in the Canidæ.

B. The dentition of the species which comes next to the former, *H. brunnea*, Thunberg — (*H. fusca* of Geoffroy, *Crocuta brunnea*, Gray, *H. villosa*, Smith), offers very considerable points of difference, the principal of which are the large development of the posterior lobe of the upper sectorial, and the small size and triangular form of the upper true molar. The latter, in its implantation, also differs from the preceding species. In the Royal College of Surgeons (Hunt. Cat. 4447), and in the British Museum (822 B. Gray's Cat.) it is supported by two fangs, while in a second specimen in the latter Museum (822 A. Gray's Cat.) it possesses but one.

In the carnassial of the lower jaw, the posterior blade is longer in antero-posterior extent than the anterior; the cusp springing from its inner base is reduced to a minimum, and the tubercular portion is very feebly developed.

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* Osteographie, Article Hyena, p. 27.
† Oss. Foss. tom. iv. p. 236, 4to. 1823.

In the premolars of both upper and lower jaw, the principal cones are developed at the expense of the accessory ones.

C. The third species, *H. crocuta*, Bodd. (*Crocuta maculata*, Gray, *H. Capensis*, Desm.) ranging through South Africa, the Guinea Coast, and Senegal, is very closely allied to the preceding in its dentition, so closely indeed, that Professor Owen has entered a skull of the former in the Hunterian catalogue (No. 4447), as belonging to the latter. In the specimens in the British Museum, the basal ridge on the inner side of the upper Premolar 2, and the lower Premolars 3, 4, is more strongly developed than in *H. brunnea*. But the most important characteristic is the absence of all trace of the cusp at the inner and posterior base of the lower carnassial. The tubercular portion of the latter, reduced to a small talon, is divided by a slight ridge into two portions of which the exterior is the smaller.

On the authority of M. De Blainville,* the upper true molar is very small and subtriangular, and, according to Professor Owen,† is implanted by two fangs.

§ 2. Having thus noted the differences which obtain in the three recent species of Hyenas, we are now in a position to turn to the analysis of the Fossil species. So far back as the year 1839, the fact that the *H. striata*, or more dog-like of the existing hyenas, was represented in the bone caverns of France, was proved by the discovery of *H. prisca* by Marcel de Serres,‡ in the caverns of Lunel-Viel. Nine years after this, the existence of the second or intermediate species *H. brunnea* in Auvergne, was shown by the labours of §MM. Croizet and Jobert, in the discovery of *H. Arvernensis*. Irrespective of size, the differences between the recent and the fossil species, in each of the above cases, would by no means warrant a specific distinction. M. De Blainville refers both these to *H. striata*, or the Striped Hyena, including *H. brunnea* also under the name of *H. fusca* in the same species. And, lastly, we owe to our great explorer of caves, Dr. Buckland,|| the proof that the third or most Feline of the recent species, *H. crocuta*, was

* Osteographie, Art. Hyena, p. 29.

† Brit. Foss. Mam. 8vo. 1840, p. 150.

‡ Recherches sur les Oss. humatiles des Cavernes de Lunel-Viel, par Marcel de Serres, Dubrueil et Jeanjean, 4to. 1839.

§ Recherches sur les Ossemens Fossiles du Puy de Dôme, 4to. 1484, p. 198, pl. 1. fig. 4.

|| Reliquiæ Diluvianæ, 4to. 1824.

represented in the caverns of France, Germany, and England, by the Spelæan Hyena.

Of the relation of *H. Monspessulana* of Christol, to *H. prisca*, and of *H. Eximia*, mentioned by M. Gaudry (Bul. Soc. Geol. de France, 1862-3, 2 Series, tom. 20, p. 404), to *H. brunnea* and *H. Arvernensis*, we can say nothing.

The equivocal premolar found in Auvergne, upon which the provisional species *H. dubia** (Croizet and Jobert) is based, and that found in the Red Crag of Suffolk, and described by Mr. Lankester under the name of *H. antiqua*,† differ to such an extent from any known or extinct species, and bear such an exceptional character, that we must wait for further evidence before discussing their merits.

The fossil species which now remain to be discussed, are the *H. intermedia*‡ of Marcel de Serres, and the §*H. Perreri* of MM. Croizet and Jobert. And as the question of their validity as species is most essentially connected with the accurate definition of the dental characteristics of *H. spelæa*, it will be more convenient to treat of them along with the latter.

§ 3. A. The following notes upon the deciduous dentition of *H. spelæa*, are based upon an examination of two upper jaws in the British Museum, and two in my own possession, and of five lower jaws and numerous isolated teeth. The pair of jaws figured (fig. 1 & 2), containing the entire unworn milk molar series, were obtained by Mr. Ayshford Sanford, F.G.S. and myself in Wookey Hole Hyena-den in our further exploration of 1863. They were lying imbedded in the red earth, with which the cavern was filled, within a few feet of each other, at the point where the passage B. joins the Antrum in the ground plan given in the Quarterly Geological Journal,|| and close to a mass of breccia, containing fragments of calcined bone and one roughly chipped splinter of greensand chert. Their state of preservation shows that they belonged to the same individual, which probably, from the teeth marks on the lower jaw, fell a prey to some of its older and more powerful fellows. The fragments of album græcum which fill up the alveolus of the lower true molar, prove also that the jaw was lying on the coprolite covered floor of the cave for some time previous to its being imbedded.

* Op. cit. p. 181. pl. 2. fig. 4.
† Annals and Magazine of Natural History, Series 3, vol. xiii. No. 73.
‡ Op. cit. p. 88.
§ Op. cit. p. 173, pl. 1, fig. 12. pl. 11, fig. 3.
|| Vol. xix. p. 261.

Dm. 1. (See fig. 1. & 2.) The first milk molar of the upper jaw presents a trenchant conical crown traversed by a slight ridge, that

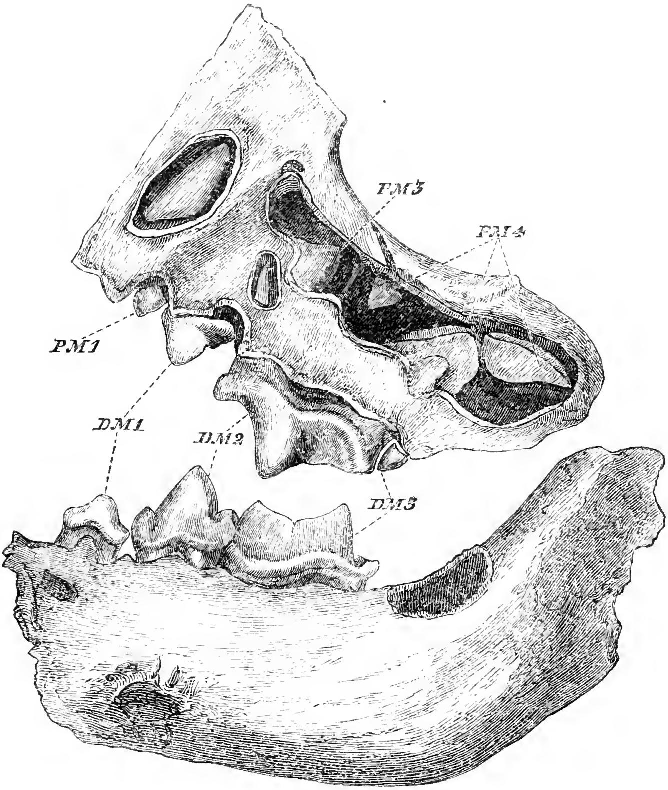

Fig. 1.

divides the latter into two equal halves. Anteriorly at its junction with the cingulum it is slightly thickened. On the posterior aspect of the crown, which, as in the Canidæ, is longer than the anterior, is a well defined notch marking off a small cusp. The cingulum is more strongly marked behind than before, and in the British Museum specimens is also largely developed on the inner side. The crown is supported by two cylindrical divergent fangs, and is implanted obliquely in the jaw, to admit of the crowding of the small Premolar 1 into the alveolar border.

Dm. 2. The second milk molar, as is usual in the carnivora, consists of a sectorial and tubercular portion. Anteriorly are two small trihedral cusps, situated obliquely and separated from each other by

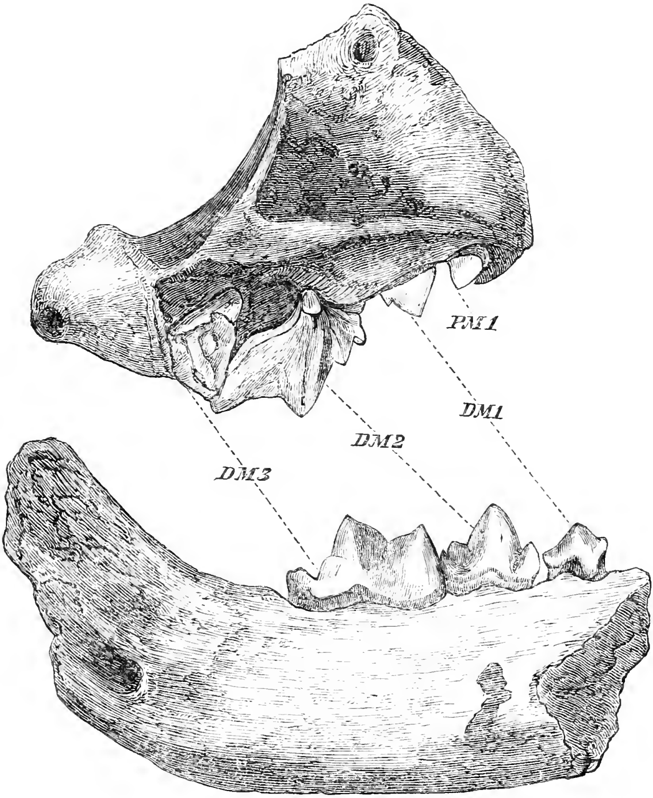

Fig. 2.

a notch (fig. 2). The outer of these is separated from the anterior blade by a slight depression, the inner by a cleft. The anterior recurved blade is the higher. Its trenchant edge shorter than that of the posterior, offers a point of contrast with the corresponding portion of its homologue in *H. striata*, where the trenchant edges are of both blades subequal. A small obtusely pointed cusp, the "inner tubercle" of Prof. Owen, is developed from the middle of the inner base of the anterior blade, as in the representative tooth (*Pm.* 4) of the Cats, Dogs, Civets, Gluttons, and Zorillas, and extends a considerable distance inwards. A faint ridge passes from the summit of the anterior blade to the interspace between the inner of the two above-mentioned cusps and the inner tubercle. The anterior portion of the crown is supported by a small cylindrical, the inner tubercle by a small incurved fang, oval in section, and lastly the posterior portion by a broad stout fang.

Dm. 3. The tubercular molar is remarkable for its size and striking resemblance to its homologue in *H. striata*. The crown, trihedral in form, with the long base on the anterior aspect, bears on its surface a stout ridge inter-connecting its three angles together. In a specimen from Brixham there is a stout cusp at each angle of the crown, while in that figured (fig. 2) it is only feebly developed in the interior angle, and entirely absent from the exterior. As in the homologous tooth of *H. striata*, each angle of the crown is supported by a divergent fang, of which the inner is by far the stouter and longer.

Dr. Buckland (Reliquiæ Diluv. 4to. 1820, pl. vi. fig. 26—27), and Cuvier (Ossemens Foss. 4to. pl. 30, fig. 14), figure the isolated tooth. In size, form and implantation, it agrees with M. de Blainville's description and figure of its homologue in *H. crocuta*.*

Dm. 1. The first tooth of the lower milk series is trenchant, conical, and slightly incurved. Its anterior base narrower than the posterior, bears a small cusp, while the posterior generally exhibits a slight thickening without the cusp. Sometimes, however, the accessory cusp is developed behind and suppressed before. The crown is supported by two fangs, cylindrical and divaricant, the posterior being by far the stouter.

Dm. 2. The second lower milk molar consists of a median trenchant cone and two trenchant accessory cusps divided from it by a cleft. On the inner and posterior side of the posterior accessory cusp is a small ridge that sometimes bears a row of small tubercles. The posterior portion of the tooth overlaps the anterior of the succeeding molar, in the alveolar border. The fangs are two in number, divergent, cylindrical, and subequal.

Dm. 3. The third, or the sectorial milk molar, presents a highly carnassial form. The trenchant edges of the two blades are divided

* Osteogr. Art. Hyena, p. 30, Pl. vi. "Elle à en effet trois racines divergentes, une pour chaque angle de la couronne trilobée qui représente assez bien un triangle rectangle à bords excavés."

from each other by a deep cleft, beneath which, on the inner side, is a broad and shallow depression. The posterior blade is the larger and in this point contrasts with the homologue in *H. striata*, in which species they are subequal. Its posterior aspect is traversed by a descending ridge, which, more or less notched immediately above its junction with the tubercular portion of the tooth, offers a rudiment of the accessory cusp so strongly developed in the representative molar 1 of *H. striata.* The tubercular portion is large and well developed, consisting generally, as in the jaw figured, of three small subequal cusps placed transversely and separated from the posterior blade by a broad smooth area. It is, however, subject to considerable variations in size and form, sometimes as in one on the table as I write (fig. 3), all three cusps are suppressed, and the ridge which

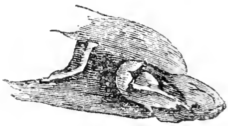

FIG. 3.

takes their place is cleft posteriorly, giving the tubercular portion a slightly bilobed appearance. In fig. 21, Pl. vi. of the Reliquiæ Diluvianæ, the latter appears to be the result of the development of the two lateral at the expense of the median cusp. This characteristic is deemed by MM. Croizet and Jobert of specific value, and to have belonged to a species which coexisted with the Spelæan Hyæna in Auvergne, and which they term *H. Perrieri.** Whether or no this difference be sufficient to map off a distinct species, will be discussed in the description of its permanent analogue, in which it also is present in three specimens from Wookey Hole Hyena-den.

The annexed table of measurements, taken at the base of each tooth, in decimals of an inch, gives the relative size of the milk series of the Spelæan Hyena, as compared with that of *H. striata.*

The antero-posterior extent of the milk series of the upper jaws, in *H. striata* is 1·52 inches, in *H. spelæa* given below, 1·53, in that figured 1·57, while that of the lower jaw measures respectively, 1·62, 1·86, and 1·63 inches.

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* Op. cit. p. 174.

Comparative Measurements of Milk Teeth.

	Upper. Dm. 1.	2.	3.	Lower. Dm. 1.	2.	3.
H. striata. British Museum.						
1. Antero-posterior extent . .	0·53	0·85	0·32	0·46	0·62	0·7
2. Transverse extent . . .	.	0·51	0·47	0·19	0·25	0·25
3. Vertical Height . . .	0·3	0·41	.	0 24	0·4	0·4
H. spelæa. British Museum. 37164.						
1.	0·46	0·85	0·3	0·3	0·58	0·85
2.	0·25	0·5	0·46	0·22	0·25	0·26
H. spelæa. Figured.						
1.	0·46	0·9	0·32	0·36	0·54	0·7
2.	.	0·5	0·55	0·22	0·23	0·26
3.	0·29	0·45	.	0·22	0·35	0·35

Succession. In the upper jaw figured above, (fig. 1, 2,) immediately in front of Dm. 1, is a small conical tooth, almost equally far advanced in growth. This is the small conical one-fanged Premolar 1, which appears in the alveolar border, while the other premolars and the canine exist as mere germs buried deeply in their alveolar cavities, and while the milk series are unworn. The small calcified cap of enamel, which is to compose the crown of Premolar 2, lies hid deep in the jaw at the point where the palatal process joins the maxillary, very much to the inner side of the Dm. 1, which it is to displace. The large conical cap of enamel, on the other hand, which represents Premolar 3, is situated immediately underneath the anterior portion of Dm. 3, which it displaces at the same time that the anterior portion of the permanent sectorial displaces the posterior half. The posterior blade displaces the third and last milk molar at nearly the same time that Dm. 2 is shed.

Coincident with the appearance of Premolar 4 on the alveolar border in the lower jaw, is that of the Canine, Dm. 1 and 2, remaining a little later, and being pushed out nearly at the same time. The lower sectorial makes its appearance very early, while the milk series is in place, and worn but little.

The teeth first to disappear in the adult hyena are—as one would expect—the large bone crushers, Premolars 2 and 3 of the upper, 3 and 4 of the lower jaw. These are always very much worn in the middle aged adult, while the upper Premolar 1, and the lower Promolar 2, exhibit scarcely any trace of wear.

§ 3. D. In the permanent dentition the crowns of the Incisors one and two of the upper jaw are divided into two cusps by a deep transverse groove, the larger anterior, the smaller posterior. The latter of these also is bisected by a groove running parallel to the median line. On the outer side of the anterior aspect is a slight ascending ridge which is more marked in Incisor 2. The fangs are very much compressed, and have square bases. Incisor 3, in its stout caniniform shape and rounded fang, contrasts strongly with the rest. The crown is composed of a stout recurved cone traversed on the anterior and inner side by a trenchant ridge, that, after sweeping round the inner base, reascends the crown on the outer and posterior side. The area circumscribed by it is very nearly one half of the crown. The upper canine is differentiated from the lower by the absence of the lateral curvature of the fang. Its crown is untraversed by the longitudinal grooves so constant in the canines of the Felidæ.

Of the Premolars the crown of the small mono-fanged first, is obtusely pointed, incurved and traversed by a ridge; the cingulum is very pronounced on the inner side. That of the second is composed of a stout obtusely pointed cone, surrounded on every side but the posterior by a stout cingulum, very marked on the anterior and inner aspects. At its inner base are two small pits of greater or less depth, and posteriorly is a small secondary cone, the feeble representative of that in H. striata. It is traversed by an ascending ridge, and supported by two cylindrical incurved fangs.

Premolar 3, by far the stoutest of the conical premolars, is composed of a stout cone incurved and slightly inclined backwards, supported by two incurved divaricant fangs. On the anterior and inner side is a stout ascending ridge, that with its fellow of the posterior side includes an area equal to one third of the tooth. Anteriorly the cingulum is thickened and presents a talon-like form : posteriorly, also largely developed, it sometimes bears a small trenchant cusp, as that figured in the Ossemens Fossiles.* The fourth premolar, or the upper carnassial, consists of two portions ; the cuspid anteriorly and the sectorial posteriorly, the former playing on the interspace between the lower molar and the lower premolar four, the latter playing scissor-fashion on the corresponding portion of the lower molar. On the inner side of the exterior stout conical cusp, which is much lower than the anterior blade, is the inner tubercle of Professor Owen. Each portion of the crown is supported by a fang, the two

* Tom. cit. Pl. XXX. Fig. 12.

blades by one broad triangular in outline, the anterior cusp and the inner tubercle, each by a cylindrical incurved one, that of the former being the smaller. The posterior blade is almost equal in antero-posterior extent to the anterior cusp and the anterior blade, and according to Cuvier* is sometimes larger than in *H. crocuta.* The blades are separated from each other by a deep cleft.

In the same transverse line with the posterior blade, and on the inner side is the upper true molar. In the two specimens which have passed through my hands from Wookey Hole, it is very small, equi-lateral-triangular, and supported by two fangs of which the anterior and outer is by far the smaller. The posterior, supporting the two posterior angles, is enclosed in an alveolus with very delicate walls, which would soon disappear by absorption after the loss of the tooth. M. De Blainville,† describes one tooth as perfectly round, and supported by one conical fang ("portée sur un racine unique, conique"); and then proceeds to cite the rounded form of the crown, as differentiating the Spelæan Hyena from the recent *H. crocuta,* in which it is nearly triangular (subtriquètre). Professor Owen, following his lead, infers from the presence of one alveolus only in the specimens that have passed through his hands, that the tooth in question is supported by one fang only, and then proceeds to quote this as additional evidence in favour of the specific difference between the two.‡ On a careful examination of the skull of the Lawford Hyena in the Bucklandian Collection, brought forward in evidence of the one-fanged true molar, I failed to detect the least trace either of it or its alveolus, on either side.§ The latter has been entirely obliterated by absorption. That, however, the true molar of Spelæan Hyena was sometimes supported by one fang only is proved not only by fig. 57 in the Fossil Mammals, the history of which is not given, but by a beautiful upper jaw in the Williams Collection at Taunton in which the alveolus is preserved. It is clear, therefore, that the upper true molar of the Spelæan Hyena was sometimes one—at others bi-

* Op. cit. p. 399. † Op. cit. p. 42.

‡ Foss. Mam. p. 150. Fig. 57. 8vo. 1846.

§ Professor Owen, (Op. cit. p. 149) indeed, seems to have laboured under some mistake when he says: "The socket of the small tubercular or fifth molar tooth is preserved on each side of this rare and beautiful cranium (the Lawford skull), illustrating the character first observed by M. De Blainville in a fragment of the upper jaw of a *Hyæna spelæa* from a continental locality, now in the Parisian Museum; viz. the small size and rounded form of the fifth or tubercular molar." Is it possible to infer the form of the crown, from the shape of the alveolus?

fanged. That this implantation by one or two fangs, putting out of the question the evidence of the two specimens from Wookey Hole, is of little zoological value, is proved by the two skulls of *H. brunnea* in the British Museum, 822, A. B., in the former of which the last molar is supported by one, in the latter by two fangs. It is, therefore, evident that neither the roundness of crown quoted by M. De Blainville, nor the implantation by one fang, according to Professor Owen, can be cited in favour of the specific distinctness of the fossil cave Hyena from the recent *H. crocuta*.

§ 3. E. The incisors of the lower jaw, smaller than those of the upper, progressively increase in size from the first to the third. Their recurved crowns are slightly hollowed behind, and bear a V-shaped furrow immediately above the V-shaped cingulum circumscribing the posterior base. In I. 2 and 3 the furrow passes over the ascending trenchant edge of the tooth on the outer side, insulating a small cusp. The fangs are straight and thicker anteriorly than posteriorly, and traversed by a broad groove on the inner and outer sides.

The lower canine, stout, conical and slightly recurved, is characterized by the stoutness of the cingulum and of the two ascending ridges that divide the inner from the outer portion of the crown, and by the absence of the longitudinal grooves so constant in its Feline homologues. Its fang is twisted slightly outwards to admit of the implantation of the succeeding tooth.

The crown of Premolar 2, separated by a short diastema from the canine, is composed of a stout obtusely pointed incurved cone, springing from above a very stout cingulum, and divided into two subequal halves by two ascending trenchant ridges. Posteriorly a small cleft divides it from the small posterior accessory cusp. Anteriorly also, in some cases, a small cleft maps off a rudimentary cusp, the homologue of that so fully developed in the Striped Hyena. Of its two fangs the anterior has its tip suddenly reflected by the growth of the fang of the canine, the posterior is the larger.

In Premolar 3 the crown consists of a stout cone pointing backwards, and divided into two subequal halves by an anterior and posterior ascending ridge. Posteriorly the cingulum is very stout and bears a small cusp, the homologue of that which in the next succeeding tooth is largely developed. It is thickened also anteriorly. The two cylindrical fangs are slightly recurved, and the anterior is slightly the longer.

The crown of Premolar 4, consists of a principal cone bisected by trenchant ridges and mapped off from the two accessory cusps by a cleft. Of the latter the posterior is by far the larger. On the inner and posterior side is a broad excavation bounded posteriorly by a ridge. The anterior of the two straight cylindrical fangs is slightly the longer, the posterior is bevelled as it approaches the cervix of the tooth to admit of the close apposition of the true molar on the inner side.

In the lower true molar (M. 1.) the sectorial portion of the crown is largely increased at the expense of the tubercular, which is proportionally diminished. The anterior blade of the unworn tooth is by far the largest. A slight ridge traverses its anterior base, and is more pronounced on the outer than the inner side. On the posterior aspect of the tooth a ridge descends down to the inner side of the tubercular portion. This latter rising but little above the level of the cingulum is variable in form and size to such a degree that its variations have been deemed by eminent French Palæontologists of specific value. So far as it is concerned the 18 jaws upon the table before me as I write, fall into three groups. In the first, represented by 8 jaws, its surface is traversed by a ridge which passes obliquely from the posterior border to the descending ridge of the posterior blade from which it is separated by a small cleft. The faint ridge bearing small tubercles on the summit of the cingulum is not cleft behind, nor is there any trace of a cusp at the inner and posterior base of the posterior blade. This is the form most common in the jaws of the Spelæan Hyena, and is that which MM. Croizet, Jobert, Marcel de Serres, Dubrueil and Jeanjean have considered strictly typical. In the three jaws representing the second group, the ridge on the tubercular portion is still present, stout in two, scarcely marked in the third. At the point, however, where it joins the descending ridge of the posterior blade, is a small well defined cusp, separated by a cleft in one, by a notch in the remaining two, from the blade (fig. 4 & 5). This is the form which Marcel de Serres, Dubrueil and Jeanjean have named *Hyæna intermedia*,* and considered representative of *H. brunnea*. M. De Blainville† has met with this form in a jaw from a foreign locality in the Jardin des Plantes, and in a second from Kent's Hole. And lastly, two jaws are characterized by the development of a stout cusp on the inner side of the tubercular portion, which, together with the ridge, give it a

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* Tom. cit. p. 88. † Tom. cit. p. 40.

bilobed form (fig. 6), the depression occupying the position that the ridge more usually occupies. In neither is there the slightest trace

Fig. 4.

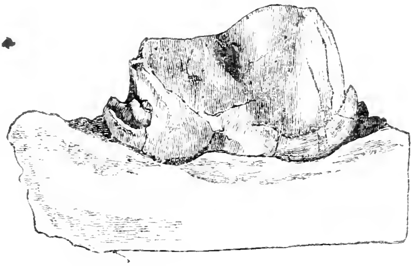

Fig. 5.

of a cusp at the inner base of the posterior blade. This, repeated also in the milk dentition as described above, according to MM.

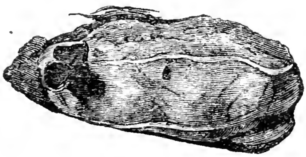

Fig. 6.

Croizet and Jobert, is characteristic of *Hyæna Perrieri.** Of the remaining jaws which make up the 18, two are allied to the second group by the small cusp at the base of the posterior blade, and two to the third by the faint division into two lobes of the tubercular surface. One, now in the cabinet of the Rev. H. H. Winwood, F.G.S., in the bilobation of the tubercular portion and the develop-

* Tom. cit. Pl. 2. Fig. 3. p. 176.

ment of the cusp on the inner side, unites the characteristics of both the second and third groups—in other words of *H. intermedia* and *H. Perrieri.* It appears to me, therefore, conclusive, that these differences must be looked upon as variations merely from the typical form of the lower molar of *Hyæna spelæa*, and by no means of specific value ; and this view is corroborated by the exact correspondence in the form and proportions of the other teeth of the jaws in which these abnormal differences occur, with those of the Spelæan Hyena. Along with M. De Blainville,* therefore, though not on the same grounds, I cannot admit the validity as species of either *H. Perrieri* of Croizet and Jobert, or of *H. intermedia* of M. de Serres.

§. IV. But on the other hand it may fairly be asked, "Is not the presence of the small cusp at the inner base of the posterior blade of the lower molar, evidence that the *Hyena brunnea* co-existed in the caverns with the Spelæan Hyena ?" It is perfectly true that the above characteristic is now confined to *H. brunnea* alone of the existing species : but the series of jaws mentioned above, proves that the fossil Hyena was subject to a considerable number of variations—" un assez bon nombre de variations qui etablissent des nuances intermediaires"† —some of which point in the direction of the *H. brunnea* of Thunberg, without, in my opinion, actually indicating that species. Just in proportion as our knowledge increases of any group of animals so do the lines of demarcation between the species become more and more faint. Nature has every where worked 'catenatim haud seriatim,' to the great confusion of systematists. If, for example, we turn to the Carnivora, one of the best defined of natural groups, we find that the various genera overlap, or if we take a particular genus—the Bears—we find that in the recent as in the fossil state they present variations almost infinite with reference to the dentition. The fossil species (*Ursi arctos, arctoideus, priscus* and *spelæus*) shade off into one another, and present a series of lower jaws, in the Museums of Taunton, Oxford, Leeds, and especially in the British Museum, offering every variation in size, in the form of the teeth, in the shape of the coronoid process, the angle and the condyle. Thus *H. spelæa* does not stand alone in its variations from the more usual form : and as these have been traced step by step to the form confined now to *H. brunnea*, I cannot but conclude that this also is a variety only

* Op. cit p. 45. and 48.
† De Blainville, Osteographie, Art. Hyena, p. 40.

of the Spelæan Hyena. It is just possible, that as now the Brown and Spotted Hyena are found side by side with the living Hippopotamus in South Africa, so both may have been associated with *Hippopotamus major*, in the Fauna of the Newer Pliocene, in Britain; but the balance of evidence preponderates in favour of the latter species only and its varieties. In a word the whole question hinges upon this point,—Is *H. brunnea* specifically distinct from, or merely a variety of *H. crocuta?*—a point which as yet has not been placed beyond all doubt.*

§. V. In systematic arrangement the Spelæan Hyena may be divided into two varieties;—*α* being the *H. intermedia* of Marcel de Serres, *β* the *H. Perrieri* of MM. Croizet and Jobert; the former of which points towards *H. brunnea.* In the preceding remarks I have attempted to prove that the apparent differences between it and *H. crocuta*, so far as relate to the dental series, do not obtain in every case, but are merely accidents of no specific value. And after a careful comparison of a very large series of remains, representing all the hard parts of the fossil hyena, I can detect no greater differences between it and the *H. crocuta*, than between the Wolf of the caves, and that now living in Europe, or between the fossil and the recent Reindeer. It is indeed to a careful search for minute distinctions between recent and fossil animals, originating in the main from the idea that the present order of things is separated from the past by some great catastrophe, that we owe a great many of our so-called fossil species. Now that Archæology is creating a kingdom for itself, in the border land between the Historical Period and that of the Newer Pliocene, it is most essential that the true relation of the fossil to the recent species should be fully realized. In this particular case the name *H. spelæa* (Goldfuss) is retained, merely as representing that section of the existing *H. crocuta* which inhabited Europe in the Newer Pliocene times.

§. VI. The following table of measurements, taken at the base of the teeth in inches and tenths, shows at a glance the relative size of the teeth of the recent and Spelæan Hyenas. It may be compared with those given by Cuvier, Deslonghamps, Croizet and Jobert, and Dr. Schmerling.

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* Van Der Hoeven (Handbook of Zoology, 8vo. vol. ii. p. 705, translated by Dr. Clarke) gives references to the literature of the recent Hyenas. I have adopted his views with reference to their classification.

Species.	Upper Jaw.								Lower Jaw.								Antero-posterior Extent of Molar Series.	
	I 1.	I 2.	I 3.	C.	Pm.1.	2.	3.	4.	I 1.	.2.	3.	C.	Pm.2.	3.	4.	M 1.	Upper.	Lower.
H. striata (British Museum) . .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2·8	2·8
1. Antero-posterior extent .	0·22	0·25	0·38	0·6	0·25	0·7	0·85	1·17	.	.		0·6	0·58	0·78	0 88	0 85		
2. Transverse ditto . . .	.	.	.	.	0 24	0·4	0·5	0·72	.	.	.	.	0·33	0 48	0·48	0·43		
H. brunnea (822 A. Gray's Cat.) .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3·15	3·2
1	0·3	0·34	0·48	0·74	0·3	0·65	0·95	1·4	0·22	0·33	0 35	0·65	0·68	0·9	0·9	1·16		
2	.	.	.	.	0·28	0·75	0·68	0 8	.	.	.	.	0·4	0·6	0·5	0·48		
H. crocuta (1232. Gray's Cat) .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3·2	3·2
1	.	.	.	.	0·28	0·5	0·75	1·4	.	.	.	.	0·52	0·8	0·82	1·1		
2	.	.	.	.	0·25	0·4	0·55	0·8	.	.	.	.	0·35	0·52	0·47	0·42		
H. spelæa. Maximum (Wookey) .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4 0	3·8
1	0·41	0·45	0·59	0·75	0·36	0·75	0·98	1·65	0·26	0·34	0·4	0 65	0·7	0·91	1·05	1.25		
2	.	.	.	.	0·35	0·55	0·68	0·93	.	.	.	.	0 51	0·72	0·62	0·52		
H. spelæa. Minimum (Wookey) .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3·85	3·5
1	.	.	.	.	0·35	0·67	0·96	1·5	.	.	.	.	0 6	0·91	0·86	1·15		
2	.	.	.	.	0·3	0·53	0·79	0·9	.	.	.	.	0·48	0·72	0·58	0·52		

XI.—Sketch of the primary Groups of Batrachia salientia. By Edward D. Cope, of the Academy of Natural Sciences, Philadelphia, U. S. A.; C. M. Z. S. L.

The peculiarities of their osseous structure appear to point out among the families of the Batrachia salientia three series. First, those characterized by an absence of teeth and manubrium sterni, where the diapophysis of the sacrum is dilated, and the sternum with or without cartilaginous arches. Secondly, those having teeth, the coracoid and epicoracoid bones divergent and connected by a longitudinally placed cartilaginous arch,* that of the one side overlapping that of the other; the sacral diapophysis being either dilated or cylindrical, and the manubrium present or absent. Thirdly, those having teeth, the sacral diapophysis cylindrical, and a sternum of the following structure. The axes of the coracoid and epicoracoid are parallel, not divergent, their distal extremities separated only by interposed articular cartilage, and that of the epicoracoid resting upon that of the coracoid, which is much dilated: there are therefore no arciform cartilages. There is always a bony manubrium, and usually an osseous styliform xiphisternal piece.

These series may be called the Bufoniformia, the Arcifera, and the Raniformia. The first is extensively developed in the Neotropical, the Æthiopian, and Palæotropical regions; many species occur in the Nearctic district, a small number in the Palæarctic, and but three in the Australian. The second is found in all the regions of the globe except the Æthiopian, but is relatively much most developed in the Australian and Neotropical faunæ; in the Palæotropical but four or five species occur. The Raniformia, on the contrary, are not found in Australia, are represented by but one species in South America, are well represented (relatively) in the Nearctic and Palæarctic regions, abound in the Æthiopian, but are most numerous in the Palæotropical.

In each of these series or suborders we find types adapted for

* Plainly homologous with those connecting the coracoids and epicoracoids of the Lacertilia. They are homologized by M. Dugès with the clavicles; and the bones usually so called in the Batrachia salientia he terms acromials. A superficial view favours the opinion that the latter are rather epicoracoids, and that the clavicles of the Lacertilia have no homologue among the Frogs.

burrowing, others for an aquatic life; some are entirely terrestrial, and some are constructed for maintaining their position upon the leaves and branches of trees. But the different adaptive modification so graduate into each other on one hand, while similar ones are so constantly separate on the other, different structures frequently serving the same purpose,* that we are compelled to believe that a different idea pervades the scheme; and that, although adaptive modifications undoubtedly distinguish many generic and such subordinate types, the direction of their series is in accordance with another law which is not explained. This is the case, it will be seen, within the more definitely restricted series, the families.

In addition to the many species constituting the three suborders above-mentioned, there are known three living and perhaps as many extinct ones characterized by an extension of the pterygoid bones so as to enclose the cava tympani and tubæ Eustachii, causing the latter to present a single united ostium pharyngium. The living species have at the same time no tongue. The genera *Pipa, Dactylethra*, and *Palæobatrachus* are alluded to. The vertebræ in these animals are opisthocœlian, as in the Salamanders, and their sternum of the arciferous type.

With our present knowledge these types may be regarded as constituting a distinct suborder; but it is possible that *Palæobatrachus* and *Dactylethra* may come to be looked upon as extremes of the series of Arcifera, succeeding the family *Asterophrydidæ* of the latter. The peculiar vertebræ without ribs and the simply articulated coccyx are points of resemblance which do not occur elsewhere. In *Pipa* the relations of the fronto-parietal, ethmoid and prefrontal bones, also the sternum, find a close parallel in the *Rhinophrynidæ*, which, with the absence of teeth, suggest that it may be the most divergent type of the Bufoniform suborder.

AGLOSSA.

Pipidæ.

No ribs; simple coccyx attached to a single condyle. Coracoid and epicoracoid divergent, their connecting arches not overlapping. No manubrium. Fronto-parietal completely ossified; prefrontals

* *Vide* Professor Owen, in Trans. Zool. Soc. vol. v. p. 91, line 21.

separate. Teeth none; sacral diapophyses dilated. Terminal phalanges acute, simple. External metatarsals separated by a web.

The Neotropical genus *Pipa* has the atlas confluent with the second vertebra, so that there are but seven anterior to the sacrum. There are distinct nasal bones, and the median septum of the ethmoid is partially ossified. The prefrontals are completely in contact with each other and with the fronto-parietal.

Dactylethridæ.

No ribs: os ilium attached to the ninth vertebra only. Coracoids and epicoracoids well separated from those of the opposite side. Fronto-parietal strongly ossified, overhanging the confluent prefrontals. Teeth present; sacral diapophyses dilated. Terminal phalanges acute, simple. External metatarsals separated by a web.

One genus *Dactylethra*, in the Regio Æthiopica. In this the interorbital ethmoid plate, though long, is not produced anteriorly, and is entirely concealed by the fronto-parietal. The prefrontal does not always extend to it. The first two vertebræ are separate, but the sacral and coccyx confluent. There are ossa nasalia above the nares.

Palæobatrachidæ.

No ribs: os ilium attached to the diapophyses of the confluent ninth, eighth, and seventh vertebræ, which form a disc; coccyx attached by a simple glenoid cavity. Fronto-parietal strongly ossified, not produced further than the separate prefrontals. External metatarsals probably separated by a web.

The genus *Palæobatrachus*, Tsch., represented by several species in the miocene of Germany. The superior plate of the ethmoid was concealed; and the atlas confluent with the first vertebra, leaving but six between the occiput and sacrum.

Von Meyer states* that, of a great number of specimens of *P. diluvianus* which he examined, but one exhibited the complete developmental stage, as indicated by the complete fusion of the sacral diapophyses, which is certainly a remarkable circumstance. Such an one preserved in the British Museum has opisthocœlian vertebræ. Von Meyer describes the vertebræ of *P. giganteus* as procœlian, while some of them are figured as opisthocœlian. It remains there-

* Palæontographica, iii. p. 147.

ore a question of interest whether any species of this family possesses the ordinary Batrachian type of vertebræ.

BUFONIFORMIA.

No species of this suborder has articulated ribs or opisthocœlian vertebræ, nor a distinct web between the external metatarsal bones. In one genus only are the sacral diapophyses cylindrical. The families are the *Rhinophrynidæ*, *Engystomidæ*, *Brachymeridæ*, *Bufonidæ*, and *Dendrobatidæ*.

Rhinophrynidæ.

Ethmoid septal walls ossified to the end of the muzzle, and separating the prefrontals; its superior plate covered by the completely ossified fronto-parietale. Fronto-nasalia well developed, entirely in contact with *fronto-parietalia*, separated by a median point of the latter and by the ethmoid septum. No os pterygoideum or pterygoid wing of ectopterygoid: the latter straight, with a short maxillary suture. Sacral diapophysis dilated. Coracoid and epicoracoid divergent, connected by a narrow single cartilage; the former not dilated, in contact with, or slightly separated from, that of the opposite side. Tongue bound or retractile posteriorly. Ear imperfectly developed.

Rhinophrynus and *Hemisus* represent this form in Mexico and Africa respectively. In the latter genus the coracoidii are in contact, and there is a strong manubrium: the posterior free border of the tongue may be drawn into a transverse slit by a flabelliform retractor muscle. This slit is beneath the free portion of the tongue when it is extended.* In both genera there are nine vertebræ (inclusive of sacral) and a coccyx attached to two condyles.

Engystomidæ.

Ethmoid septal walls cartilaginous; the interorbital portion of the superior plate usually covered by the completely ossified fronto-parietals. No pterygoidium. Sacral diapophyses dilated. Coracoids dilated, always in contact with each other, also with the epicoracoids when present (with one exception), and always without arciform cartilages. Tongue free, not retractile posteriorly.

There are two types in this family. In the first the o. prefrontalia

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* This I first observed in a specimen of *Hemisus guineensis* preserved in the museum of Professor Geheimrath Hyrtl, in Vienna, to whom I am under many obligations for opportunities of studying valuable specimens and preparations.

are developed to their fullest extent, forming complete sutures with each other and with the parietale. In the second, these bones are separated widely or partially by the exposed superior plate of the ethmoid, which may be principally cartilaginous (*Brachycephalus*), a broad bony area (*Rhinoderma*), or strongly ossified in the form of the nose-piece of a helmet, to the end of the muzzle (*Atelopus*, sp.). Of these three genera the first has the ear imperfectly developed; in species of the third the epicoracoidei are not in contact with the coracoidei, but have a very short, simple, cartilaginous connexion. There are also but eight vertebræ in some of the species, the atlas being confluent with the first, and in *A. flavescens* the coccygeal condyle is single (transverse). This peculiar group is confined to the Neotropical region, where it represents, in the structure of its skull, the typical group of *Cystignathidæ* among the Arcifera, and *Dendrobatidæ*, from which it is not far removed in affinity.

In the first section, *Micro-hyla* exhibits an imperfectly developed ear. *Calohyla* (= *Holonectes* and *Plectropus*), and *Micro-hyla* have digital dilatations similar to those of the Tree-Frogs; their terminal phalanges are furnished with a terminal transverse limb, which is most noticeable in the first-named genus, and similar to the structure in *Hylarana*, but different from those in *Polypedates* and *Hyla*. *Cacopus*, Gthr. (*Hyperodon*), auct.), *Diplopelma*, and *Micro-hyla* are the only genera in the family without o. epicoracoidea. *Engystoma* and *Calophryne* are the remaining genera, the former the only one which is not confined to the Palæotropical region: it is both North and South American. In the latter the coccyx is articulated to the sacrum by a single transverse condyle; in all the other genera it is double. In their completely developed parietal and fronto-nasal bones, the genera of this section resemble the types of aquatic *Ranidæ* of the same region. The xiphisternum is either entirely or basally fibro-cartilaginous; in the three genera of the second division it is thin and cartilaginous.

Brachymeridæ.

Superior plate of ethmoid not ossified, either medially or wholly cartilaginous or fibro-cartilaginous. Epicoracoids divergent from coracoids, and connected with them by a single or double narrow cartilaginous band, the latter in contact with each other;* no ma-

* Not observed in *Brachymerus*.

nubrium. Fronto-parietals ossified on their superciliary borders only, thus enclosing a large fontanelle. Sacral diapophyses dilated. Ear perfectly developed. Tongue free, not retractile posteriorly.

Chelydobatrachus in Australia, and *Breviceps* and *Brachymerus* in South Africa, are the only genera of this family. The double cartilages of the sternum of the first foreshadow the arches of the *Bufonidæ*, and its prefrontal bones are in contact throughout, being developed as in that family and in the *Engystomidæ*. In *Breviceps gibbosus* the prefrontals are transverse, in contact medially, often only fibro-cartilaginous. There are true nasal bones *below* the external nares. There are but eight vertebræ, the atlas and first being confluent; and the coccyx is confluent with the sacrum. In *B. mossambicus* the prefrontals are separated. The terminal segment of each ramus mandibuli has an expanded cartilaginous border inferiorly, in this as well as the next genus; it exists in a less degree in *Diplopelma*. In *Brachymerus* the prefrontals are very narrow and widely separated from each other; the terminal phalanges have a distal transverse limb for supporting a palette, as in *Calohyla*. In the three genera the epicoracoid exists. The xiphisternum in *Breviceps* is a short, broad, deeply emarginate, cartilaginous disc: in *Chelydobatrachus* it is not emarginate, and is attached by a broad bony pedicel.

BUFONIDÆ.

Epicoracoidei divergent from coracoidei; the latter dilated, nearly or quite in contact, each connected with the former on the same side by a cartilaginous arch, of which that on the right (the animal being on its back) overlaps with its convexity the left coracoid, and that of the left coracoid underlaps that on the right. Superior plate of the ethmoid completely ossified, vary rarely prolonged anteriorly, usually covered by the completely ossified fronto-parietals, or by these and the prefrontals together. No pterygoideum. Sacral diapophyses dilated; coccyx attached to two condyles. Tongue free, not retractile posteriorly.

This family embraces the genera *Pseudophryne*, *Phryniscus*, *Epidalea*,* *Bufo*, *Incilius*,† *Sclerophrys*, *Peltaphryne*, *Rhæbo*,‡ *Paludicola*, *Schismaderma*, *Otilophus*, *Phrynoidis*, *Nectes*.

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* Called *O. dentale* by Dugès.

† *Vide* Proc. Acad. Nat. Sci. Phil. 1863, p. 49.

‡ Having seen the type-specimens of *Rhæbo leschenaultii* and *R. guttatus*, I incline to consider them different species. They have been supposed identical by Prof. Peters, *l. c.*

In the first two only is the ear imperfectly developed. In all, except *Pseudophryne* and *Epidalea*,* the fronto-parietals are entirely osseous; in the genera named they embrace a large fontanelle. In *Otilophus* and *Phrynoidis*† there are but eght vertebræ, the atlas and first being confluent. In *Nectes* there are resemblances to the *Asterophrydidæ;* the profrontals are narrow, divergent, in contact only anteriorly; the superior plate of the ethmoid is small, transverse, not entirely covered by the fronto-parietals, which are but weakly ossified medially, although embracing no fontanelle. In the other genera the prefrontals are in contact with each other and with the fronto-parietals throughout.

In none of the genera *known* to belong to the family is there a manubrium sterni. The xiphisternum is a slender weak cartilage in *Pseudophryne* and *Phryniscus* and *Bufo kelaartii:* in the other species the style supporting the terminal disc is stronger, sometimes fibro-cartilaginous; in *Bufo vulgaris* and *B. melanostictus* it is broader and nearly bony, and in *Nectes*‡ *subasper* strongest and broadest.

In *Bufo kelaartii* the terminal phalanges have a slight terminal transverse extension.

Pseudophryne, the weakest and least-developed form, is Australian; *Phryniscus*, *Bufo*, *Incilius*, *Peltaphryne*, and *Otilophus* are Neotropical; *Bufo* and *Schismaderma*, Ethiopian; *Bufo* and *Incilius*, Nearctic; *Bufo* and *Epidalea*, Palæarctic; and *Bufo*, *Incilius*, *Phrynoidis*, and *Nectes*, Palæotropical.

Dendrobatidæ.

Epicoracoidei transverse, their distal extremities in contact with each other and with the dilated distal extremities of the coracoidei, which are also in contact with each other. A manubrium. Sacral diapophyses cylindrical. Fronto-parietal bones completely and strongly ossified. Tongue not retractile posteriorly. Ear perfectly developed.

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* *Epidalea calamita* (*Bufo calamita* of authors), found in Western Europe.

† The raised orbital ridges of this genus do not constitute its essential character, as formerly supposed, but rather the division of the neural spines and the wide separation of the lateral portions (they stand above the zygapophyses) throughout the vertebral column; perhaps the fusion of the atlas with the first vertebra important in the same connexion. There is but one species at present known, *P. asper*.

‡ I prefer this name to the hybrid *Pseudobufo*, though later in date.

The few species of the remarkable genus *Denbrobates*, constituting this family, are found in the Neotropical region. They are characterized by many peculiarities. The ethmoideum is the most strongly developed in the order; it is largely produced anteriorly, widely separating the small prefrontalia; postero-laterally it fills the entire space between the sphenoideum and parietale, leaving only the foramen opticum. The terminal phalanges support discs, by a transverse limb upon the extremity of each, as in *Calohyla*. There is the usual number of nine vertebræ, the sacral giving attachment to the coccyx by two condyles; the diapophyses and posterior zygapophyses are connected by a horizontal bony lamina, which gives the dorsal surface of the vertebræ an unusual extent.

ARCIFERA.

The greater number of the families of this suborder possess, as in the last, dilated sacral diapophyses: the tongue is always free, and never retractile posteriorly. It is, however, particularly interesting as embracing types which offer an approach to the Batrachia gradientia in the possession of ribs and opisthocœlian vertebræ. These inhabit exclusively the Palæarctic region, where they were preceded in miocene times by forms, some more completely developed, others quite similar. The representatives of these in the Palæotropical region do not exhibit such decided salamandrine tendencies, but form a connexion between them, the procœlian Arcifera and the Aglossa; in the case of the last, by a form common during the Miocene period in Europe, but not at present existing. With a very few exceptions, the remaining types are American and Australian. The six families are distinguishable as follows:—

I. Sacral diapophyses dilated; vertebræ opisthocœlian.

Ribs; diapophyses of first coccygeal vertebra; outer metatarsi separated by web . . . . DISCOGLOSSIDÆ.
No ribs or coccygeal diapophyses; outer metatarsi bound together . . . . ASTEROPHRYDIDÆ.

II. Sacral diapophyses dilated; vertebræ procœlian.

Terminal phalanges continuous, conic, simple . SCAPHIOPODIDÆ.
Terminal phalanges, with a swollen base, and slender, curved, claw-like termination . . . HYLIDÆ.

III. Sacral diapophyses cylindrical; vertebræ procœlian.

External metacarpal bones mostly bound together, rarely free . . . . CYSTIGNATHIDÆ.

DISCOGLOSSIDÆ.

Vertebræ opithocœlian.* Diapophyses of sacrum dilated. First coccygeal vertebra united as usual with the second or style, but furnished with posteriorly divergent diapophyses, and attached to the sacral by two cotyloid cavities (with one exception). Short ribs articulated to the anterior diapophyses.† Ossa fronto-parietalia enclosing a fontanelle (in existing genera). External metatarsi more or less separated by a web. Terminal phalanges continuous, simple. Xiphisternum of two slender postero-exteriorly diverging fibro-cartilaginous or cartilaginous styles. Tongue round, entire, and little or not at all free behind.

Genera: *Latonia*, von Meyer.; *Discoglossus*, Otth.; *Alytes*, Wagl.; *Bombinator*, Merr.

Although the species composing this family are European, and have long been under the eyes of zoologists, few have been in some respects less understood.

We may commence the series of the Arcifera with the great central family of the *Cystignathidæ*, which afford the closest points of resemblance, perhaps affinity, on the one hand to the *Bufoniformia* through *Phyllobates* and *Dendrobates*, and on the other to the *Raniformia* through *Cystignathus* and *Cassina*. We will then end it with the families *Asterophrydidæ* and *Discoglossidæ*, which are perhaps equally connected with that which precedes them—the *Scaphiopodidæ*. The former leads to *Dactylethra* through *Palæobatrachus;* the latter, as far as our present knowledge indicates, finds its completest development in the extinct genus *Latonia*, established by Von Meyer on the *L. seyfriedi*‡ from the miocene of Oeningen. A species also occurs in the freshwater deposits of Sansan, *L. rugosa*,§ whose salamander-like vertebræ have been noticed by Gervais.|| These animals were nearly related to *Discoglossus*, and had, like it, short posteriorly-

* Observed by Dugès and Gervais in *Alytes*.

† Noticed by Dugès in *Alytes* and *Bombinator*.

‡ Säugethiere Vögel u. Reptilien von Oeningen, p. 18.

§ *Rana rugosa*, Lartet (Notice sur la Colline de Sansan, p. 41). My acknowledgments are due to M. Lartet for the pleasure of being able to make an examination of the reptilian remains of Sansan, preserved in his private collection.

|| Palæontologie Française, p. 494.

directed processes on the ribs, as in the genus *Salamandra;* they were, however, much larger, had the fronto-parietal bones completely ossified, and the whole of the cranium roughened externally by a dermo-ossification. On this account the genus has been compared with *Ceratophrys*, which belongs to the family of *Cystignathidæ.* This dermo-ossification occurs in various families, especially in the New World.

In the remaining and recent genera, the structure of the sternum is worthy of note. In old individuals of *Discoglossus,* it is sometimes fibro-cartilaginous, as in *Cystignathus* and *Pipa.* This part is probably homologous, with the xiphisternum of the Lacertilia, while the part commonly called by that name is the united hæmapophysial cartilages of the anterior ribs. In the genera in question,* this part is divided nearly up to the point of attachment to that preceding, each moiety being directed outwards and backwards, and tapering into a lateral linea semilunaris. Between these and the pubis there are in *Discoglossus* the usual three pairs of lineae semilunares, connected on the median line by a remarkably strong linea alba.

In *Discoglossus* the prefrontalia are strongly developed, being in contact for most of their length, sometimes touching the fronto-parietalia. In *Alytes* they are also in contact throughout, but are transverse and do not reach the fronto-parietals; the fontanelle is larger, and the ribs without processes: the whole animal is weaker. In this genus, as well as the preceding, the pupil is a vertical slit; elsewhere found only in *Hylorhina.* A species, *A. troschelii,*† has left its remains in the miocene Braunkohle along with *Palæobatrachus. Bombinator* is similar to *Alytes* in its osseous structure, except that the prefrontalia are in contact anteriorly only, and that the sacrum presents but one condyle for the articulation of the coccyx, as is typical of the *Asterophrydidæ* and Aglossa. Along with *Alytes* and *Dactylethra* it has true ossa nasalia, which bound the external nares exteriorly, thus explaining their anomalous position in *Breviceps,* where they are inferior. In this genus there is no cavum tympani, and the tubæ Eustachii are rudimentary or wanting. This character‡ is said to be variable, and to be occasionally, more or

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* Dugès has given a figure of it in *Bombinator*, pl. 3. fig. 24.

† *Rana troschellii* (Von Meyer, Palæontographica, iii. p. 138) is undoubtedly an *Alytes.*

‡ *Vide* Günther, Proc. Zool. Soc 1858, p. where Tschudi's remarks are quoted.

less traceable, in allied genera. There are no arboreal types in this family.

Asterophrydidæ.

Vertebræ opisthocœlian (with one exception). Diapophysis of sacrum dilated, of first coccygeal vertebra wanting; the latter attached by but one cotyloid cavity (except in one genus). Ribs none. External metatarsi not separated for a web; terminal phalanges continuous, simple. O. fronto-parietalia not strongly ossified medially, but without fontanelle. Superior plate of the ethmoid well developed anteriorly. Ear perfectly developed. Xiphisternum a slender osseous style (first two genera not examined).

Genera: *Cryptotis*, Gthr.; *Asterophrys*, Tsch.; *Megalophrys*, Kuhl; *Xenophrys*, Gthr.; *Leptobrachium*, Tsch.

The *Palæobatrachidæ* differ from this family in the conversion of their seventh, eighth, and ninth vertebral centra and diapophyses into a sacrum, instead of the ninth only; and in the osseous covering of the cavum tympani and tuba Eustachii.

Cryptotis, the only Australian genus of the family, possesses two sacral condyles for the articulation of the coccyx; it has a long tooth-like process on the os dentale, similar to that seen in *Rana macrodon*, and *R. kuhlii*.

The other genera belong to the Malayan Islands, except *Xenophrys*, which has only been found in the mountains of India.* *Leptobrachium* is remarkable as possessing procœlian vertebræ, forming a point of affinity to the *Scaphiopidæ*, especially to *Pelodytes punctatus*.

There are no arboreal forms known in this family.

Scaphiopodidæ.

Vertebræ procœlian. No ribs or coccygeal diapophyses; sacral diapophyses dilated; two condyles for the coccyx. External metacarpi bound together. Terminal phalanges continuous, conic. Manubrium weak, cartilaginous.

In seven of the eight genera of this family the toes are webbed; in three there is no cavum tympani; in four there is a fronto-

* As Dr. Günther informs me.

parietal fontanelle; and in one a bony xiphisternum. They are as follows:—

I. No fronto-pariental fontanelle.

A cavum tympani; no osseous styloid xiphisternum. *Chiroleptes*, *Scaphiopus*.

No cavum tympani, or osseous xiphisternal style. *Telmatobius*.*

No cavum tympani: xiphisternal style osseous, slender. *Pelobates*.

II. A fronto-parietal fontanelle.

No cavum tympani. *Alsodes*.

Cavum tympani; atlas and second vertebra distinct. *Helioporus*, *Hyperolia*.†

Cavum tympani; atlas and second vetebra confluent. *Pelodytes*.

The xiphisternum in *Scaphiopus solitarius* is a cartilaginous plate; in *Pelodytes* the cartilage is supported by an oblong plate-like osseous style, as in many Cystignathids. In *Pelobates* and *Scaphiopus* only, are the sacral and coccygeal vertebræ confluent. In *Scaphiopus*, *Helioporus*, and *Hyperolia*, are parotoid glands. The heterogeneous structure of this family, is not more striking than its geographical distribution. Thus *Hyperolia*, *Helioporus*, and *Chiroleptes* are Australian; *Alsodes* and *Telmatobius*, Neotropical; *Scaphiopus*, Nearctic; and *Pelobates* and *Pelodytes*, Palæarctic. It is quite possible that *Alsodes*, in which the dilatation of the sacral diapophyses is extremely slight, should be removed to the *Cystignathidæ*, and placed between *Cyclorhamphus* and *Crinia*; in some species of the latter the diapophyses are quite as much dilated.‡

Remains from the Braunkohle, from Rott, near Bonn, indicate a species of *Pelobates* larger than those now existing.

Hylidæ.

Vertebræ procœlian. Sacral diapophyses dilated, the simple coccyx articulated to two condyles. External metacarpi bound together. Terminal phalanges articulated inferiorly on to the extremity of the penultimate, globular or swollen proximally, and giving rise, usually from a central emargination, to the curved, acute distal portion

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* My knowledge of the sternum in this genus is not definite.

† Sometimes written *Uperoleia*.

‡ *Vide* Gunther, Proc. Zool. Soc. 1864, Feb. 9th.

which is of a more compact tissue. O. fronto-parietalia shortened anteriorly, usually embracing a fontanelle. Superior plate of ethmoid never covered by fronto-parietals, usually produced anteriorly, between fronto-nasals. Ear perfectly developed.

This family embraces the Tree-Frogs of the New World and Australia, though in the latter country, with its usual perverseness, they are terrestrial in their habits. One species is found in the Old World, viz. *Hyla arborea* of the Fauna Palæarctica.

There are fifteen genera in this family, of which five want the parietal fontanelle. In two the prefrontals are in contact. The xiphisternum is usually a parallelogrammic fibro-cartilaginous plate, deeply emarginate posteriorly, and divided by an imperfect longitudinal suture in two halves; or it is entirely cartilaginous, as in *Pseudacris*. The manubrium is slightly developed, usually cartilaginous, rarely apparently wanting. The following is a sketch of the genera:—

I. No fronto-parietal fontanelle.

a. Head covered with a dermo-ossification.

A dorsal dermal pouch . . . . *Opisthodelphys.*
No pouch; prefrontals in contact anteriorly *Trachycephalus.*

aa. Head without dermo-ossification.

No pouch; prefrontals large, in contact medially their entire length. No parotoid . . . . *Acrodytes.**
No pouch. Prefrontals in contact. A parotoid covering head and back . . . . *Scytopis.*
A dermal pouch; toes slightly webbed . *Nototrema.*

II. A fronto-parietal fontanelle; the prefrontals separated by the horizontal ethmoid plate.

a. Parotoid glands present.

Parotoid on scapular regions. Interior digits not opposable . . . . *Pelodryas.*
Interior digits opposable. Foot without web; tongue elongate, free . . . . . . *Phyllomedusa.*

aa. No parotoid glands.

b. Toes webbed.

* Type *Hyla venulosa*, Daudin.

c. Inner finger not opposite the others; fontanelle broad; superior ethmoid plate usually with a supraorbital angular dilatation.

d. Inferior palpebra reticulate with fibrous veins.

Tongue elongate, extensively free . . . *Agalychnis.**

dd. Inferior palpebra transparent.

e. Tongue little free posteriorly, entire or nearly so.

No vomerine teeth or cranial ridges . . . *Hylella.*
No cranial ridges; vomerine teeth . . . *Hyla.*
Two longitudinal cranial ridges; vomerine teeth . . . . *Osteocephalus.*†

ee. Tongue extensively free and deeply notched behind.

Digital dilatations small . . . . *Acris.*

cc. Inner finger opposite others; ethmoid plate not dilated; fontanelle narrow. *Litoria.*

bb. Toes free; dilatations small; fontanelle wide.

Superior ethmoid plate osseous . . . . *Pseudacris.*
Superior ethmoid plate cartilaginous; prefrontals well developed, in contact medially . . . . *Thoropa.*‡

Of these genera *Pelodryas* is Australian; *Litoria* and *Hyla* are common to that and the Neotropical region; *Acris* and *Pseudacris* are confined to the Nearctic. The other genera are Neotropical; *Hyla* only being represented in the Nearctic and Palæarctic regions.

Cystignathidæ.

Vertebræ procœlian; sacral diapophyses cylindrical; coccyx simple, attached to two condyles. External metacarpi usually bound together. Terminal phalanges continuous, either uniformly conic or with divergent terminal processes or their rudiments. Manubrium

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* Embraces *Hyla moreletii*, Dum., *H. holochlora*, Salvin, and *H. callidryas*, Cope.

† I am not acquainted with the structure of the skull of these species from examination.

‡ Contains the *Cystignathus misiessii* (Eibr., Voyage de la Bonite, i. p. 148), from Rio de Janeiro.

wanting or weak, cartilaginous or fibro-cartilaginous proximally.* Ear perfectly developed.

Group A.—External metacarpi free, separated by natatorial membrane. Terminal phalanges continuous, conic, simple. Manubrium slightly developed. Ear perfectly developed. Fronto-parietal bones perfectly developed.

Genera: *Myxophyes*, Günther; *Pseudis*, Wagl.; and probably *Lysapsus*, Cope, in which the sacral diapophyses are slightly dilated, as in some species of *Crinia*.

These genera exhibit a structure more similar to that of the true *Ranæ* than anything in this or the preceding sub-orders. The first-named genus is Australian; the two remaining South American.

Group B.—External metacarpi bound together. This group embraces twenty-three genera (perhaps even more), and a considerable variety in physiognomy and special characters. About half the genera have a fronto-parietal fontanelle; seven genera are provided with digital dilatations, which are supported by phalanges formed as in many of the arboreal Raniformia, and not as in the *Hylidæ* of the same region. The following sketch will exhibit many of the minor peculiarities of the genera:—

I. Toes free, the terminal phalanges with transverse or divaricate terminal processes. No fronto-parietal fontanelle; the prefrontals extensively in contact, *typically* joining the anterior margin of the fronto-parietals. Xiphisternum slender, weak, cartilaginous . . . . *Hylodes*.

II. Toes free or slightly webbed, the terminal phalanges with or without distal processes. No fronto-parietal fontanelle, the superior plate of the ethmoid produced anteriorly, separating the fronto-nasalia.† Proximal xiphisternal piece osseous or fibro-cartilaginous, typically styliform.

a. Toes slightly webbed; terminal phalanges with processes.

A tarsal dermal wing; tongue oval, adherent . . . . *Elosia*.‡

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* Except in *Limnocharis*.

† These bones are in a very few instances partially in contact.

‡ I do not know the sternum of this genus, or whether it is truly distinct from *Limnocharis*. I am also in doubt as to the sternum of *Phyllobates*, *Crossodactylus*, *Enhydrobius*, *Gomphobates*, *Liuperus*, *Strabomantis*, and *Tarsopterus*.

? No tarsal wing. Manubrium a bony style; xiphisternal basal plate broad . . *Limnocharis.*

aa. Toes free.

b. Terminal dilatations on phalanges with processes.

No vomerine teeth or digital fringes; tongue very narrow, free . . . . *Phyllobates.*

Vomerine teeth and digital fringes ; tongue oval, adherent . . . . *Crossodactylus.*

Vomerine teeth and no digital fringes . . *Enhydrobius.*

bb. No digital dilatation; xiphisternum with a fibro-cartilaginous or osseous style.

No lumbar gland . . . . *Cystignathus.*

A lumbar gland . . . . *Gnathophysa.**

III. Toes more or less webbed, terminal phalanges simple ; basal xiphisternal piece a broad, fibro-cartilaginous disc. Prefrontals in contact anteriorly only, or separated by the prolonged ethmoid plate. No fronto-parietal fontanelle. Manubrium none, or very short. Head short, elevated.

Eyelids prolonged; a cranial dermo-ossification . . . . *Ceratophrys.*

Eyelids and cranium normal ; a metatarsal shovel . . . . *Tomopterna.*

IV. Toes webbed; no digital dilatations, phalanges simple. Fronto-parietal fontanelle present or absent; prefrontals extensively in contact medially, and more or less with the fronto-parietals. Manubrium cartilaginous.

a. No fontanelle.

Xiphisternum a thin cartilaginous disc ; a cranial dermo-ossification . . . . . *Calyptocephalus.*†

Xiphisternum smaller, medially a small fibro-cartilaginous portion. Prefrontals transverse, no dermo-ossification ; a lumbar gland . . . . *Pithecopsis.*

aa. A fontanelle.

Xiphisternum with a proximal fibro-cartilaginous disc. No glands or dermo-ossification. Prefrontals transverse . . *Cyclorhamphus.*

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* Contains the *Cystignathus labyrinthicus*, figured by Castelnau.

† *Phrynocerus testudiniceps* (Pr. Ac. Nat. Sc. Phil. 1862, p. 157) is a species of this genus.

V. Toes webbed, terminal phalanges simple, very long. A fronto-parietal fontanelle; superior ethmoid plate much developed anteriorly, separating the oblique longitudinal prefrontals. Xiphisternal basil piece broad, styliform. Manubrium short, produced transversely.

Pupil erect; head shortened in front . . *Hylorhina.**

VI. Toes free, terminal phalanges simple, not prolonged. A fronto-parietal fontanelle; superior plate of ethmoid more or less exposed anteriorly. Xiphisternal cartilage supported by a fibro-cartilaginous basal plate or style. Manubrium very weak.

a. Inguinal glands.

Vomerine teeth; no tarsal tubercle; tongue round . . . . *Pleurodema.*

Vomerine teeth; a tarsal and two sharp metatarsal tubercles; tongue subcylindrical . . . . *Gomphobates.*

aa. No inguinal glands.

b. Tongue subcylindrical.

No vomerine teeth or tarsal tubercle . . *Liuperus.*

bb. Tongue round.

c. Ethmoid plate well developed, produced between the prefrontals more or less extensively.

Vomerine teeth in two short oblique rows *Borborocœtes.*†

Vomerine teeth in one long transverse row; prefrontals well separated . . . . . *Lymnodynastes.*

cc. Ethmoid plate entirely cartilaginous.

Prefrontals separate . . . . *Eusophus.*‡

VII. Toes free, terminal phalanges simple. A fronto-parietal fontanelle. Prefrontals slightly or not in contact. Xiphisternum narrow, weak, cartilaginous throughout; sacral diapophyses usually directed upwards, and often slightly dilated.

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* This genus embraces the *Cystignathus æneus* of 'Gay's Chili,' which is probably the same as *Hylorhina sylvatica* of Bell.

† This genus will, as at present understood, include *Cystignathus roseus* of Gay's 'Chili,' where the superior plate of the ethmoid is remarkably produced beyond the separated prefrontals between the external nares, to the end of the muzzle, forming, as in *Atelopus flavescens*, a spade-shaped vizier. The only specimens of *Borborocœtes* do not allow of a comparison in this respect.

‡ Type, *Cystignathus nodosus* of the 'Erp. Générale.'

Tongue oval or narrow oval; vomerine teeth
present or absent . . . . *Crinia.**

Characters are occasionally introduced into the above synopsis which will not always be found to be generic or even specific, such as some of the conditions of the xiphisternal cartilage and prefrontal bones. The fontanelle probably disappears in very old specimens of *Cyclorhamphus fuliginosus*, and it will perhaps be found to vary in another genus; among species of the same genus the condition in this respect is generally the same.

Batrachyla, in its strong cranium, arched front, and short muzzle, resembles *Pithecopsis;* the prefrontals will probably be found to be in contact and transverse, as in that genus. The parallelogrammic fibro-cartilaginous basal xiphisternal piece resembles *Cyclorhamphus*, and differs from *Hylodes;* but the free toes and transverse processes of the terminal phalanges separates it from the genera of Section IV.

With the special structure of *Plectromantis*, *Tarsopterus*, and *Platyplectrum* I am unacquainted. *Strabomantis* (Peters) has a physiognomy between *Ceratophrys* and *Pithecopsis*, with digital dilatations.

The Australian genera of this family are *Limnodynastes*, *Platyplectrum*, and *Crinia*. The others are Neotropical; and none are found in any other quarter of the globe.† *Limnodynastes dorsalis* is interesting, as having the atlas and first vertebra confluent, and in having the intervertebral fibro-cartilage not attached to its centrum, sometimes as readily adhering to that posterior as that anterior —the nearest approach to a biconcave type that is at present known in the order.

RANIFORMIA.

This suborder, though represented by numerous types, is much more homogeneous than any of the others, and constitutes but one family, the

RANIDÆ.

Sacral diapophyses cylindrical; simple coccyx, attached by two cotyloid cavities. Manubrium with a strong bony style; the xiphi-

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* Includes *Pterophryne* R. & L., and *Camariolius*, Peters (*vide* Günther, Ann. Mag. N. H., 1864, p. 312).

† *Liopelma*, Fitz., the only New Zealand form known, possibly belongs here. I am also unable to state the position of *Neobatrachus*, Peters, and *Hemiphractus*, Wagler.

sternum similar (with one exception).* Fronto-parietal bones never embracing a fontanelle. Tongue extensively free, more or less deeply notched.† Ear perfectly developed, no paratoids.

Members of the *Ranidæ* existed during the miocene period. The remains of *Rana meriani*‡ indicate a species as large as *R. esculenta. Rana noeggerathi*, also from the Braunkohle near Bonn, was a small species, of which I have not been able to learn the form of the xiphisternum. If the species was not a *Rana*, it did not belong to any other existing genus of the family. The genus *Asphærium*§ (found in the Oeningen bed) was apparently of inferior organization, as indicated by a humerus without terminal condyle; it represents possibly another family in this suborder.

The skeletal modifications in this family are those of the ethmoid and prefrontal bones and of the posterior extremity.

Group I. External metatarsi bound together. Digital dilatations present or absent; the terminal phalanges short, simple. Ossa prefrontalia extensively in contact, typically for their whole length.||

In *Hylambates, Halophila vitiana*, and *Cassina senegalensis*, the proximal portion of the manubrium consists of two limbs, which rest upon the epicoracoidi, enclosing a foramen. This does not occur in *Arthroleptis wahlbergii*, or any other nearly allied species. I have observed it elsewhere in *Hyperolius marmoratus* and *H. guttulatus. Ixalus variabilis, Hylarana macularia*, and *Dicroglossus adolphi.*

a. Digital dilatations wanting.

Cassina, Girard;¶ *Arthroleptis*, Smith. Both African.

aa. Digital dilatations present.

Hemimantis, Peters; *Hylambates*, Duméril: African. *Halophila*, Gird., and *Cornufer*, Tschudi: from the East Indian and Pacific Islands.

Group II. External metatarsi bound together. Digital dilatations present, supported by short phalanges, which are swollen at the

* *Hylambates*, where it is shorter and more disciform.

† Except in *Theloderma* and *Dicroglossus*, where there is a median instead of lateral production.

‡ Von Meyer, Palæontographica, iii. p. 127.

§ *A. reussii*, Von Meyer, *l. c.* ii. p. 68.

|| I have not seen them in *Hemimantis* and *Arthroleptis*.

¶ Includes *Cystignathus argyreivittis* and *C. senegalensis*.

base; the remaining portion slender, claw-like. Fronto-nasals separated by the superior plate of the ethmoid, which is broad and anteriorly produced.

Leptopelis, Günther: African. This interesting genus is the only one out of the family of *Hylidæ* which presents a similar structure of the terminal phalanges.

GROUP III. External metatarsi separated by a groove or web. Digital dilatations present, supported by short phalanges, which are either obtuse depressed or more or less bifurcate at tip. Prefrontals slightly or not in contact; superior ethmoidal plate or its cartilage extensively developed anteriorly, usually entirely separating the prefrontals. Abdominal integument areolate.*

a. Terminal phalanges obtuse, simple.

Hyperolius, Rapp., Africa; *Crumenifera*, Cope, Africa. (This genus repeats one essential character of *Cassina* in the same region,—*i. e.* a large posteriorly produced vocal vesicle, with an introverted exterior pouch on each side.) *Ixalus*, Dum. et Bibr., East Indies. These genera are without vomerine teeth, according to general acceptation; but it has been asserted† that they occasionally exist in the last named. In that case the undivided terminal phalanges continue to distinguish it from *Polypedates*, though it must then embrace two species which constantly possess vomerine teeth, so far as is known—*P.* (*I.*) *microtympanum* and *P. reticulatus* of Günther. The tongue, with its rudimentary posterior inferior process, will always distinguish it from *Hyperolius*.

aa. Terminal phalanges bifurcate; prefrontals, narrow, entirely separated.

Theloderma, Tschudi;‡ *Rhacophorus*, Kuhl; *Chiromantis*, Peters; *Polypedates*, Tsch. The first two East Indian, the second African, the third from the East Indies and Madagascar.

GROUP IV. External metatarsi webbed to the base.§ Terminal phalanges elongate, slender,|| acute, or with a transverse dilatation or limb. Abdominal integument smooth.

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* Except in *Hyperolius fornassinii*.
† By Peters. See Monatsberichte Preuss. Acad. 1864, p. 455.
‡ This genus I only know from external characters.
§ Not completely in Heteroglossa.
|| Except in *Amolops*.

a. Tongue deeply emarginate posteriorly.

Terminal phalanges short; transverse limb long; tongue without median inferior prominence; no dorso-lateral glandular dermal folds; vomerine teeth . . . . *Amolops.**

Terminal phalanges slender with short transverse limb; tongue without median process. No dorso-lateral folds nor vomerine teeth. Prefrontals entirely in contact with each other and with frontoparietals . . . . *Heteroglossa.*

Terminal phalanges slender, with short transverse limb; tongue with median inferior prominence; no dorso-lateral folds nor vomerine teeth; ethmoid widely separating prefrontals, and these from frontoparietals . . . . *Staurois.*†

Phalanges as above; tongue with median inferior prominence or thickening‡; a longitudinal glandular fold on each side of the back; vomerine teeth . . . . *Hylarana.*

Phalanges elongate, acute, or slightly dilated at tip; glandular folds present or absent; vomerine teeth . . . . *Rana.*

Closely following *Rana* is *Dicroglossus*, Gthr. which wants vomerine teeth. This leads at once to *Oxyglossus*, Tschudi, also without teeth on the vomer, and further characterized by its having—

aa. Tongue elongate, entire posteriorly, in one species pointed; a structure foreshadowed by the strong median inferior prominence of that of *Dicroglossus adolphi.*§ Nearly allied to *Rana* (in Sect. *a* again) is *Hoplobatrachus*, Peters, which is provided with a fossorial metatarsal spur, and immediately precedes the genus *Pyxicephalus*,‖ the burrowing type in this family.

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* The only species is *Polypedates afghanus* of Günther, which is a *Hylarana* with the physiognomy of a *Polypedates*.

† Embraces *Ixalus natator*, *I. guttatus*, and *Hyperolius plicatus* of Günther.

‡ Very slight in *H. macularia* and *H. albolabris*.

§ It appears to me that *Sternorhynchus natalensis*, Smith ((*Dicroglossus angustirostris*, Cope), belongs to this genus. In case it does not, it must receive Günther's name *Phrynobatrachus*, and not the later *Leptoparius*, Peters, given on account of the preoccupation of *Stenorhynchus*.

‖ In a skeleton of *P. adspersus*, in the Mus. Brit., the o. iliaca are anomalously attached to a tenth vertebra, which is attached by two cotyloid cavities to the ninth, and by two condyles to the coccygeal style.

A. Prefrontals lying along canthus rostralis, separated by ethmoid throughout.				
a. Ethmoid covered by fronto-parietal	*Rana affinis**	Venezuela.		
aa. Ethmoid projecting a short distance beyond fronto-parietals.	*R. oxyrhyncha*	South Ethiopian.		
	R. mascariensis			
	Staurois	Palæotropical.		
	Hylarana (young)	Palæotropical.		
	H. malabarica	Palæotropical.		
aaa. Ethmoid produced far between prefrontals.	*Rana fasciata*	South Ethiopian	Groups II. & III. *aa.*	*Engystomidæ*, Gr. II.
	Hylarana, in gen.	Palæotropical.	. . .	*Hylidæ* (most).
	Amolops	Palæotropical.	. . .	*Cystignathidæ*, Gr. II.
	. . .	. . .	. . .	*Dendrobatidæ.*
	. . .	. . .	. . .	*Ceratophrys.*
	. . .	. . .	. . .	*Xenophrys.*
B. Prefrontals subtriangular, not united by suture medially, or in contact with fronto-parietal.	*Rana temporaria*	Palæ- & Nearctic.		
	R. esculenta	Palæarctic.		
	R. halecina	Nearctic.	. . .	*Cystignathus.*
	R. clamitans	Nearctic.		
	R. mugiens	Nearctic.		
	Dicroglossus adolphi	Palæotropical Alpine		
C. Prefrontals more or less united by suture medially, not touching fronto-parietals.	*D. natalensis*	South Ethiopian	. . .	*Acrodytes.*
	Rana fuscigula	South Ethiopian.		
D. Prefrontal united by suture, and more or less completely in contact with fronto-parietals.	*Heteroglossa africana*	Ethiopian.		
	Rana occipitalis	Ethiopian.		
	R. gracilis	Palæotropical.	Group I.	*Engystomidæ*, Gr. I.
	R. tigrina	Palæotropical.	. . .	*Bufonidæ.*
	R. vittigera	Palæotropical.	. . .	*Cystignathidæ*, Gr. I. and IV.
	R. leschenaultii	Palæotropical.		
	R. grunniens	Palæotropical.		
	R. hexadactyla	Palæotropical.		
	R. corrugata	Palæotropical.		
	R. ehrenbergii	Palæotropical.		
	Oxyglossus lima	Palæotropical.		

* I do not know whether the ethmoid arch in this species is complete superiorly; in case it is not, it will perhaps be worthy of its generic appellation *Ranula*, Peters.

The relations of the prefrontal and ethmoid bones are very various in this group, and especially in the genus *Rana*, furnishing us with illustrations of most of the types found throughout the order, which are usually characteristic of higher groups. The names of the faunæ in the accompanying Table (p. 118) refer to the species of *Ranidæ*, Group IV.

A coincidence between the condition of these prefrontal bones and the regions inhabited by the genus *Rana* is evident, as well as a certain succession in the latter; Neotropical first, Palæotropical last.

The *Cystignathidæ*, occupy nearly the territory which is wanting in *Ranidæ*, just as Marsupialia do not trench on the domains of the Insectivora. This family possesses in its arciferous type of sternum one which may be called *lower* than that of the Raniformia, *i.e.* less specially peculiar and divergent among tailless Batrachia, as compared with that of other reptiles. In its family capacity its often undeveloped fronto-parietal bones are also an element of inferiority. See then the distribution of its genera as regards these peculiarities.

a. Fontanelle.

Prefrontals little developed . .	Group VII. . . .	Australian.
	Groups VI. & V.	Australian and S. Neotropical.
Prefrontals much developed .	*Cyclorhamphus* . .	South and Middle Neotropical.

aa. No fontanelle.

Prefrontals little developed	Groups II. & III.	Neotropical in gen.
Prefrontals much developed*	Group I.	North Neotropical.

The least-developed Australian; the most so those nearest to the Nearctic.

As regards the fronto-parietal fontanelle, which has not hitherto been looked upon as an important character, it may be said it does not exist in any species of the 'Regio Palæotropica:' the Australian representatives of the various families always possess it, excepting where it is wanting in those families elsewhere. As the nearest approach to an exception to the latter statement, the genus *Litoria*, among the *Hylidæ*, may be examined. I have found the fontanelle closed in an old specimen of *L. aurea*, and nearly so in *L. jacksoniensis* and *L. punctata*. This form is throughout the least specialized in this family in the direction of Hyline peculiarities.

* One species only (*Calyptocephalus gayi*), inhabiting the western slope of the Andes, extends into Chili.

Finally, the nature of the supports of the terminal digital dilatations, which adapt the Tree-Frogs to their mode of life, may be compared.

I. Claw-like, with globular base .	HYLIDÆ.
	Leptopelis.
II. Simple, obtuse-depressed at tip .	RANIDÆ, I. *aa* & III. *a*.
III. With a terminal transverse limb .	RANIDÆ, *Hylarana* et aff.
	Calohyla.
	Brachymerus.
	Hylodes.
IV. Bifurcate	*Batrachyla.*
	Dendrobates.
	Polypedates.
	Rhacophorus.

A glance at what precedes will show that there is no completeness of generic diagnosis anywhere attempted. My object having been to point out the importance of characters hitherto much overlooked, I have dwelt but lightly upon those now sufficiently well known, especially through the labours of Günther, in whose memoirs* will be found explained also the relations between such and the geographical distribution of the species.

The arrangement and definitions of the higher groups differ considerably from those hitherto adopted. There are two of the four families of Duméril and Bibron accepted as suborders; but those authors had not completely investigated many important types, at the time their system was proposed. A complete and practically useful system is that of Günther. I have already † demurred to the recognition of the Tree-Frogs as a natural division, accepted by this author as well as by the preceding; and while agreeing with him in attaching less value to the condition of the cavum tympani than did Müller, I find it even less frequently characteristic of otherwise homogeneous groups of genera. Thus, while accepting some of his families, others are rejected.

My thanks are due to Prof. Duméril and Dr. Günther for the great advantages I have enjoyed from the examination of the specimens under their respective charges.

* Proc. Zool. Soc., 1858, pp. 339, 390.

† Proc. Acad. Nat. Sci. Phil. 1863, p. 50. Similar conclusions have been arrived at by Prof. Peters, Monatsber. Preuss. Acad. 1864, p. 455.

XII.—On Cranial Deformities.—Trigonocephalus. By W. Turner, M. B. (London), F.R.S.E. Senior Demonstrator of Anatomy, University of Edinburgh. (Read before the British Association at Bath, September 16th, 1864.)

In the number of this Journal for January, 1864, I communicated an article on cranial deformities, in which I discussed the influence exercised on their production by the premature closure of the cranial sutures. And I illustrated the effects of premature synostosis, by describing and figuring several examples of a peculiarly elongated and laterally compressed form of skull, termed Scaphocephalic, the characteristic shape of which was evidently due to a premature closure of the sagittal suture. On this occasion, I am desirous of directing attention to another very remarkable form of head, in which whilst the sides of the forehead are compressed, the middle line is projected forward in a beak-like manner, and which apparently owes its peculiar shape to a premature closure of the frontal suture.

The case I shall adduce in illustration of this kind of cranial deformity, the only one I have as yet met with, occurred in the person of a boy, between five and six years old, the son of Irish parents.*

When a full or three-quarter face view of the head of this child was taken, the peculiar form of the frontal region was very apparent;

* For the opportunity of examining and obtaining photographs of this boy, I am indebted to my friends, Dr. Joseph Bell and Mr. David Young.

the lateral bulgings indicative of the position of the frontal eminences were altogether absent, and the forehead instead of being rounded off on each side to the temporal regions, was flattened, or even concave above the orbits and eyebrows, the hollowing out of the sides of the forehead, extending upwards as far even as the line of the hair. The middle line of the forehead on the other hand, presented a very different appearance, for it projected forwards forming a sort of beak, narrow below at the root of the nose, but gradually swelling out laterally and becoming more prominent as it approached the line of the hair, the bulging being necessarily more strongly brought out by the concavities on each side, above the eyebrows. Examined from the front, this beak-like bulging had a triangular form, its apex and most receding part being at the nose, its base at the line of the hair. On a profile view the forward projection of the middle of the forehead came out very decidedly, so that this part of the cranium somewhat overlapped the face. The appearance presented by the head when looked at from above, was very characteristic. Between

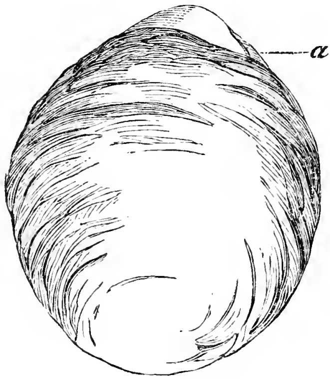

FIG. 2.—Owing to the head inclining slightly to one side, a portion of the right eyebrow *a* is seen.

the parietal eminences, it possessed a breadth of 5·7 inches, which was the broadest part of the head; traced backwards to the occiput, its transverse diameter slightly diminished, and the head had a rounded form posteriorly; traced forwards its transverse diameter diminished much more considerably, and at the middle line of the forehead, corresponding to the beak seen on a front or side view, it came almost to a point. The object it most resembled in form from this aspect, was a broadly shaped egg, the narrow end of which was directed forwards; or it might be compared to a triangle with a rounded base.

The boy was a well grown healthy looking child, and exhibited an amount of intelligence, quite equal to that usually possessed by children of his age or condition of life. The mother told me that his head was noticed, immediately after birth, to possess a peculiar form, and she particularly states that he had no opening (anterior fontanelle) on the top of his head. In all other respects he was perfectly well formed. Her labour was natural. She has had four other children, but their heads were without any special peculiarity.

The following are a few of the principal measurements:—greatest length from the most projecting part of the beak, to the most prominent part of the occiput 7·2 inches.—Longitudinal arc to the occipital protuberance 12·5.—Intermeatoid arc 13·7.—Horizontal circumference round the most projecting part of the beak 20·5: round the root of the nose 19·5.—From these measurements, as well as from an inspection of the head, it is evident that the general capacity of the cranium is good, the space lost in the frontal region by its lateral compression being compensated for by increased growth in the parietal and occipital regions.

I have had no opportunity of anatomizing this or any other specimen of a similarly formed skull, so that I cannot speak from personal observation of the exact condition of the cranial bones and their sutural margins, but so far as one can judge from an external inspection of the living head, I have no doubt that this boy's skull corresponds closely with those crania which have been described and figured by Professor Welcker of Halle, by the name of Trigonocephali.* The skulls of this form, which Welcker has personally examined, are those of two new-born children, two children about five years old, and one adult male probably between 50 and 60 years of age; but he has in addition seen a plaster cast of the head of a new-born Trigonocephalus, in the Medico-Chirurgical academy at Dresden, and he refers to a case described by Von Ammon, and to a specimen described by Meissner in the Museum at Breslau, of apparently the same form, and these seem to be the only cases which have been recorded of this description of cranial deformity. In all of them, the peculiar beaked form of the middle of the frontal region, the absence of frontal eminences, and consequent hollowness of the sides

* Untersuchungen über die Menschlichen Schädeln. Leipzig, 1862. Ueber Zwei seltnere Difformitaten des menschlichen Schädels. Halle, 1863.

of the forehead above the eyebrows and orbits, the comparative breadth across the parietal region, so that the norma verticalis approached the triangular form, (the apex at the forehead, the rounded base at the occiput,) were well marked, and showed their close alliance to the boy's head I have just described. The two new-born children examined by Welcker, had both hare lips and cleft palates, but in none of the other cases did such malformations exist. In several of the cases also he noticed that the eyes, owing to the diminished breadth of the inter-orbital space, were more closely set together than is usual. In my case this peculiarity was but slightly marked.

Two theories may be advanced, to explain the production of this description of cranial malformation. 1st. That the frontal bone had only possessed a single ossific centre, situated in the middle line. 2nd. That it had in the usual manner two primary ossific centres, but that these, instead of remaining distinct and separated from each other, had very early become blended together, so as to form in the middle line the projecting beak, so characteristic of this form of cranium. Along with Welcker I am inclined to support the latter theory. For I believe, that, if the first named mode of development had occurred, a much greater amount of deformity would have been occasioned, than is exhibited by these crania, and that a Cyclopian or other monstrous form of head would have been produced. If the second of these two theories be accepted, then these Trigonocephali are, as regards the principle which regulates their mode of production, closely allied to those Scaphocephali already alluded to, in which, as has been contended by Virchow, Welcker, and myself, the lateral compression of the cranium in the parietal region, is due to a premature blending of the ossific centres of the two parietal bones, and a consequent obliteration of the sagittal suture. The head of the boy whose case I have detailed, supports the view that this premature blending of the two originally distinct halves of the frontal bone, took place at a period of fœtal life, some time before the termination of intra-uterine existence, for if the statement of the mother is to be trusted, there was a complete absence of the fontanelle at the time of birth. It does not necessarily follow, however, that this intra-uterine closure of the anterior fontanelle is a constant occurrence in these cases, for in the heads of the two new born children, figured by Welcker, the anterior fontanelle is open, and in the head of one of the 5-year old children, a distinct anterior fontanelle bone existed.

XIII.—Proceedings of the Scientific Societies of London.

1. Ethnological Society. (4, St. Martin's Place.)

November 8th, 1864.

Some skulls exhumed in 1863 in the province of Spiti, a part of Ladak, or Chinese Thibet, were presented to the Society by Mr. Philip Egerton, of the Bengal Civil Service. These skulls were interesting as coming from a region where the Caucasian and Mongolian families meet.—Mr. S. J. Mackie exhibited a fine series of eighteen flint implements from a gravel drift of Bedford, collected by J. Wyatt. —A note from Count Marschall was read, giving an account of the researches of Prof. Jeitteles in the peat-bogs of Olmütz, where human bones and works of primitive art had been found in association with remains of ox, boar, and horse.—Mr. T. Wright, Hon. Secretary, gave an account of the proceedings in the Ethnological Section of the British Association at Bath, which were deemed highly satisfactory. —An account by Dr. Shortt, was read, " of some rude Tribes, supposed Aborigines, of Southern India." These tribes were the Yenadies of Ireehuree Cottah, a flat, sandy island on the Coromandel coast, the Villees met with in the outskirts of every village of the district; the Iroolers residing for the most part around the village of Nagalapooram, at the foot of the Ramagherry Hills; and the Dombers. The Yenadies were described as having Mongolian features, and speaking a slightly corrupted dialect of Teloogoo; the Villees, too, have the Mongolian type strongly marked; the Iroolers are seemingly of the same caste. "Dommari" and "Dombari" are applied to a certain low caste of natives, supposed to be one of the great aboriginal races, whose chief occupation at the present time is the performance of acrobatic feats. They are tall, tolerably well made, with complexions varying from bamboo to copper colour, and in some merging into black. The predominant type of countenance is stated as Mongolian.—A second paper was read, " On the Fixity of Type," by the Rev. H. Farrar, in which the author contended that an extraordinary fixity of type had characterized the races and varieties of mankind since the earliest dawn of history, and quoted numerous examples, including the Egyptians, Jews, Negroes, and Assyrians, to prove his point.—Mr. Phillips exhibited a series of exquisite water-colour sketches, and finished paintings in oil, of various personages representative of races to be met with in Upper Egypt. One portrait of a modern Copt excited great attention, Mr. Phillips having painted the mask of an ancient Egyptian head-dress, with a vacant space for the face to cover the picture. The resemblance of the modern Coptic face to the features presented by the ancient Egyptian statues, was thus rendered strikingly apparent.

November 22nd, 1864.

The first paper read was "On the Present State of Dahomé," by Capt. R. Burton.—The second paper read was "On the Principles of Ethnology," by Mr. J. S. Prideaux. As a provisional arrangement till our knowledge enables us to adopt one founded on a more philosophical basis, the author arranges the types of the British Isles and Western Europe according to their noses—first, *convex;* second, *concave;* third, *straight*, or intermediate. Each group capable of being sub-divided into three, according as the features are, first, *defined* and sharply cut; second, fleshy and *faintly outlined;* third, *intermediate* in definition. And again susceptible of being sub-divided into three, as the complexion is, first, *light;* second, *dark;* third, *intermediate.*

December 13th, 1864.

A very interesting collection of human remains, stone implements, and other articles was exhibited, which have recently been obtained by Mr. S. Laing in some extensive excavations which he has been carrying on in Caithness, and which are believed to date from a very remote period in the history of man. Mr. Laing gave an account of his operations, and described the various articles which had been found, and a lively discussion followed. Mr. Laing said he had long been of opinion that important evidence in respect to the antiquity of man might be discovered in this country by searches something resembling those which had been carried on in Denmark, by opening what were called the "Kitchen-middens" there, and last summer he had caused several large mounds to be opened near Kiess, in Caithness, about eight miles north of Wick. On removing the green turf at the top these mounds were discovered to consist chiefly of large masses of periwinkle and limpet shells, mixed with bones, flint splinters, and bone instruments of the rudest kind. In two there were remains of ancient buildings, and in one they came upon a building with solid massive walls, and three separate pavements one over the other, showing evidence of successive occupation either by successive races or by the same races at successive periods of time. In the lowest strata stone implements of the rudest kind had been discovered, but in the instruments found in the upper strata a greater finish of workmanship was distinctly traceable. In one case a pair of shears with the blades of bronze and handle of iron, and bone implements of various descriptions had been found mixed up with a mass of shells and bones of animals which had been used for food. Among these bones, too, had been discovered part of the jaw of a child, with the teeth attached to it, broken across as if to get at the marrow, affording ground for a presumption that cannibalism was prevalent, or at least occasionally resorted to, among the race to which the remains refer. The specimens of pottery varied according to the strata in which they were found. In the lower strata they were rude and of a very poor character; in the upper they showed an improved manufacture and had occasionally a blue glaze. None of the stone implements showed the mark of a tool; nor did the stones of which the buildings were formed; but the sandstone of the district, which was chiefly used—there being no flint in the neighbourhood—split naturally so regularly that there was little necessity for this. Among the animal remains which had been identified were the bones of a small whale, which had probably been driven ashore and eaten, dolphins and cod, the ox, horse, red deer in large quantities and of gigantic size, wild boar, and goat. No sheep bones had been discovered, which was an indication of great antiquity, as no signs of the sheep had ever been discovered in the Swiss lake dwellings. Remains of the dog and fox, both as articles of food, of the cormorant, the solan goose, and the great awk (*Alca imprennis*) had been found, but nine-tenths of the food of these people was shell-fish. They had no fishing tackle, nor was there anything to intimate that they had any notion of fishing or boating, though they lived on the sea-shore. Their notions of art were of the rudest and most primitive description, but their architecture was more respectable, and a spinning-wheel which had been dug out seemed to show that they had some notion of manufactures. Mr. Laing also described the result of opening a long burial mound by the sea-shore, which he found full of stone coffins at regular intervals of about 15 feet apart. The mode of sepulture was an additional proof of the extreme antiquity of the people. The corpse was extended at full length on the ground, the stone cist was built up round it, with flat blocks of flagstone, and the whole was covered with a light mound of stone and earth. There were no traces of habitation about this mound; it had been used solely as a place of sepulture. About the centre of it was found the coffin of one who appeared by the care bestowed on his burial to be the chief of the tribe, and close by his hand were discovered 15 stone weapons of rude manufacture—a hatchet, sundry spearheads, and knives or scrapers. Mr. Laing concluded that these remains belonged to the early stone period, and that the race to whom they belonged were part of the primitive population of these islands, who in that remote corner of the country had long preserved the simplicity and rudeness of their modes of life.

Professor Huxley then pointed out with elaborate minuteness the peculiarities of the human bones, from which he concluded that they were the remains of two separate and distinct races. The first was typified by a skull which, as the members would see, was large, capacious, and well arched. In fact, there were few of the able men present, the Professor said, who had a better developed cranium, and it closely resembled that type which was described in the *Crania Britannica* of Davis and Thurnham as the "ancient British" skull. The pelvis belonging to this skull was such as might be possessed by any well-grown muscular Englishman of the present day. The skulls belonging to the second race were of a much lower order—narrow, low-formed, sloping upwards towards the vertex, and then downwards again, with a great occipital protuberance, and a remarkably protruding upper lip. The pelvis, too, of this race was most peculiar, its proportions being diametrically opposite to those of the present European type, and the extraordinary development of the muscular ridges showed a rude and wild character. These skulls were comparable to what the Professor in a former paper had called "the river-bed type," and came closer than any others to the skull of the Australian native. One skull which the Professor pointed to was a woman's, and was as degraded and villanous in its form as any he had seen. The tibia and the forearm, too, of this woman were out of the ordinary proportion, which was a further sign of degradation. The Professor, in conclusion, said the remains afforded no ground for the theory that a "round-headed" had preceded the "long-headed" race in the occupation of these islands.

2. Geological Society, (Somerset House).

November 9th, 1864.

The following communications were read:—

1. "Notes on the Geology of Jamaica; with Descriptions of New Species of Cretaceous, Eocene, and Miocene Corals." By P. Martin Duncan, M.B., Sec. G.S., and G. P. Wall, Esq., F.G.S. The authors first referred to the Miocene age of the Corals that have hitherto been described from the West Indies, and then stated that in this paper conclusive evidence was brought forward, for the first time, of the existence of an Eocene formation in Jamaica. They next noticed successively the lithological characters of the different members of the Jamaican fossiliferous rocks, and then described two new species of Corals from the Lower Cretaceous beds, and six from the Miocene, besides giving notices of additional known forms from all the strata. The conclusion was drawn, that the facies of these Cretaceous Corals was suggestive of a close alliance having existed between this fauna and that of Gosau in the Eastern Alps. The question of the existence of Lower Cretaceous strata in other West Indian islands having been discussed, attention was drawn to the character of the Eocene Corals, as being confirmatory of Mr. Barrett's views on the existence of that formation in the island, and the paper was concluded by some additional remarks on the Miocene beds, and their probable correlation with those of Trinidad, Antigua, &c.

2. "On the Correlation of the Irish Cretaceous Strata." By Ralph Tate, Esq., F.G.S. The non-existence in Ireland of the formations between the Lower Lias and the Upper Greensand having been stated, Mr. Tate first showed that the Cretaceous formations occurring near Belfast are referable to the so-called Upper Greensand (Hibernian Greensand of the author), and to the Upper Chalk, the latter consisting chiefly of a "White Limestone" with flints, and containing species known to occur in the Upper Chalk of Norwich and Meudon, with others allied to Maestricht forms. The basement-beds forming lithologically a passage to the Hibernian Greensand, are (1) chloritic limestone with Sponge-remains belonging to about thirty species, and (2) a calcareo-chloritic sandstone with three species of Echinoderms, the dormant from being *Ananchytes gibba.* These passage-beds are only locally developed, and when they are absent the junction of the Greensand and the White Limestone is very abrupt. The Hibernian Greensand was considered by Mr. Tate to

represent the Upper Greensand, the Chalk-marl, and the lower part of the Lower Chalk of England, and to be the miniature counterpart of D'Orbigny's Étage Cenomanien. It nowhere exceeds 55 feet in thickness; but it nevertheless contains the following beds:—(1) Chloritic sands and sandstones of Colin Glen, or the Zone of *Exogyra columba;* (2) Chloritic sandstones of Woodburn, or the Zone of *Inoceramus Crispi;* (3) Yellow-sandstones and Marls with Chert, or the Zone of *Ostrea carinata;* and (4) Glauconitic sands, or the Zone of *Exogyra conica.* The authors concluded by giving descriptions of several new species of fossils, chiefly from the "White Limestone" and the Sponge-bearing zone.

3. "On the Recent Earthquake at St. Helena." By Governor Sir C. Elliot, K.C.B. Communicated by the Colonial Secretary through Sir C. Lyell, Bart., F.R.S., F.G.S. This earthquake, which is stated to be the fourth that has occurred during the two centuries that we have been in the occupation of the island, occurred at about 4h. 10m. A.M. on July 15th, and in this paper Sir C. Elliot described the nature of the shock and the circumstances attending it.

November 23rd, 1864.

The following communications were read :—

1. "On the occurrence of Organic Remains in the Laurentian Rocks of Canada." By Sir W. E. Logan, LL.D., F.R.S., F.G.S., Director of the Geological Survey of Canada. The oldest known rocks of North America, composing the Laurentide Mountains in Canada, and the Adirondacks in the State of New York, have been divided by the Geological Survey of Canada into two unconformable groups, which have been called the Upper and Lower Laurentian respectively. In both divisions zones of limestones are known to occur, and of them at least three have been ascertained to belong to the Lower Laurentian. From one of these limestone-bands, occurring at the Grand Calumet on the River Ottawa, Mr. J. McCulloch obtained, in 1858, specimens apparently of organic origin, which were exhibited as such by the author in 1859; and other specimens have also been obtained from Grenville and Burgess. These specimens consist of alternating layers of calcareous spar, and a magnesian silicate (either serpentine, white pyroxene, pyrallolite, or Loganite) —the latter minerals, instead of replacing the skeleton of the organic form, really filling up the interspaces of the calcareous fossil, as was discovered by Dr. Dawson, to whose paper, and to that by Mr. Sterry Hunt, Sir William refers for further details.

2. "On the Structure of certain Organic Remains found in the

Laurentian Rocks of Canada." By J. W. Dawson, LL.D., F.R.S., F.G.S. With a Note by W. B. Carpenter, M.D., F.R.S., F.G.S. At the request of Sir Wm. Logan, Dr. Dawson carefully examined the laminated material thought by Sir William to have an organic origin, and he found it to consist of the remains of an organism which grew in large sessile patches, increasing at the surface by the addition of successive layers of chambers separated by calcareous laminæ. Slices examined microscopically showed large irregular chambers with numerous rounded extensions, and bounded by walls of variable thickness, which are studded with septal orifices irregularly disposed; the thicker parts of the walls revealed the existence of bundles of fine branching tubuli. Dr. Dawson therefore concludes that this ancient organism, to which he gave the name of *Eozoön Canadense*, was a Foraminifer allied to *Carpenteria* in its habits of growth, but of more complex structure, as indicated by the complicated systems of tubuli. It attained an enormous size, and, by the aggregation of individuals, assumed the aspect of a coral reef. In a note, Dr. Carpenter corroborated Dr. Dawson's observations on the structure and affinities of *Eozoön*, but stated also that, as he considered the characters furnished by the intimate structure of the shell to be of primary importance, and the plan of growth to have a very subordinate value, he did not hesitate to express his belief in its affinities to *Nummulina*.

3. "On the Mineralogy of certain Organic Remains found in the Laurentian Rocks of Canada." By T. Sterry Hunt, Esq., M.A., F.R.S., of the Geological Survey of Canada. Communicated by Sir W. E. Logan, LL.D., F.R.S., F.G.S. Mr. Sterry Hunt first referred to the structure of *Eozoön* as made out by Dr. Dawson, and then stated that the mineral silicates occurring not only in the chambers, cells, and canals left vacant by the disappearance of the animal matter, but in many cases in the tubuli, filling even their smallest ramifications, are a white pyroxene, a pale-green serpentine and pyrallolite, and a dark-green alumino-magnesian mineral which the author referred to Loganite. The calcareous septa in the last case are dolomitic, but in the other instances are composed of nearly pure carbonate of lime. The author then gave the results of a chemical analysis of specimens from the different localities, and deduced therefrom the composition and affinities of Loganite. This mineral he considered to be allied to chlorite and to pyrosclerite in composition, but to be distinguished from them by its structure. In conclusion,

the author showed that the various silicates already mentioned were directly deposited in waters in the midst of which the Eozoön was still growing, or had only recently perished, and that they penetrated, enclosed and preserved the structure of the organisms precisely as carbonate of lime had done; and he cites these and other facts in support of his opinion that these silicated minerals were formed, not by subsequent metamorphism in deeply buried sediments, but by reactions going on at the earth's surface.

December 7th, 1864.

The following communications were read:—1. "On the Geology of Otago, New Zealand." By James Hector, M.D., F.G.S. In a letter to Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—The south-western part of the province of Otago is composed of crystalline rocks forming lofty and rugged mountains, and intersected by deeply cut valleys which are occupied by arms of the sea on the west, and by the great lakes on the east. These crystalline rocks comprise an ancient contorted gneiss, and a newer (probably not very old) series of hornblende-slate, gneiss, quartzite, &c. Eastwards they are succeeded by well bedded sandstones, shales, and porphyritic conglomerates, with greenstone-slates, &c., in patches, all probably of Lower Mesozoic age. Then follow the great auriferous schistose formations, which comprise an Upper, a Middle, and a Lower portion; and upon these occur a series of Tertiary deposits, the lowest of which may, however, possibly be of Upper Mesozoic date, while the upper, consisting of a Freshwater and a Marine series, are unconformable to it, and are decidedly much more recent. In describing the auriferous formations, Dr. Hector stated that the quartz-veins occurring in the schists were not often true "fissure-reefs" (that is, reefs that cut the strata nearly vertically and have a true back, or wall, independent of the foliation-planes), but are merely concretionary laminæ that conform to the planes of foliation. The gold occurs segregated in the interspaces of this contorted schist, but is rarely found *in situ*.—Dr. Hector concluded with some remarks on the early Tertiary volcanic rocks, observing that the period of their eruption must have been one of upheaval, and that the great depth of the valleys, which have been excavated by glacier-action since the close of that period, proves that the elevation of the island, at least in the mountain-region, must once have been enormously greater than it now is.

2. "Note on communicating the Notes and Map of Dr. Julius Haast, upon the Glaciers and Rock-basins of New Zealand." By Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—In this note Sir Roderick Murchison states that Dr. Haast has informed him in a letter that he has for the last five years attentively followed the discussions on Glacier-theories, that in March, 1862, he came, independently of other authors, to the same conclusions in New Zealand that Professor Ramsay did in Europe, and that his views have been printed in his Colonial Reports as Geologist of the Province of Canterbury. Sir Roderick also stated that the constant field and other occupations of Dr. Haast have hitherto prevented his carrying out his intention of writing a paper for the Geological Society; but he has sent the following notes as a *résumé* of his views. Though opposed to the theory of the excavation of basins in hard rocks by the action of ice, Sir Roderick commended the researches of Dr. Haast as showing the mutations of the surface in successive geological periods.

3. "Notes on the Causes which have led to the Excavation of deep Lake-basins in hard Rocks in the Southern Alps of New Zealand." By Julius Haast, Ph.D., F.G.S. Communicated by Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—Referring first to the submergence of New Zealand during the Pliocene period, and to its subsequent elevation, the author stated that the chief physical feature of the country after that elevation was a high mountain-range, from which glaciers of enormous volume, owing to peculiar meteorological conditions, descended into the plain below, removing in their course the loose Tertiary strata, and thus widening and enlarging the pre-existing depressions, the occurrence of which had at first determined the course of the glaciers.—The author then observes that, the country having acquired a temporary stability, the glaciers became comparatively stationary, and therefore formed moraines, the materials of which were cemented together by the mud deposited from the water issuing from the glaciers; new moraine matter would then raise the bed of the outlet and dam up the water below the glacier, and from this moment, he believes, the formation and scooping out of the rock-basin begins; for the ice being pressed downwards, and prevented by the moraine from descending, its force would be expended in excavating a basin in the rock below.

4. "Note on a Sketch Map of the Province of Canterbury, New Zealand, showing the glaciation during the Pleistocene and Recent times, as far as explored." By Julius Haast, Ph.D., F.G.S. Com-

municated by Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—This paper contained a general explanation of a Sketch Map, illustrating the past and present distribution of the glaciers on the eastern side of the Southern Alps of New Zealand, as well as the author's views on the excavation of Lake-basins in hard rocks, as shown by the coincidence between the positions of the lakes and the terminations of the ancient glaciers.

3. Linnean Society, (Burlington House).

November 17th, 1864.

The following papers were read:—1. "Facts relative to the Movements of Insects on Polished Vertical Surfaces," by Mr. J. Blackwall.—2. "On a Skeleton of *Dinornis robustus*, Owen, in the York Museum," by Mr. T. Allis.—3. "Account of a huge Banyan Tree of S. India," by John Shortt, M.D.—4. "On *Pæciloneuron*, a new genus of *Ternstræmiaciæ*," by Captain Beddome.—5. "On the Naturalized Weeds of British Kaffraria," by Mr. D'Urban.—Dr. Hooker laid before the Society a plate of a gigantic species of *Aristolochia* from the forests of Old Calabar, where it had been discovered by the Rev. W. Thomson, of the United Presbyterian Church Mission, who had transmitted a flower in spirits to Kew. At Mr. Thomson's request it had been named *A. Goldieana*, after the Rev. H. Goldie of the same mission. Dr. Hooker hoped to make further observations on it at the forthcoming meeting of the Society. Dr. Hooker also exhibited some hazel-nuts, said to have been taken from a closed cavity of a large oak-tree at Llanelly in South Wales, and which were supposed to have lain there for many years. The nuts presented a curious striped appearance, and the kernels were quite sound and fleshy, though discoloured. They had been sent to Dr. Hooker by Mr. J. Douglas, the proprietor of the saw-mills in which the tree was cut up.

December 1st, 1864.

The following papers were read:—1. "On the Free Nematodes, Marine and Fresh Water," by Dr. Bastian.—2. "Brief Notices of Results obtained by Experiments with Entozoa," by Dr. Cobbold. —3. "On Tubicolous Annelids from the Collection in the British Museum," by Dr. Baird.

4. Zoological Society, (Hanover Square).

November 8th, 1864.

The Secretary announced to the meeting the Head Keeper's safe return from Calcutta in July last with a valuable collection of animals, brought together for the Society by the Baboo Rajendra Mullick, Mr. A. Grote, Dr. John Squire, and Mr. W. Dunn, amongst which were a pair of Rhinoceroses and several species of Birds new to the collection. The Secretary also called the attention of the meeting to several interesting additions to the Society's Menagerie. —The Secretary exhibited a collection of Birds' Eggs made in India and presented to the Society by Lieut. R. C. Beavan.—Mr. Gould exhibited a specimen of the *Emberiza pusilla* of Pallas, which had been lately captured in a clap-net near Brighton, being the first instance of its occurrence in the British Islands, also a specimen of the *Anthus campestris* of the Continent, caught in the same locality. —The Rev. H. B. Tristram, Corresponding Member, exhibited a pair of Sanderlings from Grimsey Island, Iceland, and three Eggs, supposed to be those of that Bird, received at the same time.—A Letter was read from Dr. W. Peters, Foreign Member, in reference to some remarks made by Dr. Gray, in a paper recently published in the Society's proceedings.—Professor Huxley read a memoir on the structure of the skull of Man, the Goriilla, the Chimpanzee, and the Orang-Utan, during the period of the first dentition. Professor Huxley's deductions were based upon materials contained in the British Museum, the Royal College of Surgeons, and in particular upon the original specimen of Tyson's "Pigmy," which had been submitted to his examination by the Directors of the Museum at Cheltenham.—The Rev. H. B. Tristram read a Report on the Birds collected during his recent expedition in Palestine. Mr. Tristram enumerated 322 species as having been ascertained to occur in that country, of which twenty-seven, so far as our present knowledge extended were peculiar to Palestine, and the districts immediately adjacent. Nine of these were now described for the first time, and several others had not been previously brought to England.—Mr. W. H. Flower read some Notes on the skeletons of the *Balænidæ,* as observed by him during a recent visit to the principal Museums of Holland and Belgium. Mr. Flower also characterised a new species of Grampus, from Tasmania, under the name of *Orca meridionalis.*— Mr. A. Newton read a Paper, entitled, "Notes on the Zoology of

Spitzbergen," made during a recent visit to that country.—A Report was read by Dr. Günther on the Reptiles and Fishes collected during Mr. Tristram's recent expedition in Palestine. The most interesting part of Mr. Tristram's collection was perhaps the series of Fishes from the Lake of Galilee, of which the greater part proved to be new to science. Amongst the most remarkable of these were several species of the African genera *Chromis* and *Hemichromis*.—Dr. Günther also described some new species of Batrachians from Western Africa. —Four Papers were read by Dr. Gray. The first of these was entitled "Notes on a Revision of the Specimens of Viverrine Animals in the collection of the British Museum, with descriptions of some new genera and species," by which it appeared that about 102 species of this family were known to science, of which upwards of eighty were represented in the British Museum. Dr. Gray's second Paper was a notice of a new variety of *Galago* from Quillimane, proposed to be called *Otagale crassicaudata* var. *Kirkii*. The third was a note on the Clawed Toads (*Dactylethra*) of Africa, and the fourth a general revision of the genera and species of the Lizards of the family *Chameleonidæ*.—Mr. Sclater pointed out the characters of the new Duck from Madagascar, proposed to be called after its discoverer, Dr. Meller, *Anas melleri*.—A Paper was read by Mr. E. Blyth, entitled "Notes on sundry Mammalia."—Mr. O. Salvin characterised nineteen new species of Birds lately received from Costa Rica, amongst which was a new form of the family *Cotingidæ*, proposed to be called *Carpodectes nitidus*.—A communication was read from Dr. J. C. Cox, of Sydney, New South Wales, describing two new species of Land Shells, proposed to be called *Helix Mackleayi* and *Succinea eucalypti*.—Extracts were read from some Letters addressed by Mr. R. Swinhoe, H.M. Consul in Formosa, to Dr. Gray, describing several recent additions to the Mammal-fauna of Formosa.

November 22nd, 1864.

The Secretary called the attention of the meeting to some recent important additions to the Society's Menagerie, amongst which was a young female Chimpanzee, just received from West Africa.—A Paper was read by Dr. P. P. Carpenter, entitled "Contributions towards a Monograph of the *Pandoridæ*."—Mr. St. George Mivart read a Communication "On the Crania and Dentition of the *Lemuridæ*," giving the results of his investigations of the specimens of this group of animals contained in the British Museum, and the

Museum of the Royal College of Surgeons. According to the author's views the *Lemuridæ* were divisable into four natural sub-families, the *Indrisinæ*, *Lemurinæ*, *Nycticebinæ*, and *Galagininæ*.—A Communication was read from Dr. J. C. Cox, of Sydney, New South Wales, giving the descriptions of four new species of Australian Land Shells, lately received from Port Clarence.—Mr. P. L. Sclater pointed out the characters of some new species of Birds discovered in Brazil by the late Dr. John Natterer, of which he had lately obtained duplicate specimens from the Imperial Collection of Vienna. The most noticeable of these was a new species of the genus *Granatellus*, proposed to be called *G. pelzelnii*, and a new Tanager, the *Tanagra olivina* of Natterer's MS.—A Communication was read from Dr. L. Pfeiffer describing seven new species of Land Shells from the Cumingian collection.—Dr. J. E. Gray communicated a notice of the atlas and cervical vertebræ of a Right Whale in the Sydney Museum, New South Wales, which appeared to indicate the existence of a new form of this group distinguished by the complete separation of the atlas from the other vertebræ, and by other characters. Dr. Gray proposed for this Whale the name of *Macleayius australiensis*.

December 13*th*, 1864.

Professor Owen, F.R.S., read a further Memoir on *Dinornis*, being the ninth of a Series of Contributions to the Society's "Transactions" on this subject. The present section contained the description of the skull, atlas, and scapulo-coracoid bone of *Dinornis robustus* Owen. It was founded partly on materials submitted to his examination by Dr. D. S. Price, consisting of a mutilated cranium, and other bones, which had been obtained from the bottom of a crevice, about 50 feet deep, in a limestone rock, situated a few miles south of Timarn, in the Middle Island of New Zealand, and partly on a skull found with a skeleton, almost entire, in the valley of Manuherikia, Otago. The skeleton last referred to had been disinterred by gold-miners from one of the large basins of ancient tertiary date, which characterise the auriferous region of the interior of the province of Otago, and had been transmitted to the Museum of the Yorkshire Philosophical Society at York, the Council of which had placed it at Professor Owen's disposition for the purpose of description.—Mr. Gould exhibited and described the egg of *Parra gallinacea*, from Eastern Australia, of which he had lately received two specimens from Mr. Hills, to whom they had been forwarded by his relative, Sir Daniel Cooper.—A Paper was read by Mr. C. Spence Bate and Mr. J. K. Lord, containing descriptions of new species of crustaceans discovered by the latter gentleman on the coasts of Vancouver's Island.—A Communication was read fron Mr. W. Harpur Pease, containing remarks on the species of genus *Succinea*, inhabiting the Tahitian Archipelago, with description of a new species.—A second Communication was likewise read from Mr. Harpur Pease, entitled "Descriptions of new species of Land Shells from the islands of the Central Pacific."—A Paper was read by Dr. J. E. Gray, entitled "A revision of the genera and species of Ursine animals, (*Ursidæ*) founded on the specimens contained in the collection of the British Museum." This family, as arranged by Dr. Gray, was stated to embrace ten genera and twenty-two species—nine of which were inhabitants of the Old, and twelve of the New World, while one was common to the arctic portions of both hemispheres.—Dr. John Kirk communicated a list of mammalia met with in the Zambezi region of Eastern Tropical Africa. The total number of mammals enumerated by Dr. Kirk was sixty-seven. Amongst these were a bat and an antelope considered to be new to science, and proposed to be called respectively *Nycticejus nidicola* and *Nesotragus Livingstonianus.*—Mr. P. L. Sclater read a list of the collection of monkeys living in the Society's menagerie. The series now exhibited in the lately erected monkey-house was stated to consist of seventy-four individuals, belonging to forty-three different species, amongst which were several of great rarity.—Mr. Bartlett exhibited a curious variety of the common partridge, *Perdix cinerea*, from the collection of Mr. J. Gatcombe. The specimen was stated to be one of three similar individuals lately obtained, in a wild state, in the neighbourhood of Paris.

XV.—Miscellanea.

1. Dimorphism in the Genus Cynips.

The Proceedings of the Entomological Society of Philadelphia, for March last, contain an interesting paper by Mr. B. D. Walsh, on Dimorphism in the genus *Cynips*. His observations relate principally to *C. q. spongifica* and *C. q. aciculata*, which have hitherto been regarded as distinct species, but which Mr. Walsh looks upon as merely two forms of one and the same insect.

That the two forms are distinct enough is evident. Mr. Walsh calls attention particularly to nine points of difference.

"1. The fovea at the base of the scutel is twice or thrice as deep in *spongifica*, and the longitudinal carina which bisects it is twice or thrice as lofty."

"2. In *spongifica* there are three deep and wide, transversely corrugated, longitudinal striæ or sutures in front of the scutel, one central one extending nearly to the collare, but becoming narrower as it approaches it, and two divergent lateral ones fading out as they approach the humerus. In *aciculata*, it is only in particular lights that traces of these striæ are discoverable, and they do not extend nearly so far forwards."

"3. In *aciculata*, on each side of the notum, beginning at the collare and terminating suddenly about half way to the scutel, is an almost invariably conspicuous, obtuse, glabrous carina, each parallel with the other, and distant from the other about as far as the two posterior ocelli are. In *spongifica* it is only in two or three specimens and in certain lights, that faint traces of these two carinæ are discoverable."

"4. In *aciculata*, the mesonotum is very finely aciculate, or covered with fine regularly parallel rugæ before the scutel, except in two or three specimens, where it is somewhat irregularly, but very finely rugose. In *spongifica* it is very coarsely rugose. There is some little variation in both these two forms, but comparing the most coarsely sculptured *aciculata* with the most finely sculptured *spongifica*, the rugosities are at least twice as coarse in the latter, *i.e.* each rugosity is twice as wide."

"5. The sculpture of the rest of the thorax, and also of the head, is about twice as coarse in *spongifica* as in *aciculata*."

"6. The body of *aciculata* is uniformly black, except that the abdomen is sometimes piceous below. In two ♀ *spongifica* the thorax is almost rust red, (as observed in a single ♀ *C. q. coccineæ* by Osten Sacken, Proc. Ent. Soc. Phila. J., p. 244,) and the abdomen piceous red; in another ♀ the thorax is tinged with rust red and the abdomen piceous; and in the fourth ♀ the thorax is black, and the abdomen is piceous red; the remaining ♀ specimen being uniformly black, as are also both ♂ ♂. In the closely allied or identical species *q. inanis*, however, one of my two ♂ ♂ has a piceous red abdomen, and all my 9 ♀ ♀ have a black thorax and a piceous red abdomen."

"7. Viewed laterally, the upper edge of the second abdominal joint (counting the peduncle as the first joint) describes a circular arc of about 60°, in both forms. Taking the chord of this arc as a definite and permanent basis of measurement, in *spongifica* ♀ the lower or ventral edge proceeds straight downwards, exactly at right angles with this chord, for a distance equal to half or one-third the length of the chord, before it curves gradually backwards, to form the ventral arch. In *aciculata* ♀ on the contrary, instead of being at right angles (90°) with the chord, it forms with it an angle of about 110°, so as to exhibit a most extraordinary bulge in front, and it curves much farther downwards from the peduncle, and in a more compressed and knife-edged form, so that the abdomen is vertically at least as wide as long, and almost always much wider, whereas in *spongifica* ♀ it is always longer than wide, generally much longer. The above variation in each form is caused by the terminal abdominal joints being more or less telescopically drawn out in different specimens, so that in each form the second abdominal joint sometimes occupies dorsally half the entire length of the abdomen, exclusive of the peduncle, and sometimes almost two-thirds. St. Fargeau has observed the same thing of the genus *Megachile*, (Hymenopt II., p. 338,) and I only notice it here because Osten Sacken, having only a few specimens of each form on hand, supposes the relative length of the second abdominal joint with regard to the terminal joints to be a terminal character of each (Proc. Ent. Soc. Phil. I., p. 246.)"

"8. In consequence of the above bulge on the anterior abdomen in *aciculata*, (see Appendix, Fig. 1) the distance from the "ventral valve" (Fig. 1, v.) to the "dorsal valve" (Fig. 1, 7) is proportionately twice as long as in *spongifica*, and consequently the sheaths of the ovipositor (Fig. 1, s.s.) are also proportionally twice as long, though their proportional breadth in both forms is nearly the same."

"9. With the exception of a single specimen, my 30 ♀ *aciculata* are one quarter broader and longer than my 5 ♀ *spongifica* and my 9 ♀ *inanis*, all 14 of which are remarkably uniform in size, save a single ♀ *inanis* which is a little smaller than the rest."

"These nine differences are sufficiently remarkable, and, but for "the evidence of dimorphism, would," as Mr. Walsh truly observes, "undoubtedly be viewed by every entomologist as of specific value."

Mr. Walsh's reason for regarding these two forms as belonging to the same species is as follows:—In May and June, 1863, he gathered a number of galls from a black oak (*Q. tinctoria*), some of them "had the terminal nipple attributed to the gall of *spongifica* "by Osten Sacken, some were smoothly spherical as the gall of "*aciculata* is described by the same author, many had several nipples "scattered irregularly over their surface, and two or three had as "many as 12 or 14." During the month of June, 26 of these galls, and what is very interesting, some of all types, produced imagos 6 ♂ and 20 ♀ all of *C. spongifica.* After the 18th June, no more were produced until October, when from 50 to 60 specimens made their appearance, all ♀ and all belonging to the form known as *C. aciculata.*

Mr. Walsh supposes that *C. q. aciculata*, O.S. is a dimorphous form of *C. q. spongifica*, O.S., that it occurs exclusively in the ♀ sex and exclusively on *Q. tinctoria*, and emerges from the last of September to the middle of November, and many of them not till the following Spring, from galls that commenced their growth in the preceding May, which are undistinguishable from those which produce *C. q. spongifica*, the same kinds of gall from the same lot of trees, gathered at the same time, producing *spongifica* ♂ ♀ in June and *aciculata* ♀ in October and November, and nothing whatever but a solitary parasite in the intervening period.

We cannot but think that Mr. Walsh has been a little hasty in this conclusion. It is quite possible that two species may produce very similar galls.

Nevertheless, the conditions of life among the Cynipidæ are so abnormal and so interesting, that we hail with pleasure every attempt to penetrate the mystery by which they are surrounded.

J. L.

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2. Return of Dr. R. Spruce—the Botanical Traveller.

We extract from the *Reader* of the 12th of November last, the following account of the South-American Explorations of Richard Spruce, who has lately returned to this country after many years absence.

"A short time ago there returned amongst us, after an absence of fifteen years, and much broken in health, a traveller whose explorations in South America are more extensive and of greater scientific value than any that have of late years been recorded. Their value will doubtless be as fully appreciated by the public at large when their results shall have become more generally accessible as they are now by those scientific men who have never lost sight of the enterprising explorer from the moment he left our shores till his happy return a few weeks ago. In Germany his services have been promptly recognised by the oldest scientific body of that country, the Imperial Academy Naturæ Curiosorum, which has conferred upon him the degree of Doctor of Philosophy, the highest honour it was in their power to bestow.

Dr. Spruce left Liverpool on the 7th of June, 1849, and reached Pará on the 12th of July. After spending three months in exploring the environs of that city, he ascended the Amazon to Santarem, at the mouth of the Tapajoz, and in November of the same year went seventy miles farther up, to Obydos, where the Amazon is at its narrowest and deepest. Starting from Obydos, he explored the Trombetas and its tributary the Aripecurú, as far as the cataracts of the latter, in lat. 0° 47′ N., fixing five latitudes by astronomical observations, and making a map of those previously unknown rivers. Returning to Santarem in January, 1850, he remained there exploring the lower part of the Tapajoz and adjacent parts of the Amazon until October, when he started up the Amazon for the Barra do Rio Negro, where he arrived after a voyage of sixty-three days, thirty whereof were spent in the channels to the south of the great island of Tupinambarána.

The greater part of the year 1851 was occupied in studying and collecting the rich vegetation of the lower part of the Rio Negro and of the Amazon for a few days' journey up; and in November he started for the head-waters of the Rio Negro, in a boat of about nine tons burthen, which he had fitted up expressly for the object. Early in January, 1852, Dr. Spruce reached the village of Sao Gabriel, situated about midway between the *Cachoeiras*, or cataracts, of the Rio Negro; and, after remaining there some seven months, he proceeded up the large river Uaupés, which had been scarcely known to Europeans even by name until Mr. Wallace's adventurous exploration of it in the preceding year. Dr. Spruce found the Uaupés to possess a more novel and beautiful forest-vegetation than any other part of South America which he visited; and his collections include several undescribed genera, besides many species notable for their beauty and the value of their products. Dr. Spruce remained on the Uaupés until March, 1853, when he sailed out of it into the Rio Negro and up the latter river, beyond the Brazilian frontier, to San Carlos del

Rio Negro. This village was his head-quarters during his stay in Venezuela, which extended to November, 1854, or more than a year and a half. During that time he made two expeditions to the Orinoco—one by the way of the Casiquiari, and the other by the portage of Pinichin and the Atabapo. On the former of these, besides examining the Casiquiari, both ascending and descending, he explored its tributary, the Pacimoni, to its source, among the lofty and picturesque mountains called Iméi and Tibiali, as also the river Cunucunúma, which bathes the western foot of the immense granite mass of Dinda, and enters the Orinoco a little below the bifurcation of the Casiquiari. On his second visit to the Orinoco he went as far down as the cataracts of Maypures, rendered famous by the narrative of Humboldt and Bonpland. There and elsewhere, in the region of the Upper Orinoco and Rio Negro, he gathered many of the plants discovered by those illustrious travellers, and which had not been seen since by any botanist. He also constructed maps of the hitherto unsurveyed rivers Cunucunúma and Pacimoni.

Leaving Venezuela, Dr. Spruce descended the Rio Negro, and reached the Barra do Rio Negro about the end of 1854, after an absence of above three years. Having reposed there over two months, he took advantage of the steamers which had been lately established on the Amazon to ascend that river beyond the Brazilian frontier to Nauta in Peru, near the mouth of the Ucayali, and thence went in canoes up the Marañon, and its tributary the Huallaga, to Tarapoto, a large and thriving town in the ancient province of Maynas. In the lovely valley of Tarapoto—which, like many similar ones in the eastern roots of the Andes, will one day be the site of a magnificent city, when the immense resources of the Amazon valley, and its unrivalled fluvial system shall have been fully developed—he remained nearly two years, and collected there, besides a vast variety of other plants, no fewer than 250 species of ferns in an area of only fifty miles in diameter.

In March, 1857, Dr. Spruce left Tarapoto for Ecuador, descending the Huallaga to its confluence with the Marañon, and then ascending the latter river and its affluents the Pastasa and Bombonasa to Canelos; finally, through the forest of Canelos on foot to the village of Baños, at the foot of the volcano of Tunguragua. In this disastrous journey, which occupied a hundred days, he had to abandon all his goods in the forest to escape perishing of hunger at the passage of swollen rivers. Making Baños his head-quarters, he devoted above six months to the exploration of the forests and *paramos* of its huge volcano, and of the upper part of the valley of the Pastasa.

In January, 1858, he removed to Ambato, which, for more than two years was his point of departure for excursions to Quito, Riobamba, &c., and to various points in the eastern and western cordilleras of the Quitenian Andes, although his movements were much harassed and restricted by the revolutionary state of the country during nearly the whole of that period. In 1860 Dr. Spruce communicated a valuable paper to the Royal Geographical Society on the mountains of Llanganati, in the eastern cordillera of the Quitenian Andes (J.R.G.S. for 1861, p. 163-84). He has also communicated numerous important papers to the Linnean Society.

In 1860 he was occupied for some months in procuring seeds and plants of the *Chinchona succirubra*, or Red Bark plant, for cultivation in India—a task which was confided to him by Mr. Clements R. Markham, on behalf of Her Majesty's Government. Dr. Spruce displayed great zeal and resolution in performing this arduous service while suffering from the effects of rheumatic fever, and his labours received the unqualified approbation of the Secretary of State for India. His elaborate report on the expedition conducted by him to procure these seeds and plants (accompanied by a meteorological journal and a complete sketch of the vegetation of the Chinchona forests) is by far the best that has appeared on this subject in any language, and has been invaluable as a guide to the cultivation of these precious plants in India. It covers 111 printed pages. Afterwards, his broken health seeming to require a return to a warm climate, he removed to the plain of Guayaquil; and his active labours as a botanist may be said to have closed with the picking up of a few plants in that neighbourhood during the year 1861 and during 1862 at Chanduy, on the coast, near Punta Santa Elena, where an exceptional rainy season, coming after an interval of fifteen rainless years, enabled him to make a small but interesting collection of the ephemeral plants, which, under the influence of the rains, sprang up on the desert, and also of several curious trees and shrubs, whose blackened stems had not for some years past put forth even a leaf.

The results of this long course of travel (the objects of which were at first purely botanical) comprise from 6000 to 7000 species of flowering plants and ferns, whereof a very large proportion were entirely new to science, especially among the trees, of which the timber and other products were also ascertained to be in many cases of great value. Several new species may be instanced, and one entirely new genus, of trees producing the best kind of caoutchouc, which is now extracted from them in large quantities by the Brazilians, but which was not in use until Dr. Spruce pointed the trees out on the Rio Negro and elsewhere. His specimens of all these plants are preserved in the principal public and private collections in the world, and are, therefore, perfectly accessible for the purposes of science. A very large collection of cryptogamic plants—perhaps the largest ever made by any single collector—still remains to be worked up.

Dr. Spruce's MSS. contain, besides notes on all the plants collected, vocabularies of twenty-one native languages of the Amazon valley, meteorological observations, barometric levellings, &c., throughout the regions visited, maps of three rivers which had not previously been surveyed, notes of the aspects and capabilities of the various countries, of the customs, food, trade, and agriculture of their inhabitants."

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3. Natural History in Natal.

We have received the following letter:—

4, Corah Terrace, Port Elizabeth,
Algoa Bay, Cape of Good Hope, 14*th October*, 1864.

Gentlemen,—I have been resident in this colony two years, during which time I have given a good deal of time and attention to the Natural History of the country. The nucleus of a small museum is now being increased, and I hope, before many years, it will become a flourishing institution. We have upwards of fifty species of reptiles, a considerable collection of insects, and a small one of plants. This institution was originally set on foot by Dr. Rubidge of this town, who has devoted a good deal of attention to the Geology of this colony.

Mr. R. Pinchin, resident engineer, has made an excellent map of a section of this colony, from this Port to Somerset East, through the Zuurberg Mountains.

I write this letter to you with the hopes of drawing the attention of such men as Messrs. Darwin and Wallace to some interesting caves, which have been discovered here lately, some in the George District, and some in the Transvaal Republic, a thorough examination of which, I believe, would prove of much value to science. Mr. Colman, of Grahamstown, who has visited these latter caves, situated on the Vaal River, has brought down several specimens of minerals, some of which I have seen, but have missed the opportunity of talking with that gentleman himself.

I am now making a tour into the Free State, but fear my time will not permit my visiting the Transvaal. I purpose, as I go along, collecting, to make notes on the various points of interest, and will visit any caves I may hear of. When I left England I had not the pleasure of personally seeing Professor Huxley, but have endeavoured in vain to obtain for him specimens of Bushmen's crania. I may be more successful now, and should I meet with any will certainly forward them.

I may mention to you, that there is, to the south of Port Elizabeth, and a few miles from the town, a considerable deposit of sand, filled with shells, all apparently of recent species. In these beds are some fragments of a very coarse kind of crockery, containing quartz and sand, but principally formed of clay. I have not had time, as yet, to investigate them thoroughly, but think they will prove interesting.

There are few persons here who interest themselves in science, but a garden of acclimatization and botany, improperly called a park, is being started, and we are very desirous to obtain tea and chinchona plants, in order to give them a trial.

I may mention, that I have several times noticed dun-coloured foals in this colony with stripes; and only two Sundays ago, saw a very young one with the slightest possible trace of them on its legs.

If you could, in any way, give our small efforts publicity, I may, speaking in the name of our committee, say that we should feel much obliged. For, unless we get some sort of recognition at home, the work of pushing ourselves forward here is rather disheartening.

Apologising for thus writing at length,

I am, Gentlemen,

Your obedient servant,

J. P. Mansel Weale, B.A.,

Late of Trinity College, Oxon., and Curator of the Department of Practical Science Museum, P.E.

To the Editors of the "Natural History Review."

4. Progressive Extinction of the Native Fauna in New Zealand.

The following extract from a letter, from John Webster, Esq., dated Hokianga, New Zealand, 17th December, 1863, addressed to Mr. E. L. Layard, of Cape Town, relates to a subject already alluded to in this Journal:—

"The box sent contains the Kiwi's egg, and a few birds'-skins, which may, or may not, be new to you. I am sorry New Zealand is so poor a country for ornithological specimens, otherwise I might have made up a box more worthy of your acceptance.

It is being remarked by the natives and old settlers that many of the native birds are getting scarcer, and a few varieties have all but disappeared. This has been brought more under my notice since I began collecting for you. Of birds that were formerly common, I have failed in getting even a single specimen. Early navigators and visitors to New Zealand speak with raptures of the melody in early morn, of the birds in the woods. It was so on my first arrival in the country. I can now say, from personal knowledge, that it is a fact that the native birds are rapidly disappearing, and the question is—what is the cause?

I think it is owing to the ravages of the common rat. The bush and country is swarming with them; they are found in the trees, on the ground, by the water, and in the water. Indeed rat-life is rampant at the present moment in New Zealand. Birds' nests are found empty every where, where they ought to have been tenanted, and nests under my own eye have almost invariably been robbed by the vermin. I speak feelingly—the silence of our summer mornings is like a note struck out of natural melody."

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5. Notice of a Mule Breeding.

Mr. A. Fonblanque, of the British Consulate at Alexandria, has communicated to Mr. Darwin a notice of a "curious birth" which has lately taken place at Cairo—that of a foal produced by a mule. Mr. Fonblanque says, so great was the excitement at this unheard of event amongst the native population that it produced an official enquiry—a copy of which, together with a certificated translation, Mr.

Fonblanque has forwarded along with his letter announcing the *prodigium.* The latter consists of the deposition of one Mohamed Effendi Ashmani—a veterinary surgeon—before the police at Cairo on the 27th June, 1864, and states that, on the previous day, the said Mohamed had proceeded, "in pursuance of instructions received, to "the house of one Ibrahim, a master marbler, situate at Darb el "Ahmar, to examine a mule, which had given an offspring. It "appears that the said mule had been covered by an ass, as the off-"spring is a jennet. The mule is twenty-two years of age, and as "she has no milk, which is indispensable to maintain the jennet, "directions were given for feeding it."

Although Mr. Fonblanque has no personal knowledge of this case, he does not believe that "any intentional deception has been practised." "No attempt has been made to turn the affair to profit by exhibition or otherwise—in fact, it furnished considerable annoyance to the owner of the animal."

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6. The Dentition of the Aye-Aye.

The anatomy of the Aye-Aye (*Chiromys madagascariensis*) formed the subject of a paper read by Dr. W. Peters, before the Berlin Academy, on the 14th of April last, in the course of which he gave some interesting particulars relative to the milk-teeth of this animal. Professor Owen's valuable essay on this genus has made us acquainted with several new points in which it approaches the Lemurs, whilst, on the other hand, the structure of its incisor teeth, which are covered with enamel at the front only, and are not, as Blainville has stated, entirely surrounded by it, shows an important relation to the Rodents. It is, therefore, a point of some interest to study the milk-dentition of the genus, and to ascertain whether Blainville's supposition as to the presence of teeth between the molars and incisors during the primary dentition be true or not. No teeth are found between the two large incisors, where, according to Blainville's conjecture, there should be another pair of smaller incisors during immaturity. On each side, however, behind, and at some little distance from them, nearly in front of the upper maxillary, is a very small deciduous incisor; and, at the front end of the upper maxillary, a somewhat stronger but shorter canine. Further backwards in the upper jaw are two molars, the first of which is small and deciduous, but the second precisely resembles both in form and size the false molar of the adult animal. It is not, however, permanent, as Professor Owen has supposed, since there is above it an alveolus containing the germ of a new tooth. No traces of teeth corresponding to the posterior upper incisor and the canine are found in the lower jaw; but on the left side the two corresponding molars, and on the right side the posterior molar only, are present. The latter tooth had been previously noticed by Gervais. The space between these molars and the incisors is covered with smooth membrane; so that if teeth had previously existed there, they must have been exceedingly small. As regards the upper and lower true molars, the crowns only are partly developed. The deciduous formula of this genus is therefore as follows:—$\frac{2}{1}$, $\frac{1}{0}$, $\frac{1\text{-}1\text{-}1\text{-}1}{1\text{-}1}$, $\frac{1}{0}$, $\frac{2}{2}$, which exhibits a close relation to that of the Insectivora, in which the lateral incisors, the canines, and the teeth in the diastema often become obliterated owing to the increased development of the anterior incisors. Another distinction between this genus and the Glires is that, in the female, the distance between the anal and genital apertures is very considerable, and the two-horned uterus differs in shape from that of the Rodents. The internal structure differs from that of the genus *Lemur* and *Microcebus* in the fundus of the gall-bladder being, as is usual, directed forwards, and not backwards. If we are not prepared to make a separate order for this genus, to be placed between the Quadrumana and the Rodentia, as Brandt has proposed, it would, on the whole, be the most natural to regard it as an aberrant family of the Lemurs, according to Isidore Geoffroy's suggestion. Besides the form of the soles, and the opposable thumb of the hinder extremity, the principal characters to be considered are the formation of the skull and of the brain. As regards the dentition, it would be of much interest to investigate whether at any period of the fœtal life of the Glires, there exist teeth corresponding to the milk-teeth of the *Chiromys*.

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7. Calluna vulgaris in Cape Breton, in North America.

Notices respecting the existence of the *Calluna* in Massachusetts and Newfoundland have appeared in former numbers of this Review, namely, No. VII. page 346, No. XIII. page 151, and No. XIV. page 313. It is worth while to add to those two former records an intermediate habitat, as a link of connection, which fixes the American shrub in a latitude only about four degrees to the northward of Massachusetts. Professor George Lawson, of Halifax, Nova Scotia, has favoured me with a flowering specimen of the *Calluna*, sent through the post, and located by its accompanying label at "St. Ann's Bay, County of Inverness, Cape Breton Island, August 30, 1864." I do not detect any constant difference between this example from Cape Breton and the *Calluna* of Europe and its islands. Among two score specimens in my herbarium, varying somewhat among themselves, I find some of similar slender growth, and with the flowers equally large as in this American example; also seemingly with the flowers equally globular, through the curling inwards of the coloured calyx, although that alleged difference between the European and Massachusetts flowers is not so readily judged of in a dried example. The flowers on the little specimen from Cape Breton are few and distant, comparatively with the European examples in my own herbarium; but I believe to have seen them quite as sparingly scattered on living English plants of the *Calluna*.

HEWETT C. WATSON.

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8. Discovery of Asplenium viride, in New Brunswick.

I have just received a specimen of *Asplenium viride* from G. F. Matthew, Esq., of the Natural History Society, St. John's, New Brunswick, gathered on sea-cliffs, Taylor's Island. This discovery is a most interesting one in connection with the glacial migration of Scandinavian plants over the North American continent; the plant being common in the subalpine regions of Europe, and also found in the Rocky Mountains, but not occurring in Greenland or in any other part of North America.

J. D. HOOKER.

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9. The Tartarian Antelope alive in England.

A recent interesting addition to the Zoological Society's series of living Mammals is a young male example of the Tartarian Antelope (*Saiga tartarica*), an inhabitant of the Steppes of Central Asia, which has, we believe, never before been brought alive to Western Europe, and is a rare animal even in museums. In its outward appearance the Saiga is certainly very different from the Gazelles (*Gazella*), with which it is structurally not very distantly allied, and gives one more the idea of a Sheep than one of the elegant group of Antelopes, although its singular swollen nose renders it very distinguishable from every other known Ruminant. It will be recollected that the Saiga is the only true Antelope that has a high northern range—nearly the whole species of this numerous division of the Bovidæ being confined to Africa and South-western Asia.

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10. List of Publications Received.

(1.) Entozoa: An Introduction to the Study of Helminthology, with reference, more particularly, to the Internal Parasites of Man. By T. Spencer Cobbold, M.D., F.R.S., London. Groombridge and Sons. 1864.

(2.) Die menschlichen Parasiten und die von ihnen herrührenden Krankheiten. Ein Hand- und Lehrbuch fur Naturforscher und Aerzte. Von Rudolf Leuckart. Leipzig und Heldelberg. 1863.

(3.) Homes without Hands, &c. By the Rev. J. G. Wood, M.A., F.L.S. Parts VII.—XI. Longman and Co. 1864.

(4.) Oversigt over det Kongelige, danske Videnskabernes Selskabs Forhandlinger, og det Meddlemmers Arbeider i Aaret 1862. Kjobenhaven. 1863.

(5.) Ofversigt af Kongl. Vetenskaps-Akademiens Forhandlingar. 1863. Nos. 9, 10. 1864. Nos. 1, 2, 3, 4. Stockholm.

(6.) Mittheilungen der Naturforschenden Gesellschaft in Bern. aus dem Jahre 1863. Hft. 531—552. Bern. 1863.

(7.) Die Klassen und Ordnungen des Thier-Reichs, wissenschaftlich dargestellt in Wort und Bild. Von Dr. H. G. Bronn. Band I. Amorphozoa. Leipzig und Heidelberg. 1860. Band II. Actinozoa. 1860. Band III. Part 1. Malacozoa. 1863.

(8.) Abhandlungen des zoologisch-mineralogischen Vereines in Regensburg. Heft IX. Regensburg, 1864.

(9.) The Dublin Quarterly Journal of Medical Science. No. LXXVI. November, 1864. Dublin, Fannin and Co.

(10.) The Canadian Naturalist and Geologist. Vol. I. Nos. 3, 4. Montreal, 1864.

(11.) On the Growth of the Jaws. By G. M. Humphry, M.D. F.R.S. (From the Transactions of the Cambridge Philosophical Society, Vol. XI.)

(12.) The Anthropological Review. No. 7. November, 1864. London, Trübner and Co.

(13.) Harmonic Maxims of Science and Religion. By the Rev. W. Baker, M.A. London, Longman and Co. 1864.

(14.) Our House and Garden: What we see, and what we do not see, in them. By Cuthbert Johnson, F.R.S. London, Ridgway. 1864.

(15.) Report on the Government Central Museum, and on the Agricultural and Horticultural Society of Western India, for 1863. By E. Birdwood, M.D. Bombay. 1864.

(16.) Neu-Guinea, und seine Bewohner. Von Otto Finsch. Bremen. 1865.

(17.) The Neanderthal Skull. By Joseph B. Davis, M.D. London, Taylor and Francis. 1864.

THE

NATURAL HISTORY REVIEW:

A

QUARTERLY JOURNAL OF BIOLOGICAL SCIENCE.

Reviews and Notices.

XV.—The Zoology of British India.

(1.) Catalogue of the Mammalia in the Museum of the Asiatic Society of Bengal. By Edward Blyth, Curator, Calcutta, 1863.

(2.) The Birds of India, being a Natural History of all Birds known to inhabit Continental India. By T. C. Jerdon, Surgeon-Major, Madras Army, 3 vols. 8vo. Calcutta, 1862-4.

(3.) The Reptiles of British India. By Dr. Albert Günther. London, 1864. Published for the Ray Society, by Robert Hardwicke.

In our last number we called attention to the recent publication of three works relating to the Zoology of British India, the titles of which are again given at the heading of the present article. We also endeavoured to furnish our readers with a general outline of the principal features of the Mammal-fauna of India, as deducible from an examination of the first of these works. On the present occasion, taking the second of these publications as our chief text, we shall attempt to give some sort of general account of the principal forms of the second great class of Vertebrates—that of Birds—which inhabit the same country.

In Dr. Jerdon's volumes we have to deal with a work of much greater pretensions, and indeed of quite a different character from Mr. Blyth's "Catalogue of Mammals." Dr. Jerdon's aim, as he has told us in his prospectus, was to issue a "Manual, which should "comprise all available information, in sufficient detail for the dis- "crimination and identification of such objects as might be met "with, without being rendered cumbrous by minutiæ of synonymy or "of history." And so far as regards the Ornithology of India—taking the difficulties and the novelty of the task into due consideration, we think he has very fairly carried out the object he has had in view in the present volumes, which are the first of a series of similar Manuals intended ultimately to embrace all the vertebrate classes of Indian Zoology.

Of the great want of such a series of Manuals we think there can be no question. There is no work at present in existence which can supply the information on such subjects required by the many residents in India, who now devote more or less of their spare time to the cultivation of some branch of Natural History. To obtain any acquaintance with what is already known on these subjects, it is necessary, as Dr. Jerdon well observes, to wade through the voluminous Transactions of learned Societies (such as those of the Asiatic Society of Bengal and the Zoological Society of London), besides divers scientific journals, wherein the records of the numerous Indian observers and describers of such objects are scattered piecemeal. These are of course perfectly inaccessible to the majority of the residents in the up-country stations in India, and even the Naturalist who dwells in one of the great capitals of Europe, will often be at a loss when he has occasion to refer to some of them. No one can deny, therefore, that Dr. Jerdon has achieved a good work in having brought to a successful conclusion his first Manual, relating to the Birds of India, contained in the three solid volumes now before us. And although we have heard a report that his labours in continuation of his present task are likely to be interrupted by orders from head-quarters to return to his ordinary duties as Surgeon-Major in the Madras Presidency, we trust that the approbation universally bestowed by the reviewers of Natural History works upon the present earnest of his labours, may induce the rulers of British India to continue the exercise of their unwonted liberality, until the final termination of his self-imposed task.

Before commencing our general survey of the Indian Ornis, as deducible from Dr. Jerdon's work, it may be as well to give an outline of the principal authorities which have heretofore dealt with this subject, and upon which Dr. Jerdon, with the assistance of his own prolonged personal investigations in the same field, has founded his work.

From the older writers on Natural History we can glean little special concerning the birds of the Indian peninsula, and countries immediately adjoining—indeed much of the territory now subject to British rule was *terra incognita* in the days of Linnæus and his immediate followers, at any rate, as far as its Natural products are concerned. "It is only within a very recent period," says the late Mr. Strickland, writing in 1844, "that any really original and "trustworthy researches have been made into Indian Ornithology. "Twenty years ago, the utmost that was done by the numerous "British officers in that country to illustrate this science, was to "collect drawings of the species which attracted their notice. These "drawings were in most cases made by native artists, who, be- "ing utterly ignorant of any scientific principles, executed them in "a stiff mechanical style, and neglected the more minute but often "highly important characters. Such designs are useful as aids to "scientific research, but ought not to usurp its place; yet, from "these materials the too undiscriminating Latham described, and "named a great number of so-called species, many of which have "not yet been identified in nature. The largest collection of these "drawings was made by the late General Hardwicke, a selection of "which were engraved and published in 1830; but though care- "fully edited by Dr. T. E. Gray, the number of nominal species "there introduced, shows the danger of founding specific characters "on the sole authority of drawings."

About the year 1830, however, several British officers resident in India became interested in the subject of Ornithology. The first contribution from these gentlemen to our scientific literature, was Major Franklin's "Catalogue of Birds, collected on the Ganges between Calcutta and Benares, and on the Vindhyan Hills," published in the Zoological Society's "Proceedings" for 1831. This was shortly followed by Col. Sykes' "Catalogue of Birds observed in the Dukhun," issued in the following volume of the same journal. About the same time also the "Journal" of the "Asiatic Society of Bengal"—a well.known scientific institution, of the merits of which we have already spoken in our last number—was started, and a third officer in the East Indian service, Lieut.-Col. S. R. Tickell, whose name is also well known to Science—published in it, "a list of the birds of Borabhum and Dholbum." In the succeeding volumes of that "valuable repertory of Oriental Literature," will be found numerous Ornithological papers of these and other Indian Naturalists—such as Hodgson, Hutton, Pearson, McClelland, Elliot, and Blyth, who have all worked long and laboriously in the same good cause. In 1832, Mr. Gould's celebrated series of illustrated Ornithological works was commenced by the publication of his "Century of Birds from the Himalaya Mountains,"—in which 100 of the many remarkable forms that people the southern slopes of the Himalayas were first pourtrayed. About the same period also Mr. Brian H. Hodgson, for many years British resident at the Court of Nepal, began his labours. This gentleman—it may be fairly said—has distinguished himself far beyond all his fellow-workers, by the great extent of his collections, and the numerous observations he has given to the public on almost every branch of Natural Science. Before Mr. Hodgson commenced his residence in Nepal, the Zoology of that country and of the high ranges of the great adjacent mountain-chain was almost unknown in Europe—and the novelties, which it fell to his lot to discover and describe were consequently both striking and numerous. With the utmost liberality Mr. Hodgson has from time to time presented the whole of his enormous collections to the British Museum, and to other scientific institutions in this country—and though it is much to be regretted that he has never collected the whole of his scattered writings into one connected series, this deficiency has been to some extent supplied by two catalogues of Mr. Hodgson's collections, published by the Trustees of the British Museum in 1846 and 1863. Referring to the list of Birds in the second edition of this catalogue, (prepared, we believe, by Mr. G. R. Gray,) it will be seen that the species of this class of Vertebrates obtained by Mr. Hodgson, in Nepal, Sikim, and Tibet, number no less than 658. Nearly the whole of these are represented in our National Collection, through Mr. Hodgson's munificence, by several specimens in skins, as well as by drawings made from life, and in many instances, by skeletons or portions of skeletons.

Of the impulse given to the study of Natural History generally in India, by the appointment of Mr. Eward Blyth to the post of Curator of the Museum of the Asiatic Society of Calcutta in 1841, we have already spoken in our previous article on the Mammals of India. Besides very numerous contributions to the pages of the Asiatic Society's Journal, in the shape of reports on the additions made to the Museum,* original papers and notices contributed by

* Referring to these reports Mr. Strickland has remarked :—"The reports which Mr. Blyth presents to the Asiatic Society, contain a mass of interesting observations, and present an example which the curators of European museums would do

correspondents, Mr. Blyth prepared and published in 1849, a "list of the specimens of birds" in the Society's Museum, which is of great scientific value, and for some years remained the only available guide for students to the scattered records of Indian Ornithology.

Although the Presidency of Madras has no Scientific Institution to compare with the Asiatic Society of Bengal, it produced for some years a "Journal of Literature and Science," to which Dr. Jerdon himself and Mr. Walter Elliot, lately member of the Supreme Council of that Presidency, contributed various memoirs relating to the characters and habits of the birds of that country. Dr. Jerdon's "Catalogue of the Birds of Southern India," with its two Supplements, published in that Journal in 1839, and the following years, still remains our best authority on the Ornithology of that district. In 1844, Dr. Jerdon made another valuable contribution to our knowledge of the birds of this part of India, by the issue of his "Illustrations of Indian Ornithology," in which fifty, chiefly before-unfigured birds of Southern India, are pourtrayed in a style which has generally been allowed to be very creditable, considering the circumstances under which the work was produced.

In 1839, the late Dr. John M'Clellan published in the Zoological Society's Proceedings, a catalogue of a small collection of Mammals and Birds, which he had collected in Assam, during his service with an expedition sent by the East India Company into that country. Little has been done, as far as we know, since that period, towards the further investigation of the Birds of Assam, and there is no doubt that the extreme frontiers of the British dominions in that direction, which now embrace a portion of the water-shed of the great rivers of Burmah, contain a promising field of investigation for future naturalists.

Of several minor contributions to the Ornithology of India, Dr. Jerdon, in his Introduction, speaks as follows:—

"Burgess has given an account of the habits, and nidification of "many of the Birds of Western India (Proc. Zool. Soc., 1854-55); "and Dr. Adams (Proc. Zool. Soc., 1859-60), has published two "lists, one of the Birds of Cashmere, and the other of the N. W.

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well to imitate. By comparing complete lists of the species comprised in each successive accession to the museum, accompanied by critical remarks on the more novel and interesting specimens, previous to their being incorporated into the general collection, a number of important observations on structure, habits, and geographical distribution are preserved from oblivion."—*Report of the Brit. Ass.* 1844, p. 187.

" Provinces, and Bombay, both containing some most instructive " details on the habits of the birds mentioned."

" Captain (now Lieutenant-Colonel) Tytler has given in the " Annals of Natural History, two highly interesting articles on the " Faunas of Barrackpore and Dacca. Kelaart and Layard have " written extensively on the Ornithology of Ceylon. Hutton has, " in various papers, given some interesting notes on the habits of " several birds, and their nidification ; and Tickell (Journ. As. Soc., " 1848), and Theobald (J. A. S. 1854), have also contributed to our " knowledge of the Ornithology of India. The notes of the Rev. " Mr. Phillips, on the habits of some of the birds of the N. W. " Provinces (P. Z. S. 1857), and Pearson's notes on the Birds of " Bengal (J. A. S.) also deserve notice."

To supplement this we may add that the well-known work of Sir J. Emerson Tennent, on " Ceylon," contains a well written summary of the Ornithology, as of the other branches of Natural History of this Island, to which such of our readers as have occasion to require information on this subject would do well to refer.

Two more important works relating to the Ornithology of India remain to be noticed, before we terminate our remarks on this subject. The first of these is the " Catalogue of the Birds in the Museum of the Hon. East India Company, by Thomas Horsfield, and Frederick Moore," two parts of which have been issued ; the first in 1854, the second in 1858. This work, unfortunately, remains and probably will remain, incomplete, owing to the removal of the old Museum from Leadenhall Street to Fife House, and the dissolution of the Company, to which it formerly belonged ; but the two volumes already published, for which, we believe, Science is mainly indebted to the exertions of Mr. F. Moore, are of great value, and contain the whole of the Rapacious, and Insessorial groups. The East India Museum has been made the resting place of the specimens and drawings of a long series of Indian Naturalists and Collectors, from the beginning of the present century. In the list of these we find the names of Hamilton, Raffles, Dr. Horsfield himself, Colonel Sykes, M'Clelland, Falconer, Griffith, Strachey and Cantor, all of whom have made large contributions to the Ornithological branch of the East India House Museum. A well drawn up catalogue of the collections amassed from these and other sources, containing so many types of descriptions and authenticated specimens, could not fail to be an important work. And the present catalogue has been rendered of greater importance from the way it has been prepared, not only full synonyms and explanatory remarks being given, but copious extracts, relating to the habits of the species, having been added, selected either from the MSS. of the collectors, or from their published notes in various Journals, and other publications. The Catalogue of the East India Company's Museum must, therefore, although now to a certain extent superseded by Dr. Jerdon's volumes, ever remain an important work of reference for the Indian Ornithologist.

Lastly, Mr. Gould's great work, "The Birds of Asia," although not specially devoted to the Ornithology of India, claims our attention, as containing full-sized and life-like illustrations of many of the rarer Indian birds, and destined ultimately, as we believe, to furnish us with similar figures of all the principal forms. Mr. Gould commenced the issue of this work in 1850, and has hitherto proceeded but slowly with it, publishing usually but one number in the year. Now that some of the other portions of his magnificent series have been brought to a conclusion, we trust that more rapid progress will be made with the "Birds of Asia"—as the importance of good coloured illustrations, for the ready identification of species in ornithology cannot well be over-estimated.

In concluding this rapid sketch of the principal authorities, upon which our knowledge of Indian ornithology is based, it will be noticed, that, as might have been expected, the work has been nearly entirely performed by our countrymen. One or two French naturalists, such as Jacquemont and Delessert, have, it is true, made some contributions to the same subject, in the reports of their several expeditions into the East. The well-known Swedish Ornithologist Sundevall also published in 1838 a valuable memoir upon the birds, collected and observed by himself, in the neighbourhood of Calcutta, during a three months' residence in that capital, which was translated into English by the late Mr. Strickland. With these exceptions, as we have already stated, the special work relating to the Indian Ornithology has mostly been performed by our compatriots.

Having said thus much about Dr. Jerdon's predecessors in the same field, let us now turn our attention to the summary of their labours he has prepared, with the advantage of great personal experience gained during many years' hard work on this and kindred subjects in different parts of British India.

Dr. Jerdon commences his work in orthodox fashion, with the

Birds of Prey, which, in India, are very numerous, being represented by no less than 81 species. Including the aberrant form, *Gypaetus*, there are seven Vultures, and amongst these most of the finest and largest species of this group of Birds, of which India may be considered to be the head-quarters. The Falconidae are likewise abundant throughout India; nearly the whole of our well-known European species extending their range through Southern Asia over the Indian Peninsula. Among these, are three, if not more, species of typical *Falco*, which are highly prized by the natives for hawking purposes. These are the *Shahin* (*F. peregrinator*) the *Laggar* (*F. jugger*), and our well-known Peregrine (*F. peregrinus*), called the *Bhyri* by the Indian falconers, although there are stated to be some small differences between the Indian and European examples of this bird. Of the third family of rapacious birds, the Owls, twenty-one species are enumerated by Dr. Jerdon as occurring in British India. Two of these, the fine large, naked-footed *Ketupa Ceylonensis* and *K. flavipes*, have the somewhat extraordinary habit of feeding chiefly, if not entirely, on fish. Mr. Tristram has recently made the interesting discovery,* that the former of these two species extends its range into Southern Palestine, where he found it exhibiting the same partiality for a fish-diet.

The very numerous group of Insessores, which follows next in Dr. Jerdon's pages, occupies the remaining portion of the first, and the whole of the second volume. The Avifauna of this part of the great Indian region, although not to be compared for variety of form and brilliancy of colour with that of the corresponding portion of the New World, still embraces a large and varied series of forms, belonging to this predominant section of the class *Aves*. Following the time-honoured, though we cannot say, the very natural arrangement of Cuvier, as modified by Swainson, Vigors and Gray, Dr. Jerdon divides his Insessores into five tribes, Dentirostres, Conirostres, Tenuirostres, Fissirostres, and Scansores, each of which contains, according to the arrangement adopted by our author, several families belonging to the Indian *Ornis*. Beginning with the Fissirostres, Dr. Jerdon commences his series of this group rather unhappily, as we think, by uniting the Swallows and Swifts in the same family. We are not indeed surprised that he should be able to quote "some strong remarks" by Dr. Kaup, as well as the opinions

* See P. Z. S. 1864, p. 430.

of Gray and Horsfield, in defence of this most unnatural combination but we regret that he should be able to adduce the respectable authority of Van Der Hoeven on the same side. When will our ornithologists begin to trouble themselves to study internal characters as well as external? A very slight acquaintance with the anatomy and osteology of the two groups in question serves to settle this (amongst ornithologists) much disputed point. Indeed, it is not necessary for them, in the present instance, to examine anything more than the feathers of one of their much-loved skins. Already, thirty years ago, Nitzsch had shown that the Swallows and Swifts are as distinct in pterylographic characters as in every other essential point of structure.

The Swallows are represented in India by some twelve or thirteen species, our familiar Swallow of this country (*Hirundo rustica*) standing at the head of the list, and the common Sand Martin and House Martin being also included in it. The Swifts of India belong to four well-marked types of structure, including, besides our two well-known European species, representatives of the Tree Swifts (*Dendrochelidon*), the Spine-tailed Swifts (*Acanthylis*), and the genus *Collocalia*, so celebrated as containing the birds which form edible nests from the inspissated product of their highly developed salivary glands. One widely distributed member of the last-named group is found in several parts of our Indian dominions, and about a hundred weight of its much-prized nests is stated to be taken annually from its breeding places on the Malabar coast.

The next family treated of by Dr. Jerdon is the Goat-suckers, or Night-jars (Caprimulgidæ)—represented in Europe by two species only, but in India by not less than ten species, belonging to several different genera, all of strictly insectivorous habits, and destined in this, as in other tropical climates, to keep in check the superabundance of insect-life. The Trogonidæ, which now follow, are a still more strictly tropical group, being exclusively confined to the hot countries of Asia, Africa, and America. In the Indian peninsula they are represented only by two species of *Harpactes*—a genus apparently exclusively insectivorous, although the more typical American members of the group feed, it is believed, nearly altogether on fruit. In the Bee-eaters and Rollers (Meropidæ and Coraciidæ), which now succeed, we meet with two allied families of insect-eating birds, peculiar to the Old World—and represented but feebly in Europe, but each of them containing several species which form well-known features in Indian Ornithology. The Indian Bee-eater (*Merops viridis*) is, as Dr. Jerdon tells us, "a very common "bird, and is a most characteristic adjunct of Indian scenery. It "generally hunts, like the Fly-catchers, from a fixed station, which "may be the top branch of a high tree, or a shrub, a hedge, a bare "pole, a stalk of grain or grass, some old building, very commonly "the telegraph-wires, or even a mound of earth on the plain. "Here it sits looking eagerly around, and on spying an insect, which "it can do a long way off, starts rapidly, and captures it on the wing "with a distinctly audible snap of its bill, it then returns to its perch, "generally slowly sailing with outspread wings, the copper burnish "of its head and wings shining conspicuously, like gold, in the sun-"beams. The Indian Roller (*Coracias indica*) is also a widely-"distributed and well-known bird—not quite so active as the last-"named species, but of somewhat similar habits. It generally takes "its perch on the top, or outermost branch, of some high tree, and, "on spying an insect on the ground, which it can do at a very great "distance, it flies direct to the spot, seizes it, and returns to its perch "to swallow it."

To the east of the bay of Bengal the Indian Roller is replaced by an allied form, the *Coracias affinis* of McLelland. Comparing specimens from distant localities these two generally-recognized species are quite distinct. But it is a noteworthy fact, that in the district where the two so-called species inosculate—that is in the neighbourhood of Calcutta—intermediate forms occur. In the Asiatic Society's Museum are specimens, procured by Mr. Blyth, "which "present every gradation of plumage from one to the other." Dr. Jerdon seems to believe that these are hybrids produced by the interbreeding of two originally distinct forms. Those who accept the doctrine of the derivative origin of species will prefer a much simpler and more easy solution of the problem.

Our well-known Kingfisher is the sole representative in this country of a very numerous group of fissirostral birds distributed all over the world, but especially abundant in the warmer portions, where, however, a large section of them are widely divergent in their habit from the Linnean *Alcedo ispida*. The King-hunters (*Halcyon, &c.*), as they are called, so far from generally affecting the vicinity of water, are many of them denizens of the driest parts of the forest, and dart forth into the air "upon land-crabs, mice, lizards, and insects." But some of the Indian species of this group appear rather to follow the fish-eating practices of the *Alcedines* and their allies, which are also well represented in India.

The Eurylæmidæ or Broad-bills, which Dr. Jerdon, following Gray and Bonaparte, arranges next to the Kingfisher, have, we believe, nothing to do in this place. M. Blanchard has shown this conclusively, as we believe, in his recently published observations on the sternum of this group, and we are, therefore, inclined to accept Mr. Wallace's views on this subject, that the Eurylæmidæ are the Paleogean representatives of the American Fruit-eaters (Cotingidæ). However this may be, they must certainly be arranged among the typical Passerinæ. As regards the next family, however, which Dr. Jerdon enters upon, we congratulate him on having emancipated himself in this instance from the arrangement he usually follows. It would be impossible, we think, to find a more unnatural place for the Hornbills than among the *Conirostres*, with which they seem to have no single character in common, and there can be no doubt that their nearest allies are among the *Fissirostres*, with which Dr. Jerdon arranges them. The breeding habits of the Hornbills are, as is now well known, eccentric in the highest degree. As we learn from the records of experienced observers, the male builds the female into her nest, by covering the hole in the tree where she incubates, with mud, leaving only room for her bill to protrude, and to receive food from his. In the "Ibis" for 1864, will be found some extended notes by Lieut.-Colonel Tickell, who was, we believe, the first scientific discoverer of this fact, upon these curious habits of the Bucerotidæ. Dr. Livingstone has noted similar facts, concerning certain species of the same family in Africa, and Mr. Wallace has confirmed them by his personal observations in the Eastern Archipelago.

With the Hornbills we close the list of Indian Fissirostres, according to Dr. Jerdon's arrangements, and enter upon the Scansorial or Zygodactyle groups—four families of which are well represented in the Indian Ornis, whilst several others are found in other parts of the world. The Parrots (Psittacidæ), which Dr. Jerdon takes first in order, are not very numerous in India, embracing only seven species, chiefly belonging to the genus *Palæornis* of Vigors—so characteristic of the Indian Fauna. Amongst them is the *Palæornis Alexandri* supposed, not without reason, to be the species first introduced into Europe by the great conqueror whose name it bears, and likewise that commemorated by the Latin poet in the pathetic elegy commencing:—

"Psittacus eois imitatrix ales ab oris,
Occidit—exequias ite frequenter aves."

Next to the Parrots, Dr. Jerdon places the Woodpeckers—a group well developed in all the forests of the world, excepting those of Australia, and numbering in the well-wooded Indian dominions of our Gracious Sovereign, some 35 species. To them succeed the Barbets (Megalæmidæ)—curious Eastern representatives of the Toucans of the New World, and feeding, like the latter, principally on fruit, though occasionally, more or less, carnivorous. The Cuckoos (Cuculidæ) which close the ranks of the Scansores are again a very numerous family—not by any means all agreeing with our single European representative of this group, either in form or in habits—but presenting in India, as in most other parts of the Tropics, several divergent sections of varying structure and with habits adapted thereto. The Indian species of this family are, according to Dr. Jerdon, some twenty-four in number.

Under the term Tenuirostres—the next tribe of the great order Insessores— Dr. Jerdon arranges three families with Indian representatives, the Sun-birds (Nectariniidæ), the Creepers (Certhiidæ) and the Hoopoes (Upupidæ). The first two of these are certainly typical Passerine groups—the last, although isolated in many points of its structure, it is now well known can be only satisfactorily located in the neighbourhood of *Buceros* and *Alcedo*. The "Sun-"birds of India and Africa comprise a large number of mostly very "beautiful birds, which in the brilliancy of their hues and the general "style of their decoration quite remind one of the Humming-birds, "and they are popularly known in India as Humming-birds"—with which, however, we may add, they have not the slightest natural relationship. Under the head of Creepers (Certhiidæ) Dr. Jerdon arranges the Tree-creepers and Nuthatches—the different genera of which embrace in India some eleven species. Of the Hoopoes (Upupidæ), besides our European *Upupa epops*, a second nearly allied form is found in Southern India and Ceylon, apparently hardly separable from the typical species.

We now enter upon the great group of insect-eating birds which form the tribe Dentirostres of English Ornithologists—and which from their uniformity of structure and intimate relations of the different parts *inter se* are excessively difficult to classify in a satisfactory manner—Dr. Jerdon, following nearly the ordinary English arrangement, divides the numerous Indian representatives of this tribe into six families — Laniidæ, Muscicapidæ, Merulidæ, Brachypodidæ, Sylviidæ, and Ampelidæ. Each of these families is again sub-divided into several sub-families. The limits of this Journal, will, we fear, hardly allow us to follow Dr. Jerdon into the discussion of all these divisions. We shall merely observe therefore that the Indian Dentirostres, recorded in the present work, are no less than 202 in number, and that there is no doubt that, while future researches may lead to the abolition of some of the so-called species, numerous others still undiscovered await the researches of future Onithologists, particularly in the less explored districts of our Indian possessions.

In the like manner of the tribe Conirostres, embracing the families Corvidæ, Sturnidæ, and Fringillidæ, altogether numbering some 110 species, we shall say but little. As regards the two first of these families they are both well-marked groups, and there can be little doubt about their limits. The Finches (Fringillidæ) taken *per se* are likewise a very natural family, but before considering them in this light, we must isolate the anomalous Larks (Alaudidæ) which Dr. Jerdon, not without formidable precedents in his favour, annexes to them, and give them the rank of a very distinct family of Insessorial birds.

Dr. Jerdon's third and last volume, which we now enter upon, commences with the Order Gemitores—more familiarly known to us under Latham's name Columbæ. Following Bonaparte—much too closely for our taste—our author divides the Indian members of this group into three families. The Fruit-pigeons (Carpophagidæ), the Typical Pigeons (Columbidæ), and the Ground Pigeons (Phapidæ). The Fruit-pigeons of the Eastern Tropics form — there can be no doubt—a well-marked section of the Columbine Order—distinguished by their frugivorous habits and fourteen tail-feathers. Of this group there are eleven representatives in India. Of the true Pigeons, Dr. Jerdon enumerates sixteen Indian species, dividing them, according to our ideas, as also the Fruit-pigeons, into far too many generic sections. But in this, as in other cases, he has been misled by Bonaparte, who in the latter years of his life strove to solace the paroxysms of the fierce disease under which he laboured by coining new and unnecessary scientific terms in the most barbarous Latin. Of the Phapidæ or Ground-pigeons we find only a single species in Dr. Jerdon's work—the *Chalcophaps indica*—hardly separable from its nearly allied forms of the great Eastern Islands and Australia.

The Gallinaceous order, which succeeds to the Pigeons, contains, as is well known, some of the largest and finest forms of the whole class of birds, and is that from which nearly all our domesticated fowls have been derived. In India we meet with the head-quarters of this group. We find the Jungle-fowls and Pea-fowls still inhabiting the woods, whence the parents of the present inhabitants of our poultry-yards were derived ages ago—besides numerous other game-birds of kindred nature well known to the sportsman of the East. Dr. Jerdon rightly begins his order Rasores with the Sand-grouse, Pteroclidæ, which, as betrayed by their ordinary name of Rock-pigeons, show in some points evident traces of an alliance with the Columbæ. Of this beautiful group, which is essentially African in its origin, not extending further eastward into Southern Asia than the plains of India, there are four Indian species. Next to the Sand-grouse, Dr. Jerdon places his family *Phasianidæ*, which, as here restricted, comprises the Pea-fowls, Pheasants, Jungle-fowls and Spurfowls, and forms a group particularly characteristic of the Indian region. Fourteen species of this family are contained in Dr. Jerdon's work, and amongst them, the splendid Monaul, or Impeyan Pheasant, the Tragopans, the Pukras, the Cheer, and the two Kaleeges, the magnificent game-birds of the favoured sportsmen of the Himalayas. The next family, the Tetraonidæ, likewise contains several species of not less interest to the large class of Indian sportsmen. At the head of Dr. Jerdon's list of this family stands the Jer-moonal or Great Snow-partridge, which inhabits the higher parts of the Himalayas, in the vicinity of perpetual snow. Those who penetrate into Ladak will, if fortunate, meet with a second species of this fine genus, the *Tetraogallus Tibetanus* of Gould, which, although mentioned by Dr. Jerdon, hardly comes within the scope of his work. Several genera of true partridges have representatives scattered over different parts of India, amongst which we may particularly note the Francolin, formerly abundant in Southern Europe, but now, as shown by Lord Lilford,* apparently extinct within the limits of our continent. Dr. Jerdon's account of this family as well as of the rest of the

* Ibis, 1862, p. 352.

Gallinaceous group is, we think, very satisfactory, and will, without doubt, be of the utmost interest to the numerous sportsmen of the East, who have been hitherto utterly without a guide to a knowledge of the numerous varieties of Indian game-birds. At the end of the Gallinaceous group, Dr. Jerdon rightly places the four Indian members of the aberrant family *Turnicidæ*, which, however, we believe, can hardly be associated with the American Tinamoos. The latter birds, as recently shown by Mr. Parker, offer a still more remarkable approximation to the Struthiones.

Dr. Jerdon rightly commences his account of the Grallatorial order, which we now enter upon, with the Bustards (*Otis*). Two fine species of these noble birds frequent the bare open plains of India, and two others, commonly known by the Anglo-Indian name of "Florikin," resort to the grassy tracks which intersperse the jungles of the peninsula. Our author then proceeds to discuss the numerous Indian species of Plovers, separating from them as distinct families, rather unnecessarily, we think, the Couriers (*Cursorius*) and the Pratincoles (*Glareola*). These three groups together embrace about twenty Indian species. Next to the Plovers, Dr. Jerdon arranges the cosmopolitan Turnstone (*Strepsilas*), the remarkable form *Dromas*, and the Oyster-catcher (*Hæmatopus*), each of which has a single Indian representative. *Dromas*, we, however, may remark will, we are of opinion, when everything is brought into its correct position, be removed into a different order of birds, and placed, as Blyth has already located it, next to the Terns (*Sterna*). The Cranes (Gruidæ), which now succeed, have four representatives in India. Amongst them is our European *Grus cinerea*, a visitant to India during the cold season, arriving in flocks and committing great havoc among the wheat and rice crops of Central India and Bengal. Certainly, no mistake could have been greater than to have associated these grain-feeding birds with the carnivorous Herons or Storks, and we are glad to see Dr. Jerdon fully alive to the errors of former naturalists upon this subject.

The Scolopacidæ, which are next treated of in Dr. Jerdon's work, are numerous in India as in other parts of the world. Some thirty species, amongst which we recognize almost all our well-known friends of the woods and marshes of Europe, occur within the limits to which our author confines his attention, and keen observation will doubtless increase the list of this wandering group of birds. The Stilt and the Avocet, which succeed, are regarded as belonging to a separate family, but the distinctions are in reality much too slight to be insisted upon. The next two birds treated of by Dr. Jerdon, on the other hand, are members of a very easily recognizable and independent type of the Grallatorial order, which has not yet been satisfactorily located by naturalists. There can be little doubt, indeed, that the association of the Jacanas (*Parra*) with the American form *Palamedea* is erroneous, and unless we adopt Mr. Parker's views of placing them near the Plovers, perhaps the safest plan is to leave them, where Dr. Jerdon arranges them, next to the Gallinules. Two species of Jacana are met with in India, and of the next succeeding family, the Rallidæ (embracing the Water-hens, Coots, and Rails), of very similar general habits, thirteen species. With them we conclude the list of those families of the Grallatorial Order that produce their young clothed and able to run immediately on their exclusion from the egg, according to the orthodox fashion of the great sub-class "Præcoces." The Storks, Herons, and Ibises, which Dr. Jerdon places at the end of the Grallatores, under the Bonapartean term "Cultrirostres," hatch their young helpless and dependent on their parents' care, like those of the sub-class "Altrices," although we think it still remains to be seen that the condition of the young in these two cases is exactly of the same character.

The Storks (Ciconidæ) have some six representatives in India, amongst which are to be counted two species of Adjutant (*Leptophilos*)—one of them we believe very well known to all dwellers in Indian cities, where it acts as a common scavenger. The Herons (Ardeidæ) are more numerous. Seventeen species of this group are treated of by Dr. Jerdon, amongst which are nearly all our European species—several of them very rare in the west—will be found to recur. Lastly the Tantalidæ, under which head our author unites the Ibises, Spoonbills, and the anomalous form *Anastomus*, number six species, and close the category of Indian Grallatores.

With the final order of Natatores or Swimmers, which Dr. Jerdon now enters upon, we shall not detain our readers long. In this branch of Ornithology we may remark the British Naturalist has a larger field of work than his Indian brother. Yarrell's Birds, gives upwards of 100 Swimming-birds as met with within the limits of the British Isles, while Dr. Jerdon's work only contains 65. About one half of these are common to the two Faunas. The Anatidæ, a very natural group, which Dr. Jerdon unnecessarily divides into four families, muster some 30 species, most of which also occur in Europe. Of the Grebes and Divers (Colymbidæ), which are mostly Arctic forms and numerous in more northern regions, two only have been hitherto recorded as Indian. Two species of Petrel have been observed in the Bay of Bengal, and are at present the only Indian representatives of the family Procellariidæ. The Gulls and Terns forming the family Laridæ are, however, more numerous. Dr. Jerdon includes 19 species in his list, not more than half of which are identical with European forms. Lastly, the Pelicanidæ, under which term we should include the five families of Mr. Blyth's tribe "Piscatores," include 13 Indian species, amongst which are two species of Tropic-bird (*Phaëthon*) and a Darter (*Plotus*).

Thus we find that the Avifauna of India, as treated of by Dr. Jerdon—that is the peninsula and adjacent lands up to the sky-line of the Himalayas, excluding, however, Ceylon and the countries on the further side of the Bay of Bengal—contain, according to the present state of our knowledge, about 1008 species of birds. To show how the Ornithology of India contrasts with that of Europe, we add the corresponding numbers of each Order, as given in the lately-published list of the Birds of Europe by Professor Blasius.*

	India.	Europe.
Accipitres	81	52
Clamatores	129	21
Oscines	560	163
Columbæ	28	5
Gallinæ	37	16
Grallæ	108	73
Natatores	65	90
	1008	420

With this comparison we take leave of Dr. Jerdon's work, cordially recommending it again to the especial attention of those of our readers in India who have any taste for Natural History. To relieve the dull monotony of the up-country station, no pursuit can be imagined more attractive than the charming study of Ornithology. Aided by Dr. Jerdon's hand-book the student will experience little difficulty in making himself acquainted with what is already known concerning the ornithic life of India, and by assisting to fill

* A List of the Birds of Europe. By Professor J. H. Blasius. London, Trübner & Co., 1862.

up the numerous gaps in this branch of knowledge may materially contribute to the promotion of science.

So much for the Birds of India. In our next number we hope to be able to find space to discuss Dr. Günther's volume on the Reptiles of the same country.

XVI.—The Bats of North America.

Monograph of the Bats of North America. By H. Allen, M.D., Assistant Surgeon, U. S. A. Washington, Smithsonian Institution, June, 1864.

A few years since Professor Baird, the well-known Naturalist who fills the office of Assistant Secretary in the Smithsonian Institution, Washington, published the elaborate review of the Land-mammals of North America, which forms the eighth volume of the Pacific Railway Report.* From this review, which is very complete as regards the greater part of the Mammal-fauna, the Chiroptera were altogether omitted, as the materials then in hand did not appear to be sufficient for the working out of this difficult group. This deficiency in our knowledge of the Mammals of North America is now filled up by the memoir of which we give the title above. Dr. Allen, its author, is one of a number of young and rising naturalists who have grown up under the auspices of the Smithsonian Institution—an Institution, we may remind our readers, dedicated entirely to the advancement of human knowledge, an object which has been worthily carried out by those to whom its direction has been entrusted. The materials employed by Dr. Allen have been principally the specimens in the Museum of the Smithsonian Institution, to which the care of the objects of Natural History, collected by the numerous exploring expeditions sent out by the U. S. Government (each of them invariably accompanied by a competent staff of professed naturalists) is entrusted. The collections of the Philadelphia Academy of Sciences and of the Museum of Comparative Geology of Cambridge have also

* Reports of Explorations and Surveys, to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean. Made under the direction of the Secretary at War in 1853-6. Vol. viii. Washington, 1857.

been consulted by Dr. Allen for the purposes of this Memoir, so that he may be fairly said to have had at his disposal all the materials of the three chief Zoological collections of North America.

Dr. Allen commences his Memoir by an introduction, in which the various types of modification assumed by the vertebrate skeleton, with the object of adapting the animal to flight are discussed, and diagrams are given, showing the bony structure of the wings in the Bat, the Pterodactyle, the typical Bird, and the Archæopteryx. He then proceeds to describe shortly the general structure of the Chiroptera, and gives some particulars of their habits, of which, however, at present, our knowledge is very small. Dr. Allen then enters upon the general subject of his work, heading it by an "artificial Key to the Genera" of the Bats found within the limits of America, north of Mexico, concerning which we may say a few words. As in Europe, the Chiroptera met with in the northern parts of the New World mentioned, all belong to the insectivorous families of the order. The true frugivorous Bats of the family Pteropodidæ are, we need hardly remind our readers, strictly confined to tropics of the Old World. There are found, however, within the limits to which our author extends his work, representatives of three insect-eating families of Chiroptera, which are here termed, *Megadermatidæ, Noctilionidæ*, and *Vespertilionidæ.*

The family with which Dr. Allen begins his Memoir has only one representative in the North American Fauna. This is the *Macrotus Californicus,* Baird, stated to be nearly allied to *M. Waterhousii,* Gray, of Cuba, Hayti, and the other West Indian Islands. The alliances of this genus appear to be rather obscure. Dr. Allen refers it to the Megadermatidæ, with which, however, it has probably but a very remote connection. The Megadermatidæ are a family of Bats confined entirely to the Old World. Although *Macrotus* has its ears united together by a connecting membrane, there can be little doubt that its true place is in the family Phyllostomatidæ—a group peculiar to the tropics of the New World, of which it forms a northern outlier.

The next family containing the naked-tailed Noctilionidæ is likewise very feebly represented in the Nearctic Region—one species only —the *Nyctinomus nasutus,* a well-known and wide-ranging South American form, occurring in different parts of the southern frontier of the United States. The remaining Chiroptera treated of by Dr. Allen—18 in number, all belong to the insectivorous family Vespertilionidæ—which is likewise the most extensively developed group in the corresponding parts of the Old World.

The differentiation and description of these 20 species of Bats has, we think, been effected by Dr. Allen in a fairly satisfactory way. The characters of the genera and species are well drawn up and precise, and are accompanied by numerous woodcuts illustrating the dentition, the form of the ears and tragus, the outlines of the interfemoral membrane, and other characteristic parts of the structure of the different species. Dr. Allen has certainly not erred on the side of creating too many species—nay, if any fault is to be found with our author on this subject, it should probably be just the other way. It is certainly remarkable that only 20 species of Chiroptera should occur within the whole of the large area of America north of Mexico, when even little Europe produces upwards of 25 species. If we are not much mistaken future researches are destined to add not immaterially to our knowledge of the North American Chiroptera.

XVII.—The Fauna of Spitsbergen.

(1.) Anteckningar till Spetsbergens Fogel-Fauna. Af A. J. Malmgren. Œfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar. 1863. p. 87.

(2.) Iakttagelser och anteckningar till Finmarkens och Spetsbergens Dæggdjursfauna. Af A. J. Malmgren. Ibidem, p. 127.

Spitsbergen is a "No-man's land"—to which of the Powers of Europe it rightly belongs is probably beyond the knowledge of the most profound international lawyer to decide. We, therefore, need not be surprised that hitherto Zoologists have had but a very incorrect notion of its animal productions, and are accordingly greatly indebted to Mr. Malmgren for his carefully drawn up lists of the Beasts and Birds, which throng the deeply recessed fjords, or the precipitous shores of this horribly inhospitable country.

At least four expeditions have been sent out by our own Government, within the last ninety years, with the object of taking a start from Spitsbergen, and then sailing to the North Pole, or as far in that direction as circumstances would allow. Our business is not with what they accomplished, or with what they failed to effect. The skill and bravery displayed, alike by commanders and crews, are written in the annals of the British Navy. But it is akin to our purpose here to observe that not one of these expeditions can be said to have been properly equipped. Not one of them was accompanied by a competent Naturalist—unless, indeed, we may except the earliest, under Commodore Phipps, afterwards Lord Mulgrave, with whom sailed Mr. Israel Lyons, a botanist of some note. But it remains a fact that not much more has been added to our knowledge of Zoology from these expeditions, than we might have expected from amateurs,—adventurous yachtsmen, like Lord Dufferin or Mr. Lamont—and the only Englishman who has materially assisted our special branches of science, was an energetic north country whaling-skipper,—William Scoresby, of pious memory.

In 1838 and 1839, the French Corvette, *La Réchercke*, bearing on board a distinguished company of *savans* of various nations, visited two districts on the west coast of Spitsbergen. But it is vain to seek in the multitude of volumes—thickly printed octavos, bristling with tabulated figures, showing the results of all sorts of magnetic and meteorological observations—or ponderous folios, wherein we see displayed through Gallic spectacles the whole Arctic world, from Magdalena Bay to Godthaab, which record the progress of President Gaimard's 'Commission Sciéntifique du Nord,' more zoology than is contained in a few anecdotes respecting Whales and Eider Ducks.

Some few years ago it occurred to the leading men of science in Sweden that a plan, long projected and talked of in other countries, might be carried out by their means. This was no less than the measurement of an arc of the meridian in Spitsbergen, between the parallels of 76° and 81°. Not much time was lost in putting the plan into execution. We believe that the Swedish Government have had no hand in the matter. The expenses have been defrayed by the ancient Universities of that country. But much of the success already achieved is owing rather to the unselfish nature of the explorers themselves—who, aware of the scanty supply of funds forthcoming, have been content to carry on their researches on a system the most economical—and to put up with no inconsiderable amount of personal discomfort, by doing without many accessories which by most persons in their situation would be regarded as absolute necessaries. In 1858 the first expedition in pursuit of this object started. In 1861, a second expedition was sent out, to which Mr. Malmgren was attached; and, we understand, that last year a third sailed, of which this gentleman was again a member. The zoological results of the voyage of 1861, were by him communicated to the Royal Swedish Academy of Sciences on the 11th February, 1863, and form the papers quoted at the head of this article, which we may mention, for the benefit of those of our readers who are unacquainted with the Swedish language, have fortunately been translated into German, one by Dr. C. F. Frisch, and published in the 'Journal für Ornithologie' for 1863, while the other is printed in first part of the 'Archiv für Naturgeschichte' for 1864.

To each of these papers Mr. Malmgren prefixes a summary of the information that has already been recorded, respecting the subject of which it treats, though it will be gathered from what we have already said this is not much. With respect to the ornithology of Spitsbergen it is no exaggeration to say that nearly a third of the observations of his predecessors has been founded on error—but, though not blind to their faults, our author deals gently with them, as well becomes a man of science. This is particularly the case in regard to two species of birds, which the officers of Parry's celebrated expedition believed they had recognised. Mr. Malmgren even goes out of his way to explain how the mistakes originated, and his explanation is natural enough. He proves, at any rate to our own satisfaction, that Spitsbergen is not the abiding place of either ***Larus sabinii*** or *Larus rossi*—the latter being certainly one of the very rarest of known birds. It is extremely probable, as he says, that Parry's officers mistook the young of *Larus tridactylus* for the one, and *Sterna arctica* for the other.

The following twenty-two species are considered by Mr. Malmgren to be the proper inhabitants of, or regular breeders in, Spitsbergen :—

Emberiza nivalis	Anser bernicla
Lagopus hyperboreus	„ leucopsis [?]
Charadrius hiaticula	„ segetum [?]
Tringa maritima	Harelda glacialis
Phalaropus fulicarius	Somateria mollissima
Sterna arctica	„ spectabilis
Larus eburneus	Colymbus septentrionalis

Larus tridactylus	Uria grylle
„ glaucus	Alca bruennichii
Lestris parasitica	Mergulus alle
Procellaria glacialis	Mormon arcticus [?]*

That is to say there is no bird of prey domiciled in the country; only one Passerine, one Rasorial, three Grallæ, and seventeen Swimmers. Of these all occur, more or less frequently, in other parts of Europe, excepting only the *Lagopus*, which appears to be peculiar to Spitsbergen, though Mr. Malmgren does not speak very positively as to its specific distinction. Of the stragglers, or unauthenticated species, we need not here say anything.

In Mammals the Spitsbergen Fauna is proportionately richer, the Seals and Cetaceans, as might be expected, predominating. It is pretty nearly certain that no Rodent inhabits the country, and whence the single specimen—a skeleton only—of *Arvicola hudsonius*, which was found by Parry's expedition on a floe of ice, in latitude 81° 45′, came, must remain a matter of conjecture. Mr. Malmgren is inclined to take old Frederick Martens' second sort of "Butskopf" —but with a back fin three times as high as that of a "Bottle-head" —for *Orca gladiator*, a species said to be sometimes seen between the coasts of Norway and Spitsbergen, but which was not observed about the latter by the Swedish expedition. *Cystophora cristata* has been obtained on Bear Island, but not further north, though it is considered that it may occasionally wander to the latitude of 76°—the scarcity of large fish, on which it chiefly feeds, being the probable cause of its absence. The Mammals of Spitsbergen, which appear certain to our critical author, are these:—

Ursus maritimus	Cervus tarandus
Canis lagopus	Delphinapterus leucas
Odobænus rosmarus	Monodon monoceros
Phoca barbata	Chænocetus rostratus
„ grœnlandica	Balænoptera gigas
„ hispida	„ rostrata

Balæna mysticetus, which in former days was so numerous, now never shows itself on these coasts. How long will it be before the Walrus, in like manner, disappears?

* We preserve Mr. Malmgren's nomenclature; but we have appended a query to the names of three species, about the identification of which, we think, some doubts may yet exist.

We trust soon to have to congratulate our author on the appearance of other treatises from his pen. At present all the knowledge we have of the Ichthyology of Spitsbergen is contained in Sir James Ross' Appendix to Parry's 'Fourth Voyage,' wherein *four* species only of fishes are enumerated. The lower forms of life, also, require much more attention than they have as yet, judging from published records, received. No doubt we shall have our wishes gratified. Meantime we tender our warmest thanks to Mr. Malmgren, for the careful papers we have here been noticing, which are exactly of the kind that the present state of Zoological Science needs respecting the Fauna of every country from one Pole to the other.

XVIII.—Hall's Esquimaux.

Life with the Esquimaux: the Narrative of Capt. C. F. Hall, of the whaling-barque 'George Henry,' from the 29th May, 1860, to the 13th Sept. 1862. Two vols. 8vo. London, Sampson Low, & Co. 1864.

There is perhaps no race of men who are more curious in their habits, and less affected, as yet, by the influence of civilization, than the Esquimaux. Capt. Sherard Osborn has recently recalled the attention of the public to the interesting problems which, after all that has been accomplished, are still unsolved, and might perhaps be determined by another Arctic expedition; but even without this stimulus, Capt. Hall's book would certainly have been read with much interest.

The author is an American gentleman, living at Cincinnati, and of a decidedly enthusiastic and religious turn of mind. Strongly impressed with the belief that some, at least, of Franklin's unfortunate companions might perhaps be still alive, "it seemed to me," he says, "as if I had been called, if I may so speak, to try and do the "work. My heart felt sore at the thought of so great a mystery in "connection with any of our fellow-creatures, especially akin to "ourselves, yet remaining unsolved. Why could not their true fate "be ascertained? Why should not attempts be made, again and "again, until the whole facts were properly known?"

Capt. Hall's idea was that the Esquimaux must be perfectly well aware of the fate which had befallen the remnant of Franklin's expedition, and the present whereabouts of the survivors, should any such exist. He proposed, therefore, to make friends with the Esquimaux, to live among them, and to share their hardships and dangers, hoping, in this manner, to obtain the wished for information. In this, the main object of his voyage, he has, unfortunately, been unsuccessful; but he has accumulated a number of interesting facts, and has produced a work which, although far from faultless, will be read with pleasure, and is deserving of warm commendation. The manners and customs of the Esquimaux, and their extraordinary peculiarities, have already been well described by previous travellers in the Arctic regions; but there are few who have so completely identified themselves with this remarkable people, and have enjoyed such favourable opportunities of making friends with them, as appears to have been the case with Capt. Hall.

It is impossible not to admire the determination and energy of a man who could conceive and carry out such a scheme. Certainly the dangers of Arctic travel are not in reality so great as they are generally supposed to be. After the great storm of 1830, a thousand shipwrecked sailors had to make their way over the ice, from Baffin's Bay to the Danish settlement, a distance of 600 miles, and yet they all arrived safely at their destination, except two, who died from drinking. Still the hardships and discomforts are very great, though Capt. Hall, with the true spirit of a traveller, makes light of them, and dwells rather on the bright side of affairs. "Recording," he says, "my own experience of igloo life at this time, I may here say "that, having then spent twenty nights in a snow-house, I enjoyed "it exceedingly. *Now*, as I look back at the past, I find no reason "to utter anything different. I was as happy as circumstances "permitted, even though with Innuits only for my companions. "Life has charms everywhere, and I must confess that Innuit life "possesses those charms, to a great degree, for me."

The foundation, if we may so say, of life in the far north, appears to consist, on the one hand of seaweed, and on the other of moss. The seaweed supports an infinite number of minute crustacea and mollusca, which in their turn afford abundant nourishment to fish, which again are preyed upon by seals. The fish, the seals, and the walrus, supply the principal part of their nourishment to the Esquimaux. On land, the most important vegetables appear to be the reindeer moss, and a small species of *Andromeda;* the latter of which serves as bedding, while the former supports numerous herds of reindeer, the prey of the wolves, the bears, and the Esquimaux. Thus both series culminate in the Esquimaux; but although this voracious people make up for the almost entire absence of vegetable food by devouring nearly everything animal that comes in their way, still it is mainly to the seal that they owe the possibility of existence. They have, in fact, been described "as singular "composite beings, a link between Saxons and seals, hybrids, putting "the seals' bodies into their own, and then encasing their skins in "the seals'; thus walking to and fro, a compound formation. A "transverse section would discover them to be stratified, like a roly-"poly pudding, only, instead of jam and paste, if their layers were "noted on a perpendicular scale, they would range after this fashion, "first of all seal, then biped, seal in the centre."

Every part of the seal is eaten by the Esquimaux. Nothing comes amiss to them. We will spare our readers any description of an Esquimaux dinner. In this respect Capt. Hall appears to have become entirely one of themselves. He describes, almost *usque ad nauseam*, the things which he ate, and ate even with pleasure. "To say that I enjoyed this food," he tells us, "would only be to "repeat what I have before said, though no doubt many will feel "surprised at my being able to eat, as I so frequently did, raw "meat——," and other things, the enumeration of which we will avoid. It is hardly necessary to state that the Esquimaux eat most of their food in a raw state; from this practice, indeed, their name is derived—*Ushke* in the Chippeway language meaning *raw*, and *Umwau, he eats*. One great reason for this, no doubt, consists in the scarcity of fuel. In fact, the Esquimaux have no fires, in the ordinary acceptation of the term, though each woman has a little lamp of lapis ollaris, in which she burns seal-oil with a wick of moss, and which she uses sometimes for cooking, but mainly to dry clothes and to melt the snow in order to obtain water. In fact, the Esquimaux in the north, like the Fuegian in the south, has but little idea of warming himself at a fire. In winter, the small snow igloo, or hut, in which he lives, is so close that the difficulty is to keep it cool, rather than to warm it. If the temperature is allowed to rise too high, the hut melts away; and the most trying time to the Esquimaux is in the spring, when it is still too cold for tents, and yet when the snow huts are giving way before the increasing power of the sun. Of all the remarkable points connected with the Esquimaux, the little use which they make of fire, and, surrounded as they are with water in a solid form, the difficulty which they experience in obtaining enough to drink, are perhaps the most striking. Again, the analogies between the chemical actions which take place in the human body, and the ordinary processes of combustion are remarkably brought out by the above-mentioned facts. The same substance, namely, the oil of the seal, serves both as food and as fuel: it raises the temperature of the Esquimaux, and enables him to maintain an internal warmth, perhaps even greater than that of an ordinary Englishman, while the thermometer stands far below zero; and it does this, whether burnt in the lamp as fuel, or in the Esquimaux as food.

Capt. Hall gives some interesting particulars as to the habits of Arctic animals. The seal, for instance, forms for itself an igloo, in which it brings forth its young, and which has apparently served as a model for those used by the Esquimaux. This happens about the 1st of April. The prospective mother works her way upwards through the ice, on the surface of which she scoops out a semicircular excavation in the snow, scraping it away with her forefeet, and carrying it down beneath the thick ice. None but very sharp scented animals, such as the polar bear, the fox, and the seal dog, can find these igloos. "By the time the sun melts off the covering "snow, exposing and destroying the dome of the igloo, the young "seal is ready to take care of itself." Although a popular writer has recently assured us that the seal can remain for a whole winter below the water, we need hardly remind our readers that this is not the case. The seal, like the whale, and all other mammalia, must come up to the surface from time to time for the purpose of respiration. Each seal, therefore, has at least one breathing hole in the ice. When an Esquimaux, by the aid of his dog, has found one of these breathing holes, he thrusts his spear down through the hard snow to ascertain the exact locality of the hole, "which is not more than one "or two inches in diameter. After, perhaps, a dozen attempts, he "finally strikes the hole. Now, he carefully withdraws his spear, and "marks with his eye the hole which leads down through perhaps 18 "to 24 inches depth of snow. When now he hears the seal, he raises "his spear, and strikes unerringly through the snow to the seal's head. "The animal at once dives and runs out to the full length of the line, "one end of which is fast in the hand of the sealer. He proceeds to "cut away the deep snow, and to chisel the ice, so as to enlarge the "top of the seal hole, from which he soon draws forth his prize." This mode of sealing requires great patience, and the Esquimaux has sometimes to wait two or three days and nights, in constant expectation, before he secures his prey.

The Innuits or Esquimaux have a great respect for the polar bear, and tell many interesting anecdotes of its sagacity. "In August," they say, "every fine day, the walrus makes its way to the shore, draws his "huge body up on the rocks, and basks in the sun. If this happens "near the base of a cliff, the ever watchful bear takes advantage of "the circumstance to attack this formidable game in this way. The "bear mounts the cliff, and throws down upon the animal's head a "large rock, calculating the distance and the curve with astonishing "accuracy, and thus crushing the thick, bullet proof skull. If the "walrus is not instantly killed—simply stunned,—the bear rushes "down to it, seizes the rock, and hammers away at the head till the "skull is broken. A *fat* feast follows. Unless the bear is very "hungry, it eats only the blubber of the walrus, seal, and whale."

Capt. Hall gives an excellent figure of a large bear, sitting on its haunches, and having in its fore-paws a great mass of rock which it is in the act of throwing down upon the head of an unsuspicious walrus. This will, no doubt, prove conclusive to many of his readers, and remove any doubts which they might otherwise have felt about the story. Moreover, Dr. Rae heard a very similar account from an Esquimaux in whom he had good reason to feel great confidence, and who declared that he had actually seen a bear throw a mass of ice on to the head of a walrus. We confess that we are hardly prepared to give the bear credit for so much sagacity, though we cannot altogether reject a statement which appears to rest on good authority.

The following story is more satisfactory :—Capt. Hall had killed a young bear, and thought that the Esquimaux would rejoice in his success. He soon discovered this to be a mistaken idea. They always, he found, avoided killing the young of a bear, until the old one was dead, because the death of the offspring "made the mother a hun- "dred-fold more terrible than she would otherwise be." They feared, therefore, that the old bear would return and attack them in the night, in order to avoid which they prudently took to flight.

"After making a distance of some ten miles from where the bear "was killed, and as we were making good progress homeward directly "down the bay, all at once the dogs were turned by the driver "sharply to the left, nearly, but not quite, half round, and directed "towards the south termination of Pugh Island, where we made our "eighteenth encampment. Before we retired for the night, the "sledge was stuck up on end in an ice crack, and the guns and "spears were put in order, at the head of our couch, for immediate "use, if occasion should require it. As I needed an explanation of "some of these movements of my Innuit companions, so my readers "may require one of me. I thus give it. The reason of going to "such a distance from the scene of the bear-hunt before making our "encampment has already been given. The sharp turn—nearly re-"versing our course—was designed, as the Esquimaux explained it, "for a safeguard against pursuit by the enraged old bear. If she "should attempt to pursue on our sledge track, her movements "would be rapid; and, finding the track nearly in a straight line "for so long a distance, she would become somewhat confident, "'thinking' that the same undeviating course had been kept till the "end: therefore, on her reaching the place of the sharp turn, it "might be unnoticed and unscented, and she would continue her "course sometime longer before discovering her mistake. But in "case she should track us to our igloo (our sixteenth, seventeenth, "and eighteenth encampments were igloos or snowhouses), then the "first thing she would do would be to throw down the sledge (one "of many things that Polar bears do not like to see standing), and "thus we should be awakened and put on our guard against the "ferocious beast."

Next to the walrus and the seals, the bear is the animal of greatest importance to the northern Esquimaux. Its fur is largely used for clothing, and the flesh, with the exception of the liver, which they regard, and apparently with reason, as poisonous, is a staple article of diet. It is surprising indeed, according to our notions, how largely carnivora are used as food by different nations. The dog was kept for the purposes of the table by many of the South Sea Islanders, and was even preferred to pork by our early voyagers. But, as in this instance, the animals were fed entirely on vegetable food, it is perhaps hardly a case in point. Among the northern travellers, however, the fox seems to have been quite a favourite article of food. Ross found it a very good dish. McClintock preferred it to preserved meat, and Lyon thought it very good eating. So again, as regards the bear, Capt. Hall assures us, though we confess that in the matter of food we should not ourselves be much guided by his opinion, that its flesh is excellent, "appearing and tasting like veal." Kane became quite a connoisseur in bears. Those in a "lean condition," he says, "are much the most palatable "food. The impregnation of fatty oil through the cellular tissue "makes a well fed bear nearly uneatable. The flesh of a famished "beast, although less nutritious as a fuel diet,* is rather sweet and "tender than otherwise."

Like other Arctic travellers, Capt. Hall frequently mentions the quantity of bones which were to be seen lying about upon the surface of the ground. Those who are surprised by the absence of human remains in the drift-gravels, might turn with advantage to those passages (for instance, Vol. ii. pp. 83, 90, and 154) in which he mentions numerous bones of reindeer, walrus, seals, and other animals, without any belonging to man. In our own country, and still more in hotter regions, any bones which are occasionally left upon the surface of the ground soon perish. A hundred different kinds of animals, and the action of our comparatively rapid vegetation, combine to ensure their destruction; but in the frozen regions of the North, these influences are absent, or at least, highly inefficient. It has often been a matter of surprise that our bone-caves appear to belong almost exclusively to the glacial epoch. On the other hand, it has been also difficult to understand how it should come to pass that, in those caves which appear to have received their stores of bones from the action of floods, in opposition to those which were evidently the dens of wild beasts, the bones bear so large a proportion to the inorganic materials. May we not find, in the accounts given by Arctic travellers, an explanation, perhaps, of these two phenomena? Bones in the far north, are, as we have seen, far more frequent than in our temperate clime. They lie, not upon the soil, but in many cases, at least, upon ice. The caves would be filled up, not by bones with sand, and gravel or loam, but by bones and ice. The ice, gradually melting away, would continually make room for fresh accumulations of bones. In his description of a glacier in North Greenland, Dr. Kane expresses himself as follows:—"Within the area of a few acres † we found "seven skeletons, and numerous skulls: these all occupied the snow "streams, or gullies, that led to a gorge opening on to the ice belt, "and might thus be gathered in time to one spot, by the simple "action of the watershed."

The abundance of life in the far north, is indeed surprising. No better evidence of this can be given than the fact that the northern Esquimaux are entirely carnivorous; the only vegetable food they

* Arctic Explorations, vol. I., p. 360.

† Kane, l. c. p. 95.

ever taste being that which they obtain in a digested state from the inside of the reindeer, and which is regarded by them as a great delicacy. Nevertheless, we must remember that by the conditions of the case, the life which does exist there is not uniformly spread over the whole area, but is confined to certain limited oases. Thus, it has occasionally happened, that our countrymen have been reduced almost to the verge of starvation, or have suffered terribly from scurvy, and from the want of fresh meat, while the Esquimaux, at a distance of perhaps not more than thirty or forty miles, have been luxuriating in the abundance of wholesome food. We have been too apt to judge of the real, from the apparent, profusion of life in different countries. South America, for instance, has been described as singularly deficient in this respect. Yet it is surely, *à priori*, very improbable that this should be the case, in a country with a vegetation so luxuriant. And we should remember that the Brazilian forests, while they could feed an almost unlimited number of animals, must tend to conceal them in a manner almost as complete. It is mentioned in Mr. Bates's excellent work upon the Amazons, that on one occasion, when he had shot a parrot, suddenly, and although up to that moment the forest had been silent, and apparently deserted, he was surrounded by a large flock of parrots, belonging to the same species, not one of which had at the previous moment been in sight.

It is customary, on the other hand, to quote Southern Africa, as a striking instance of the marvellous development of animal life. If, however, we judge by the ear, rather than the eye, and compare the nocturnal chorus of a South American forest with the comparative silence of the African desert, broken only by the occasional roar of the lion, or the scream of its terrified victim, we should probably come to a very different conclusion as to the relative *fertility* of these two continents in animal life. Moreover, we must remember that in Africa, not only can the eye often range at once over a large extent of ground, but also that, owing to the scarcity and partial distribution of water, the sportsman may often take up his position at the side of some piece of water, confident that, during the night, every animal for miles round must come under his observation.

Something of the same kind happens in the far north. Deserts of ice take the place of those of sand, and the herds of seals and walrus are driven to the pools of open water, not indeed to drink, but to breathe. The bear follows the seals; the Arctic fox follows the bear almost as the jackal the lion; and where blubber is, there will the Esquimaux be gathered together. Thus we find oases of animal life, if we may use the expression, here and there enlivening the frozen deserts of snow and ice.

Of the Esquimaux themselves, Capt. Hall speaks very favourably. They are, indeed, a singular people, and in one sense any thing but savages. Their implements are made with the greatest skill and ingenuity; their clothes would pass muster, even with the Ladies' Dressmaking Association. Yet they have no chief, no laws, no government, and no form of religion. Although with a vague belief in the immortality of the soul they have no idea of prayer; yet they are dimly apprehensive of sorcery, and are conscious apparently that there is some such thing as supernatural power. This feeling is worked upon by a class of conjurors, who take advantage of it to secure more food, more clothes, and more wives, than would otherwise fall to their lot. Tattooing, among the Esquimaux, as among the Fijians, is regarded as a religious ceremony, a kind of baptism; nor do they believe that any one will be happy in the next world who has not been tattooed in the orthodox manner in this. As, however, many of the Esquimaux are untattooed, this belief cannot be general amongst them, or must be as little realized as some which are generally professed in civilized countries. Capt. Hall, moreover, speaks of course only of those who inhabit the neighbourhood of Frobisher Bay.

They have many other curious customs, and prejudices. Like all savages, they are anything but free, being slaves to superstition and to habit—which we call precedent. A woman must not eat by herself for a year after the birth of a child. At certain periods the women are compelled to live by themselves. At certain times again, certain food is forbidden to them. After walrus-hunting has begun, no one may work on reindeer skins. Women are not allowed to taste the first seal of the season. Many other similar prohibitions might be mentioned, most of which, as usual, apply to women.

In hunting, the Esquimaux are very skilful. With their bone and stone weapons they kill seals, walrus, and reindeer, where, even with the assistance of the rifle, we should fail utterly. In fact, most of our northern expeditions have derived large supplies of fresh meat from the natives.

War is entirely unknown among the Esquimaux. Capt. Hall does not allude to the subject, but other travellers have tried in vain to make the natives comprehend the idea of war. Nor does crime appear to prevail among them. Polygamy is permitted, but even their best hunters cannot obtain and retain more than two or three wives.

In the far north boats are unknown, but the Southern Esquimaux show wonderful ingenuity in the construction and management of their boats or kayacks. Some of them are even able to turn, boat and all, head over heels in the water.

Capt. Hall found them "a kind, generous people," and to some of them, indeed, he seems to have been sincerely attached. Too Koolito was a special favourite. Capt. Hall "could not help admiring the "exceeding gracefulness and modesty of her demeanour. Simple "and gentle in her way, there was a degree of calm intellectual "power about her that more and more astonished me." Still, he condemns strongly their inattention to the sick and dead. No kind friends and affectionate relations soothe the last moments of the dying Innuit. When life is despaired of, they are left alone, the snow hut or the tent is closed up, a few simple implements and a small store of food are placed by their side, and thus they are left to their fate. At first sight this certainly appears to say little in their favour. Nevertheless, if the picture which has been drawn of them, both by Capt. Hall and by previous observers,—their strong affection for one another, their readiness to share the last piece of meat, the last drop of oil, be not very inaccurate, we should be disposed to look for some explanation of the apparently heartless custom to which we have alluded. Among the many Esquimaux observed by Capt. Hall, one was a blind man, who must have been dependent upon the affections of his relatives. Another was a very old woman, who could certainly have done but little to supply herself with food. Among a small community who were often on the very verge of starvation, the presence of such individuals as these is incompatible with the cold selfishness which the custom of leaving the dying to their fate would appear to indicate. I should, therefore, almost be disposed to account for this, in our eyes, unnatural practice by the existence of some curious superstition; and this is certainly encouraged by the idea that no implements nor dresses which are present in a dwelling which has been the scene of death ought ever to be used again. Thus, their inutility to the living, rather than any notion that they could be useful to the dead, accounts for the various objects generally found in an Esquimaux grave.

Like some previous writers, Capt. Hall thinks that the Esquimaux are rapidly dying out. "Not many years more," he says, "and the "Innuits will be extinct." It may seem presumptuous to differ from Capt. Hall on such a question as this, but he has certainly given no sufficient reason for such a belief. It has arisen, we think, from the numerous ruins of old huts, and vestiges of ancient occupation which are every where to be found on the shores of the Arctic Ocean, and which at first sight certainly appear to indicate a much larger population than that now in existence. But we must remember that the Esquimaux are essentially a nomad people, whose huts are the work of a few hours, and when a locality has been occupied for a few weeks, the traces of it would remain almost unaltered, for years and years afterwards.

Capt. Hall appears to have been greatly impressed with the beauty and magnificence of the Aurora Borealis. He ranges himself on the side of those who maintain that this glorious phenomenon is unaccompanied by noise: and he gives, we think, a probable illustration of the manner in which the contrary opinion may have originated. "Hark, hark," he says, "such a display! almost as if "a warfare was going on among the beauteous lights above, so "palpable, so near, seems impossible without noise. But no noise "accompanied this wondrous display. All was silence."

It is evident that a less careful and accurate observer would have supposed that he heard those sounds which Capt. Hall as evidently expected, and at the absence of which he seems to have been almost disappointed.

There are some few cases, however, in which we are compelled to call in question the accuracy of Capt. Hall's observations, or at least, the manner in which they are expressed. Thus he tells us, that on one occasion, the cold wind "froze the water of the eyes, "locking them up in ice, so that it was only by vigilance and effort "that I could keep myself in seeing order." If, however, the water of his eyes had really been frozen, no vigilance or care would ever have brought them into "seeing order" again. Probably, however, he only means the moisture on his eye-brows, and eye-lashes. Again he tells us that having inadvertently touched his brass sextant with the bare hand, "the effect was precisely the same as if I had touched "red hot iron. The ends of my finger nails were like burnt bone "or horn, and the fleshy part of the tips of my fingers and thumbs "were, in appearance and feeling, as if suddenly burnt by fire." It is certainly curious how the effect of great cold on the flesh resembles that of heat, but surely our author must have been mistaken as to the effect on his *nails,* which would not have suffered from the cold more than the fur gloves which he had on this occasion forgotten to use.

When we read of such extreme cold as this, of the thermometer 75°, 80°, and even more, below the freezing point, of reindeer, seals, Esquimaux, and other Arctic animals, it is astonishing to find that Capt. Hall never went farther than 64° north, just the latitude of Trondeim, where an electric telegraph, cathedral, churches, banks, and all the appliances of modern comfort and civilisation are to be found. In spite of isothermal lines, and Prof. Dove's maps, we are apt to forget how exceptionally favourable is the present climate of Western Europe.

Capt. Hall is an American, and writes from an American point of view. Thus, he always speaks of "London, England." This expression sounds peculiarly odd, in some cases where he is explaining names given to particular localities. Thus he talks of "Sabine Bay, "named after Edward Sabine, of London, England," lest we should not recognize the President of the Royal Society. And again, Cape Murchison, "named after Sir Roderick I. Murchison, of London, "England," for fear, we presume, that we might suppose it to be called after any Roderick I. Murchison of London, America. On his return home, he met with a great rebuff. When the pilot came on board, at St. John's, Newfoundland, he asked, naturally enough, "Who is the President of the United States?" "But so little did "our affairs trouble this Newfoundlander, that he could give us no "information. I put the leading names to him, but still without "effect; he did not know." "This," adds Capt. Hall, "was mortify-"ing." But a still more painful surprise was in store for him. "The North and the South," he was afterwards told, "are fighting "against each other." "What!" I exclaimed, in utter amazement, "what, *war? war in the United States, and among ourselves?*" No wonder he was astonished, but even he can hardly have realized the full horror implied by those words.

One of the most interesting results of Capt. Hall's voyage, was the discovery, if indeed it be the discovery, of relics of Frobisher's expedition. Frobisher left England in June, 1576. On the 11th of July, he was within sight of Greenland, and after various misfortunes, returned to England in the following October. He brought with him many pieces of black stone, some of which, "being accidentally put "in the fire, presented an appearance something like gold. Certain "refiners of London expressed the opinion that the specimens "submitted to them contained gold, and a second expedition was "quickly set on foot." This second expedition sailed in May, 1577. Capt. Hall rests his opinion as to his discovery of remains of it partly on the traditions preserved among the Esquimaux and partly on the objects which he discovered. These consisted of "coal, flint stone, fragments of tile, glass, and pottery; an excava- "tion, which I have called an abandoned mine, a trench made by "the shore, on an inclined plane, such as is used in building a "ship on the stocks; the ruins of three stone houses, one of which "was 12 feet in diameter, with palpable evidence of its having been "erected on a foundation of stone, cemented together with lime "and sand, and some chips of wood, which I found on digging "at the base of the ship's trench. Upon this evidence, then, "coupled with Esquimaux tradition, as given to me by several "persons, apart from each other, and at different times, I founded "my opinions respecting Frobisher's expedition, as I have already "stated them."

We confess that this interesting discovery does not appear to us so well established as Capt. Hall seems to think. Nor do the illustrations shown in the plate, page 295, of "Frobisher relics," throw much light upon the question. As far as we can judge from the figure, they might just as well be the relics of any other expedition. This plate, however, is an exception to the rest, which show that Capt. Hall can use his pencil as well as his pen.

The Author's preface is dated "June 30, 1864, on board the bark "Monticello, bound for the Arctic regions." We trust that by this time he has rejoined his friends in the North, and that he is rejoicing in an abundance of seal's blubber, and walrus flesh. We need not say that we wish him success in the main object of his journey; and if, alas! we can feel little hope that in this he will be successful, we trust, at least, that he himself will meet with no more than the unavoidable hardships of Arctic life, that he may return safely to his family and friends, and that, as his first return was darkened by the news that his country was plunged in war, on his next he may be rejoiced by finding that she is again at peace.

XIX.—The Linnean Society's Transactions.

Transactions of the Linnean Society of London. Vol. XXIV. 4to. London, 1863-4.

The Linnean Society stands confessedly at the head of all English institutions for the promotion of Biological researches. In thus saying, we reproach no other scientific body. The objects of the Royal Society are of a more general, those of the Geological and Zoölogical Societies, of a more special character. All these Societies issue quarto volumes of 'Transactions.' But the Transactions of the Linnean Society alone are wholly devoted to the two great departments of Biological Science, Botany and Zoölogy.

The volume of 'Linnean Transactions,' just brought to a conclusion, includes three separate Parts, published during the years 1863-4. The first volume of Transactions appeared in 1791; the twenty-fourth, and last, at the close of the past year. On an average, therefore, three years has been the period of gestation for each volume. Henceforward, we may expect one every alternate year.

The present volume numbers 532 pages and 59 plates. There are, in all, 27 separate communications. But, as one of these is merely a note to its predecessor, and two others form successive portions of the same series of records, the real number of papers may be estimated at 25. Looking through these papers, we find an absence of any on Vertebrate or Cœlenterate animals, while Cryptogamic Botany is represented solely by Mr. Currey's 'Notes on British Fungi.' With these restrictions, the volume displays a considerable diversity of subject-matter. Of the 25 papers, 15 are zoölogical and 10 botanical. The former include 388 pages, the latter 142. But this discrepancy is chiefly caused by the excessive dimensions of one zoölogical memoir, Mr. A. Murray's 'Monograph of the Family of Nitidulariæ,' which extends to 204 pages, and was originally designed as one of the Catalogues of the British Museum.

In the following comments we shall refer to many of the papers under abbreviated titles. Of the ten on Botany, six may be set down as purely descriptive or nearly so, and the remaining four as morphological and physiological, namely,—

1. Hooker—On *Welwitschia*.
2. Salter—On certain Monstrous Passion-flowers.
3. Harley—On the parasitism of the Mistletoe.

4. Oliver—On the contractile tissues of the pods of *Pentaclethra.*

The above have all received due notice in our pages, more especially Dr. Hooker's Essay on *Welwitschia.* This essay may justly be regarded as the most important special addition to the literature of phænogamic botany since the appearance of the classic memoirs of Robert Brown. Thus, whatever the botanical moiety of this volume wants in quantity, it more than gains in the quality of its contents. And this meed of praise its zoölogical contributors may, without disparagement of their own claims, courteously accord.

The six papers on descriptive botany are as follows:—

1. Currey—Notes on British *Fungi.*
2. Hanbury—On *Cassia moschata.*
3. Mann and Wendland—On the Palms of Western tropical Africa.
4. Hanbury—On the Siam Gamboge-tree.
5. Kirk—On *Walleria.*
6. Miers—On the *Conanthereæ.*

Mr. Currey's 'Notes,' so far as published, contain diagnoses and more detailed accounts of thirty-eight species of *Fungi*, one half of which are new to science. Ten others are mentioned as new to the British Flora, while the nine remaining forms display peculiarities of structure, either previously unnoticed or interesting because of their bearing on most questions touching the nature and relations of this anomalous group of plants. Thus, the 'cystidia,' or vesicles, organs of doubtful function, to which reference was made in the last number of this Review, (pp. 65-67), are described and figured as they occur on the gills of *Agaricus esculentus.* Again, in *Cribraria intricata,* one of the Myxogasteres, Mr. Currey has observed a mode of germination of the spores similar to that which takes place in *Sphæria herbarum* and other undoubted *Fungi.* And in *Badhamia,* true spore-sacs, like those of the ascigerous *Fungi*, occur. These and other facts militate against the view of De Bary that the Myxogasteres should be removed to the animal kingdom. As various matters of general import in connection with the organization of the Fungi are referred to in these 'Notes,' they may be looked upon as effecting a transition between the two classes of botanical memoirs indicated above.

Of the papers devoted to descriptions of phænogamic plants, that by Gustav Mann and Hermann Wendland, "on the Palms of Western tropical Africa," is the most striking. From this extensive region only five species of Palms had previously been recorded. Twelve new Palms are here described, besides one other collected by Dr. Welwitsch. "The group of *Arecineæ* have, up to the present "time, been quite unknown on the mainland of Africa; now, however, "two species have been discovered, they constitute two new genera, "viz. *Podococcus* and *Sclerosperma*." Of the remaining species, old and new, to which the memoir refers, five belong to *Raphia* and eight to *Calamus*. The others are *Phœnix spinosa*, *Borassus Æthiopum* and *Elæis Guineensis*, the palm-oil plant, the economic importance of which may be inferred from the statement "that during the last "three years 130,381 tons of palm oil, of the value of £5,605,913, "have been imported into Great Britain."

Mr. Hanbury has two papers, both on medicinal plants. In his 'Note on *Cassia moschata*,' he shows that this species, closely allied to *C. brasiliensis*, yields pods which have been confounded with those of the true *C. fistula*. *C. moschata* had previously been noticed by Kunth, and Humboldt and Bonpland, though now for the first time adequately described and figured.

All the gamboge "found in European commerce is produced in "Siam or in regions contiguous to that country," and it would seem, by a single species, *Garcinia morella*, Desrousseaux; of which *G. elliptica*, Wallich, *G. gutta*, Wight, and *Hebradendron Cambogioides*, Graham, are synonyms. Other species of the same genus yield, however, a similar substance. Mr. Hanbury describes a variety of *G. morella*, with pedicellate male-flowers, from specimens supplied him by the Messrs. D'Almeida of Singapore, who have long cultivated on their estate several examples of "the real gamboge-tree," originally transported from Siam. Messrs. D'Almeida state "that "the trees, of which they have twenty-eight (but which might have "been increased to thousands had any pains been taken to do so), "are from 35 to 50 feet in height, the largest with a circumference "of about 3 feet; and that they grow very luxuriantly, without any "attention, on the slope of a low hillock." Mr. Thwaites of Ceylon where *G. morella* is indigenous, aided in the determination of these plants, and the same specimens afforded Mr. Oliver an opportunity of investigating anew the peculiar circumscissile anthers of *Hebradendron*, the structure of which he explains in an addendum to Mr. Hanbury's paper.

Mr. Miers reviews the genera and species of a tribe of *Liliaceæ*, to which Don, in 1832, gave the name of *Conanthereæ*. From this group Miers excludes the genus *Pasithea*, while, on the other hand, he would refer to it *Tecophilea* of Colla, which Dr. Leyböld makes the type of a new order, between *Liliaceæ* and *Iridaceæ*. *Distrepta*, Miers (1825), *Pöppigia*, Kunze (1828), non Bert. nec Presl., and *Phyganthus*, Pöpp (1838), are shown to be synonyms of *Tecophilea*. The other genera are *Zephyra*, *Conanthera*, *Cummingia*, and *Cyanella*. The floral characters of all these are represented on a single plate.

To the same group probably belongs the new genus *Walleria*, of which Dr. Kirk describes two species. The structure of its fruit is unknown. The ovary is free or very slightly immersed: in other characters the flowers resemble those of the *Conanthereæ*, the stamens opening just as in *Conanthera* itself. Dr. Kirk adds the following " diagnostic table of

GENERA OF THE CONANTHEROUS LILIACEÆ.

I. *Ovary semi-adherent; stamens unequal.*

1. *Zephyra*, Dav. Stamens 2 abortive; anthers opening by a terminal pore, spurred at base.
2. *Cyanella*, Linn. Stamens all fertile, one enlarged, pendulous.

II. *Ovary semi-adherent; stamens equal.*

3. *Conanthera*, Ruiz and Pav. Perianth 6-parted; anthers connate, opening by pores, ending in a single arista.
4. *Cummingia*, Dav. Perianth campanulate; anthers connate, opening by pores, ending in a double arista.
5. *Pasithea*, Dav. Stamens free, opening by longitudinal valves the length of the anther.

III. *Ovary free; stamens equal.*

6. *Walleria*, Kirk. Stamens opening by pores; perianth 6-parted."

The geographical distribution of these genera is interesting. *Walleria* is from the mountains of Eastern tropical Africa; *Cyanella*, known to Linneus, from the Cape of Good Hope. The remaining *Conanthereæ* are South American.

An arrangement of the zoölogical memoirs contained in this volume under two heads, the descriptive and the more abstract, would appear arbitrary. More naturally do those papers fall into groups, according as they affect the classes of the animal kingdom. To these they bear the following proportion—

Astomatous Protozoa	1
Rotifers	1
Scolecids	1
Annelids	2
Crustaceans	3
Insects	4
Lamellibranchs	1
Pulmo-gasteropods	1
Branchio-gasteropods	1
Other classes (about 16)	0

—or one paper on Rhizopods, four on Worms, seven on Arthropods, and three on Molluscs: in all fifteen papers, representing nine of the twenty-five 'classes' of animals.

Mr. Brady, in his Essay 'On the Rhizopodal Fauna of the Shetlands,' demonstrates an evident affinity between the *Foraminifera* of this district and those of the opposite Norwegian coast. He also, we think rightly, inclines to the opinion that the Gulf-stream has little or no direct influence on the animal population of these northern shores. And, in common with Mr. Jeffreys, he questions the *bonâ fide* occurrence of *Peneroplis* and *Vertebralina* (Mediterranean and tropical forms) in such high latitudes. Mr. Brady has met with all the species figured in Williamson's Monograph, with the exception of ten (of which about half are doubtful). In a useful table he records the relative frequency of these forms and the depths at which they were obtained, adding references to Williamson's figures and to the nomenclature of other writers. The study of the minor modifications of type presented by the *Foraminifera*, in relation to the external conditions under which they occur, discloses an almost unworked subject of great interest. We are glad to find our author bearing practical testimony to the truth of the "views advocated in Dr. Carpenter's work;* and the easy way "in which the various members of the group fall into their places "when treated with reference to this system."

New facts of undoubted value are brought forward by Dr. Moxon

* Noticed in N. H. R. July, 1863, p. 323.

in his 'Notes on some points in the Anatomy of *Rotatoria*,' referring chiefly to the water-vascular apparatus, alimentary canal and 'feelers,' or supposed organs of sense, in these animals.

Limnias is here said to possess a water-vascular system agreeing with that of Rotifers in general. A similar system exists also in *Floscularia*, but its "vessels" are very small in diameter "when com-"pared with the bulk of the creature's body." There is no other circulatory apparatus, albeit that Mr. Gosse has described such, apart from the general cavity of the body. Dr. Moxon has seen ciliated appendages of the usual kind in connection with the lateral vessels of *Pterodina*, in which genus they could not be detected by Leydig. The true structure of these organs, 'tags' or 'cilium-funnels,' is still an open question. By careful observation of *Euchlanis dilatata* in several distinct aspects Dr. Moxon shows that the 'candle-flame like appearance' which the tags often exhibit is not due to the presence of a single long 'flickering cilium,' as many have supposed, but of numerous short cilia, clothing the (inner) surface of the tag. "Whether [he adds] this is a triangular flattened "ampulla, or whether the tube opens, and one side of its orifice is "produced and expanded into the triangle, so that the latter is a "single plane, I cannot make out; but I believe the cilia must be on "two opposed surfaces." In support of this last conclusion the author further states, "that an identical appearance of flickering cilia is pro-"duced by the same conditions in the tube-valve of the crop of *Flos-*"*cularia*," a characteristic structure, which he describes as "a thin-"walled, flattened, cilium-lined tube," waving loosely about in the manducatory cavity, or crop, with the pharyngeal margin of which its attached edges are continuous. "This tube-valve has often been seen "by describers, but its nature has been entirely mistaken; it has been "viewed as a 'slit-like opening fringed with vibratile cilia' [Dobie], "as 'many plates or filaments' [Dujardin], as two delicate mem-"branes [Huxley], and as a stream of water trickling into the "gizzard." In three instances the author has seen the tube completely everted along with the anterior third of the alimentary canal of the *Floscularia*. The cilia were plainly observed to vibrate on the surface of what thus became the tube's exterior. "I have thus," he concludes, "fully described this structure, as I believe the em-"ployment of a long, lax, ciliated tube as an intestinal valve is not on "record." The 'feelers,' or tactile organs, of the Rotifers are either stalked or sessile, and are median or lateral in position. Lateral feelers occur in *Floscularia* and *Limnias*, as well as in *Melicerta*, "and it is highly probable that they exist in all the stationary genera." These also possess the median feeler of other *Rotifera*, which would appear to be seldom absent. The lateral feelers are symmetrically situated "towards the ventral aspect, and close to the part which forms the upper end when the lobes are retracted." In *Floscularia* they are very small, and, as in *Limnias*, "placed on slight conical elevations." The conspicuously stalked lateral feelers of *Melicerta* strikingly contrast with the obscure median feeler, "sessile on the back of the head," and homologous with the single stalked feeler of *Philodina* and *Rotifer*. The median feeler is always 'dorsal,' as is, also, the opening of the cloaca. Thus, when other characters fail, we may determine with accuracy the principal aspects of the body. Dr. Moxon seeks to remove the obscurity, in this regard, which has too often involved the writings of his predecessors.

Mr. Bastian's paper 'On the Structure and Nature of the *Dracunculus*, or Guinea-worm,' is worthy of a more detailed notice than we can here afford it. We hope afterwards to present an analysis of it to our readers, when we come to review the same writer's observations on the free *Nematoidea*, which will appear in the next Part of the 'Transactions.'

Dr. Baird describes a new species of *Amphinome* (*A. didymobranchiata*) from Ascension Island and, in a second paper, *Chætopterus insignis* from the British seas. Mr. Williams adds a note containing additional particulars on the structure and habits of this curious Annelid.

The seven papers on Arthropod animals are as follows:—

1. Hancock and Norman—On *Splanchnotrophus*.
2. M'Intosh—On the hairs of *Carcinus mænas*.
3. Lubbock—Notes on *Entomostraca*.
4. ———— On the development of *Chloeön*.
5. ———— On two aquatic *Hymenoptera*.
6. Haliday—On *Iapyx*.
7. Murray—Monograph of the *Nitidulariæ*.

Splanchnotrophus, nov. gen., is a parasite of Nudibranchiate Molluscs, and is closely allied to *Chondracanthus*, but the body is much more distinctly segmented. There are two species, *S. gracilis* and *S. brevipes*. The males of the latter are unknown. Those of the former, or what would seem to be such, are distinguished from all other Lerneoid *Crustacea* by their well developed thorax, exhibiting distinct traces of five somites. Each is about one-fourth the length of the female, and is furnished with a median rudimentary eye, wanting in the other sex.

The parasitic relations of this genus are peculiar. In the case of both species only a single female inhabits the same Nudibranch, within the visceral cavity of which she dwells; the minute extremity of the abdomen and the ovigerous sacs being the only parts projecting beyond the integument of the mollusc selected. *S. gracilis* "invariably occupies the same position, resting upon the under sur-"face of the liver-mass and embracing two-thirds of it with its long, "attenuated lateral processes." *S. brevipes* was always found "im-"mediately below the dorsal skin in the neighbourhood of the heart." Several males of *S. gracilis* accompanied each female and attached themselves to its body, as in *Chondracanthus*, or to the surface of contiguous viscera. Like many other internal parasites they seem to cause little injury to their host, notwithstanding their great comparative size. "*S. gracilis* is not very much shorter than the "length of the liver upon which it lies, and which it almost encircles "with its arm-like processes; while *S. brevipes* nearly occupies one-"third of the visceral cavity of *Doto coronata*, and lives in a position "where it might be thought to interfere with the central organs of "circulation; and in the case of *Eolis rufibranchialis*, before alluded "to, the parasite must have been in contact with the cerebral "ganglions. Yet these animals seemed perfectly unconscious of the "presence of the insidious foe that was feeding upon their life's "blood. They moved about apparently quite at their ease, and were "in no way distinguishable from unafflicted individuals, except by "the presence of the protruding ovigerous sacs of the parasite. "They had mostly attained their full growth, and there seemed every "probability of their living the usual time allotted to the life of the "species. When they perish, the contained parasite must perish "also; for it is an inert, helpless creature, quite incapable of any "active exertion in search of food or for self-preservation."

We commend Dr. M'Intosh's paper to those naturalists who complain of the want of materials for investigation. What can be a more accessible 'subject' than the common shore-crab, yet to a competent and painstaking observer we see how readily it displays new and interesting features. It would not be easy to offer a condensed account of the various hair-like organs which clothe the body of this animal, all of which are here described in connection with the several regions and appendages to which they were found attached. Not only do they occur on most parts of the exterior, but even the stomach of this crab is seen to be supplied with a rich diversity of similar structures. They are not, however, continuous with those of the integument, since none could be found along the course of the intestine or œsophagus.

Mr. Lubbock's 'Notes on some new or little-known species of Fresh-water Entomostraca' refer to seven species of *Cyclops,* two of *Diaptomus* and one of *Lepidurus.* We select the last by way of sample. *Lepidurus productus* is a near ally of *Apus,* type of the *Branchiopoda phyllopoda*—which, excepting the *Trilobita,* are the only Crustacea possessing more than the typical number of somites. This simple fact, in no wise subversive of the doctrine of common plan, has proved a stumbling-block to so distinguished a carcinologist as Prof. Dana, who, with perverse ingenuity, has devised what we must term an uncalled-for explanation of it. Mr. Lubbock courteously points out the futility of such views, in a note on the homologies of the Branchiopod group; the irrelative repetition of whose somites is paralleled among air-breathing Arthropoda by the Myriapods, which exhibit a similar divergence. *Apus* is also remarkable for the scarcity of its males, first described in 1857, more than a century after the discovery of the genus, by Kozubowski, who counted only 16 among 160 females. Mr. Lubbock, in stagnant pools near Rouen, found the males of *Lepidurus,* hitherto undetermined, very abundantly, though the females appeared to preponderate. The males, unlike those of *Apus,* were as large as, or larger than the females, but Mr. Lubbock lays no stress on this circumstance, since the species which he obtained were probably not adult and, therefore, did not rightly display the true proportions, as to size, of the two sexes.

But if the males of *Apus* be zoölogical wonders, how much more marvellous is an Hymenopterous insect "actually *swimming* by "means of its wings?" Mr. Lubbock has been the first to witness this strange sight; nor has he, like the too susceptible Redi, making undue application of the maxim of his great compatriot:

> Sempre a quel ver ch'ha faccia di menzogna
> De' l'uom chiuder le labbre finch' ei puote,
> Però che senza colpa fa vergogna;

hesitated to put the discovery upon record. Moreover the fact has been confirmed by the observations of others. *Polynema natans*, the insect which exhibited so unlooked-for a phenomenon, was found "in a basin of pond-water," together with another member of the same order, of which no truly aquatic species had previously been noted. This second form is referred to a new genus, *Prestwichia*. Its wings closely resemble those of *Polynema*, though it holds these organs "motionless, and uses its legs as oars." Both these insects afford the text for a number of suggestive considerations on the varying relations of animals to the elements in which they live, which we forbear to abridge, referring our readers to the paper itself. No branch of natural history is more interesting or less technical than this, yet how few are the methodised contributions made to its annals by those who have leisure and ability to become constant observers. But the mind sees what it brings with it the means of seeing. Mr. Lubbock's opportunities for the quiet contemplation of living organisms in their native habitats are well known to be few and far between, and we rejoice, therefore, at his success,—a success, however, at which *ex-professo* entomologists should blush. They have described about 12,000 Hymenopterous species, of which one-fourth are British, transfixing with pins some millions of individuals and detailing, with painful minuteness, their most obscure and transient characters; yet, in spite of all this trouble, they have allowed the most curious member of the entire group to escape them.

Mr. Lubbock contributes a third paper, 'On the development of *Chloëon* (*Ephemera*) *dimidiatum*.' Its main object is to show that the terms by which we seek to define the metamorphoses of insects need revision, if we would henceforth employ them with scientific accuracy. We are accustomed to resolve the life of insects into three or four definite stages, but facts prove that in several insects, "there is no such "well-marked, threefold division; and that, in the Ephemeridæ at "least, the young insect gradually attains its perfect condition "through a series of more than twenty moultings, each accompanied "by a slight change of form." In support of this proposition Mr. Lubbock describes seventeen successive states in the development of *Chloëon*. These details are introduced by some striking prefatory remarks on the metamorphoses of insects in general, their causes, and the external conditions to which they are adapted, and which, in turn, modify their occurrence.

Iapyx is a new genus of *Thysanura*, allied to *Campodea*, Westwood. It has been found in various parts of France and Italy, also in Algeria. Mr. Haliday proposes to make it the type of a separate family between *Lepismidæ* and *Poduridæ*. We could wish that this experienced entomologist would more frequently print for our instruction his notes on similar aberrant or interesting forms.

Mr. Andrew Murray's 'Monograph of the Family of *Nitidulariæ*' is one of those miraculous accumulations of industry which none but an entomologist could raise. It almost takes one's breath away to read the list of foreign cabinets which Mr. Murray examined by way of preparation for his task, and Mr. Herbert Spencer himself could not frame even a 'symbolic conception' of the hundreds, we might say thousands, of drawings and dissections executed during its prosecution. Mr. Murray avowedly undertook "no journey of a Sabbath day," and if, as he somewhat mournfully anticipated, there are few from whom he "could expect an intelligent appreciation" of his work, he should remember that the estimation of one of these must, in any just allowance, overweigh a whole theatre of others. Labour of this kind is not lost, though no man can hope to achieve it who will not rise up early, and late take rest, and eat the bread of carefulness; as all genuine workers know. It would be tedious, though far from unprofitable, to analyze the great body of facts which this Monograph includes. The *Nitidulariæ* are a group of beetles, including *Nitidula* of Fabricius with its subsequently discovered allies, now amounting to we are afraid to say what number of genera and species, whose figured representations, to the non-entomological eye, look terribly like one another as, in artistic guise, they sprawl gracefully over the surface of numerous plates, the intermediate blankness of which is usefully relieved by a crowd of outline sketches, showing in detail the characters of their several parts. Yet, as loyal subjects, we may boast that our national collection, thanks to Mr. Murray's exertions, possesses the most complete series of these creatures known to students.

As might have been expected from the careful study of so extensive an assemblage of forms, Mr. Murray has been led to recognise the general conclusion that the minor groups of systematists are "to a greater or less extent artificial." He is not here speaking of the larger, or Linnean, genera which may possibly have "boundaries laid down by nature and not by man," but of the genera and sub-genera established by modern entomologists. "If genera "really did exist in nature, we ought to be able to find positive and "defined characters by which to distinguish them. That we do not "find any limiting boundaries, goes far to prove that there are no "such things as genera in nature, and that what we call so are "neither more nor less than artificial aids to memory and classifica- "tion. In no family which I have studied have I been more struck "with this than in the *Nitidulariæ*. The affinities which we find "constantly appearing in unexpected places, and the gradual shading "off which we see in others, show that the whole group is a perfect "network of relationship, and that, with a few exceptional breaks, "the boundaries of the genera, or subsections, into which for con- "venience sake we divide them, have no real existence."

Of papers on *Mollusca* we have three, viz.:—

1. Wright—On *Nausitora.*
2. Blanford—On *Tanalia*, *Philopotamis* and *Paludomus.*
3. Hancock—On the Renal organ in the Nudibranchs.

Nausitora is a new sub-generic form, related to *Teredo*, and is worthy of note because of its fresh-water habit, thus differing from all previously known members of its group. The specimens here described were taken from trees which had been immersed in the river Comer, a remote tributary of the Ganges.

Mr. Blanford considers *Tanalia* and *Philopotamis* as sub-sections of the old genus *Melania.* This opinion he demonstrates in the first part of his paper. In the second he describes the Cingalese species of *Philapotamis* and *Paludomus.*

We have seen that the best Essay in the volume before us was also the first, and discussed a botanical subject. By a curious contrast, what we must consider the memoir next in order of merit concludes the volume, and is zoölogical. We refer to Mr. Hancock's paper 'On the Structure and Homologies of the Renal organ in the Nudibranchiate Mollusca,' of which we hope to offer an analysis in our next number. It would be impossible to give it adequate notice within the brief space remaining at our disposal.

Of the plates which accompany this volume we have said but little. All its memoirs are illustrated, those on Botany, with few exceptions, by Fitch. Excellent, also, are the illustrations appended to the papers of Mr. Murray and Mr. Hancock, though differing as much in style as in subject matter from one another.

In truth it is a pleasing task to take up a richly-varied volume like this, and glance, as we have done, through its contents. Thus may the naturalist, putting aside for a time more special studies, refresh his own mind while he contemplates the labours of others and enjoy a series of new and vivid impressions. As in a carriage-drive through an agreeably diversified country, we feel the rapid movement which we do not cause, and gaze, reposing, on the changing prospect. Such relaxation exerts a healthful influence; nor can it be rightly enjoyed by those who do not themselves labour for science, so that, indirectly, it serves to stimulate research. Some there are who would denounce all pleasures of this kind as tending to excite desultory habits, forgetting that it is one thing, after work-hours, to vary our moments of leisure,—another to waste our whole time in multiple pursuits. They forget, also, that for want of a wider acquaintance with previous investigations, many discoverers have brought little aid to science, because the true import of what they have seen has but dimly revealed itself to their ill-trained powers of apprehension. These miss much which the more accomplished student of nature is ever ready to secure. Opportunity offers new objects of study, of which they are slow to avail themselves, and their restricted habit of mind, if it does not engender positive errors, tends at least to beget the evils that accompany an inadequate method. For what is the real use of special investigations? Others, of course, will value them in so far as they increase the general stock of knowledge, but to the investigator himself they are mainly serviceable as a means of mental culture—as affording him, so to speak, a key wherewithal to unlock the treasures which his fellow-workers have collected. Thus is he enabled to make their experience his own. Many expend their hours in going over the old ground of their predecessors, forgetting how impossible it is that each should study everything for himself. If this were so, why print books or papers, except to promote self-glorification? The man whose illogical mind will not teach him when he can trust what has been done by others should be expelled the threshold of science, neck and heels. How little in the way of direct observation is even the best of us able to effect! "The greatest genius," wrote Goethe, "will never be worth "much if he pretends to draw exclusively from his own resources. "What is genius, but the faculty of seizing and turning to account "everything that strikes us?"—let us call it the faculty of appropriation. Edward Forbes, in a well-known passage, advocating the study of our native fauna, has made eloquent reference to "the glorious variety of Nature," which those only will contemn as an empty-sounding phrase, who have neglected to cultivate the varied faculties of mind on whose exercise the genial interpretation of Nature depends. Yet, in spite of the example which Linnæus has set, do we still find botanists ignorant of zoölogy, and zoölogists equally ignorant of botany, to the great detriment of both. Is not the healthy observation of living animals, the best preliminary study for every young zoölogist, too often wantonly divorced from systematic zoölogy on the one hand, and from embryology and anatomy on the other? Persons educated in other respects, but unacquainted with Biology, are deterred from its pursuit by such unnatural isolations. Why is it made to assume this forbidding aspect to those without the gate, who very willingly would come in, were they graciously invited? "Everything in science," now, as in Goethe's time, "is become too "much divided into compartments." On this account a Society, embracing Biological inquiry in all its aspects, deserves the fullest recognition. Linnæus himself owed to the diversity of his studies, no less than to his mental endowments, that extraordinary influence which, during the lifetime of their master, inspired his pupils with such zeal, that it might be truly said they would have compassed sea and land to make one addition to the 'Systema.' The spirit of the great Swede, loath to leave his collections, still survives, and beholds, unseen, the substantial progress of the Linnean Society.

XX.—The Ancient and Modern Floras of Montpellier.

Étude des Tufs de Montpellier au point de vue Géologique et Paléontologique, par G. Planchon, Docteur-des-Sciences. Montpellier: 1864. 4to.

Des Modifications de la Flore de Montpellier depuis le seiziéme siécle jusqu'à nos jours. By the same.

These are, as far as we know, the first productions of a young naturalist, and we hail them with satisfaction as evincing great ability, and doing credit to a name already eminent in systematic and structural botany through the labours of his distinguished brother. From their form we conclude that the two memoirs constitute the author's thesis on taking his degree of Doctor of Science, and he justifies the presenting them together, notwithstanding the difference of their titles, as being closely connected, each one forming as it were the complement of the other. The two tend to the solution of one and the same problem, the one in investigating the state of the Montpellier vegetation before any probable intervention of man, the other in indicating the modifications which the flora has undergone within a determinate historical period. Both of them furnish data of considerable interest towards the general history of vegetation, as we shall endeavour to show, taking first into consideration the second memoir relating to the recent historical period.

The Montpellier district has some peculiar advantages for researches into this branch of its history during the last three centuries—a minute portion of time it is true when compared with that which it must have taken to establish its present flora, but yet sufficient to test the value of several of the opposing theories recently propounded on the introduction, dispersion, and extinction of species. Its rich and varied vegetation has been carefully observed and repeatedly described by eminent botanists from the eighteenth century to the present day, during which period also various efforts to introduce new plants have been recorded, accidental importations have been observed, and the real or supposed disappearance of others more than once commented on.

Rondelet, professor at the University of Montpellier towards the middle of the eighteenth century, was the first great promoter of botanical studies in that country. He did not himself publish anything on its Flora, but the works of the period describe him as exploring the region at the head of his numerous pupils and directing them into the true scientific paths for the study of its vegetable treasures. Amongst these pupils are reckoned Rabelais, Dalechamp, Clusius, Jean Bauhin, Pena, and Lobel, and many of these, especially Lobel and Pena have, in their various works, left numerous indications of the precise localities of plants in the neighbourhood of Montpellier. In 1596 Richer de Belleval founded the celebrated Jardin des Plantes in the suburbs of the town, which has ever since been kept up as a great centre of botanical research. He also drew up some "Herborisations autour de Montpellier," which, however, were never published. In the latter half of the seventeenth century Magnol published his "Botanicon Monspeliense," of which Dr. Planchon says: "under its modest exterior, this little book of Magnol's, the first catalogue of our species, is an important work, revealing the qualities of a conscientious observer and a really scientific mind. It is yet in the present day the best local Flora we possess, it is deserving of full confidence, and would perhaps be the guide the most consulted by explorers, had it not been that its now antiquated nomenclature renders its practical use very difficult"—an approbation which we can fully endorse from personal experience. In the eighteenth century the Linnean nomenclature was first applied to the Montpellier Flora, by Nathhorst, in a dissertation, entitled, "Flora Monspeliensis," maintained in Upsala under the presidency of Linnæus, but which is a mere catalogue of species. And during the whole of the latter half of that century and the first years of the present one, the botanical sceptre at Montpellier was in the hands of the celebrated Gouan, the steady and favoured correspondent of Linnæus, whose devotion to the science only increased with age, and whom we still remember, some years above 80, and perfectly blind, yet enjoying nothing more than being led to feel his favourite trees and plants. His regular herborisations were attended, amongst other pupils, by Commerson, Dombey, Bruguière, Olivier, Riche, and Labillardière, and his several works on the surrounding Flora, embodying most valuable information, are well known to all northern botanists, although, as observed by Planchon, they must be used with caution, for they are far from possessing the reliable precision of Magnol's little book. Stations are occasionally set down from memory, subalpine plants from the Cevennes are sometimes confounded with the low vegetation of the plains, and thus facts met with in Gouan's works which may appear startling, cannot be admitted without confirmation from other observers.

Since Gouan's time no special work on the Montpellier Flora has appeared, but De Candolle and Delile, who respectively occupied the botanical chair, Duval, Salzmann, Roubieu, Pouzin, Bouchet-Doumenq, Cambessèdes, etc., besides numerous botanists yet living, have amassed extensive materials or published numerous notes scattered through their works, from which very accurate details of the present vegetation of the country may be obtained. Gouan and Amoreux have left detailed lists of the exotic plants they attempted to introduce, chiefly by sowing, in the last century, and in the present one, the adventitious plants which spring up at the Port Juvenal, the place where foreign wools are landed and washed, first adverted to in the supplemental volume of De Candolle's Flore Francaise, have more especially occupied the attention of Delile, Touchy, Godron, Cosson, Lespinasse, and others. These and other sources from which Dr. Planchon, independently of personal observation, has collected his facts, are critically reviewed in a preliminary introduction.

In sketching out the plan of his work Dr. Planchon distinguishes two questions, the research into the facts observed relating to the modifications of the Flora, and the inquiry into the various causes which have produced these changes. In the following chapters, however, the two questions are combined, and the subject matter divided into two parts, 1. the destruction or disappearance of old species, and, 2. the introduction of new ones. The region which he takes as the field of his observations is defined as limited by the Hérault on the west, and the Vidourle on the east, a breadth of about 30 miles, and as extending between 40 and 50 in length from the seaboard on the south, to the mountains of Esperou and Aigoual on the ridge of the Cevennes, which bound on the north that hot, botanically rich, district known under the name of the region of Olives.

The causes of destruction the most striking to the casual observer, and which would *a priori* appear to be the most effective in a region like that of Montpellier, where the cultivator and the botanist have been equally at work during the three centuries in question, are the *defrichements* or breaking up and bringing under cultivation of old woods, pastures, and wastes, and the extirpation of rare species by the collecting zeal or wanton rapacity of botanists and dealers; but a closer observation shows that neither of these causes have had the effects popularly attributed to them. Cultivation, observes Dr. Planchon, can only be a cause of destruction to species occupying a very limited area. "It is a difficult matter," he continues, "to extirpate a plant from a country where it is well established. Wherever it occupies an area of any extent, it always finds some points which suit it, where it can maintain itself, and from whence it can take advantage of the first favourable opportunity for reinvading its ancient possessions."

These observations, applied generally by Dr. Planchon, are more peculiarly applicable to the Montpellier districts. That the advance of agriculture during the last three centuries has been comparatively slow, is proved by the study of Olivier de Serres' Théatre d'Agriculture, published at the close of the eighteenth century, and still a standard work for that country. Deep ploughing, rotation of crops, drill sowing, clearing the banks and borders of fields, and other devices, practised in central and northern Europe, for giving to the objects of cultivation exclusively the beneficial possession of the soil, are scarcely yet brought into bearing on the arable lands of Lower Languedoc; and nowhere else, perhaps, do the cornfields teem with such a variety of De Candolle's "plantes cultivées malgré la volonté de l'homme." The draining of large tracts of bog, to which so much effect is attributed in the north, in causing the disappearance of rare plants, has none at Montpellier, for there are no bogs to drain; and the vast lagoons and marshes which border the Mediterranean still occupy at least as great an extent as they did some centuries back. When waste lands are broken up they are rarely enclosed, and from the broken, rocky nature of the country, scattered spaces are usually left undisturbed, quite sufficient to perpetuate the previous wild vegetation. If the conversion of the forest of Gramont, below the town, or of the greater part of the rocky hill of Cette, with vineyards and olive-grounds, the disappearance of the few meadows of Boutonnet, or the reduction of the once extensive woods of *Pinus halepensis*, around Montferrier, may have spoiled some of the best herborising grounds of the botanists of the sixteenth or seventeenth centuries; on the other hand, a few miles further north, from Montferrier to beyond the Pic St. Loup, many a ruin of cottage or castle, barn or enclosure, many an ancient track of the spade or plough in what is now the open *garrigue*, or wild barren pasture of the country, show the extent of land, or at least the numerous patches, once under cultivation, but now again left to the operations of Nature, checked only by the ravages of the real enemies of scarce plants —the flocks of sheep and goats that roam over them, and the countless swarms of the insect tribe.

Cultivation alone has, therefore, had but very little effect in destroying established species, and still less the wanton efforts of botanical collectors. Montpellier has indeed had her dealers or even amateurs who, after having supplied themselves with what they conceived a sufficient stock of specimens of some of the rarer species, have used every exertion to destroy the remainder; but they have not succeeded. *Lavatera maritima*, *Pastinaca Opopanax*, *Diplotaxis humilis*, etc., are still to be met with. Even the exertions of gardeners to collect for planting all the roots they could find of *Pancratium maritimum*, and some other Liliaceæ and Orchideæ, from their very limited stations, have not yet effected their extirpation.

Dr. Planchon finally alludes to another cause of destruction, in a manner which shows how steadily, although gradually, thinking naturalists on the Continent, in spite of opposition, are adopting one of the important principles laid down by Lyell and Darwin, that of gradual change through countless ages *versus* sudden catastrophes. "This cause," he says, "is the action slow but sure of the thousand often inappreciable modifications, by which nature gradually substitutes new species for the preexisting ones. This succession of vegetable forms, in one and the same region, is a well-established law, and without going back to geological periods, when it presents itself to us on an immense scale, we can recognise its effects in the present period." After alluding to the substitution of one tree for another as the prevailing essence of forests, as observed in other countries, and to the disappearance of trees and shrubs common in former ages about Montpellier, as more especially considered in the memoir we shall revert to further on, he further observes :—

"But if the operations of Nature are carried on with a certainty that our feeble means never obtain, it is also with the slowness of a power that has ages at its disposal. Nothing, therefore, is more difficult to establish than this gradual progress of certain species towards destruction during periods when the action of physical causes can be leisurely exercised without being disturbed by human intervention.

"To such a cause may, perhaps, be attributed the local disappearance of trees formerly common in some of our woods: the Nut tree and the Holly, much less frequent in the low grounds than they used to be; the Sycamore indicated by Magnol and Gouan at the Capouladoux, but which, to our knowledge, has not been found there in our days. These are, however, probabilities only; man may have assisted nature and hastened the loss of these species in restricted localities. At all events it will require much time yet before the work of their destruction is completed over our whole region; and before these species, scattered here and there in the Cevennes, can be entered in the list of our extinct species." We may suggest in addition, that these three trees, as well as the wild gooseberry, alluded to by Planchon as disappearing also from the low ground, all thrive best in a more temperate climate, and that the additional exposure, occasioned by the destruction of woods, may have been the last stroke that disabled them from resisting the difficulties they had to contend with during the burning Montpellier summer.

As the general result of physical causes, combined with human action, Dr. Planchon can only establish the loss from the region of Montpellier of five species since the sixteenth century. Five species, however, in three centuries, might be considered as a large number in proportion to what has been observed elsewhere, if all five had been really old well-established species. But two of them, *Lupinus luteus* and *L. varius*, from the details he gives further on, can scarcely have been more than weeds of cultivation, and should probably have been classed with the more or less temporary intruders, spoken of under the head of introduced plants. The three others, *Clematis recta*, *Coronilla juncea*, and *Arum arisarum*, are still not uncommon in some parts of Provence to the east, and in Catalonia to the south-west, and are most probably species which in fact are slowly but steadily losing ground.

In investigating the causes of introduction and dispersion of new species, Dr. Planchon has been unable to trace any results within the last three centuries to the action of purely physical causes, such as currents of water or wind, or to the action of animals independently of man. The Montpellier seaboard is not exposed to any extensive maritime currents, which, on some of our own and other Atlantic coasts, bring seeds from great distances rapidly enough to preserve their powers of germination, and if, as is most likely, some are brought from smaller distances, and germinate and grow, they are the same which have done so repeatedly during tens or hundreds of centuries, and cannot be distinguished from those raised from native seeds. Fresh water currents can still less have introduced foreign plants, for every stream of the region rises within it. All that they can do is occasionally to bring down mountain plants into the valleys, or to disperse along their banks species otherwise introduced. The action of winds and that of animals, always independently of human agency, take effect chiefly within limited distances; and in this respect the same observation applies to them as to that of the sea, that the present conformation and condition of the country has lasted so long, that their force has long since had its full effect, and they have no new plants to act upon, unless brought within their influence by other means. The only new species which the author thinks may possibly have been introduced by these means, is the *Erigeron canadense*, which the winds may have brought into the region from other parts of France, where it had previously established itself. It must, however, be recollected, that whatever be the means by which a plant is first introduced into a region, it is, according to the definition of the term, by the action of physical causes alone that it can be *naturalized*—that is, maintained, propagated, and dispersed without human protection or aid.

All means of introduction, independently of the above-mentioned regular physical causes, are, unless some great change takes place in the physical conformation, climate, or other condition of the country, reduced to the direct or indirect influence of human agency.

The most important and direct influence of man is by cultivation. "Wherever he has established himself, he has deeply modified the aspect of vegetation; he has broken up large tracts, covered them with plants foreign to the country, and, by his constant care, protected against the attacks of the indigenous vegetation, those plants necessary for his wants or his industry. But this introduction of cultivated plants does not enter within the scope of our essay; we only take into consideration those species which, once confided to the soil, are abandoned to their own resources, and must maintain themselves, without other aid, against the enemies of all kinds which surround them."

But direct efforts have not been wanting on the part of botanists really to naturalize exotic plants in various parts of the region by sowing and planting them in localities where they were supposed to be likely to succeed. Nissole in the seventeenth century, Gouan and Amoreux in the eighteenth, and Moquin-Tandon in the present one, carried on the operation on a large scale. Gouan and Amoreux especially have left records of about 900 species so treated; but after a careful research, Dr. Planchon cannot discover that a single one has established itself, or is now to be found in the localities indicated, if it was not already naturally there. It is true that, on examining the lists, there appears to have been very little discernment on the part of the experimenters in the selection of species or of stations. "They have taken into account neither the favourite stations of these species, nor the aspects which they usually prefer, nor the chemical or physical condition of the soil, nor the association of the vegetation which surrounds or shades them." It is probable also that the number of seeds sown, or of roots planted, was always very limited. "It is, therefore, not surprising that the rare individuals which succeeded in germinating, isolated amidst the rightful possessors of the soil, should rapidly have been smothered by them." But it is observed, "notwithstanding the imperfection of these attempts, it must be admitted that some species amongst the number must have met with the conditions favourable for their development. Why have they not spread and established themselves in the country? It is evidently because the naturalization of a plant meets with many more difficulties than one would suppose without experience. There are indeed very few that triumph over all the obstacles opposed to their establishment. If a species does not early show its tendency to naturalization, if it does not sow or multiply itself on its arrival in the country, one must inevitably expect a failure in endeavouring to introduce it."

In recent days, a few attempts, made with more judgment and perseverance, have met with rather better success, but only in the case of aquatic plants propagated by their rhizomes. Three of these appear to be more or less established: *Aponogeton distachyon* in the Lez at Lavalette, planted in 1838; *Acorus calamus* in the pool of Gramont, planted in 1849; and *Jussieua grandiflora*, thrown into the Lez many years since, and now spread all along its course from Pont Juvenal downwards.

The indirect or involuntary agency of man has been here, or elsewhere, much more effective in the introduction and naturalization of new species. This takes place by the natural propagation and dispersion—1, of plants cultivated in fields or gardens; 2, of weeds or other plants whose seeds have been sown with imported grain or cast aside in picking it; 3, of seeds imported with wool, ballast, or other substances spread out or heaped up on waste places.

The escapes from cultivation permanently established in the neighbourhood of Montpellier during the three centuries, have been remarkably few. Of the numerous species cultivated in the botanic garden since its establishment in the eighteenth century, although several have spread as weeds within the enclosure, and five have even extended beyond, two only — *Hypecoum procumbens* and *Veronica peregrina*—have become really naturalized in the neighbourhood, and those to no great distance. Besides these, the only cases within the region which Dr. Planchon has been able to ascertain, are those of *Cyclamen hederæfolium*, established for the last century at Chateaubon, near Montpellier, but which has not passed the limits of the park; and of *Œnothera biennis*, now scattered here and there along streams and in sandy places, but whether escaped from local gardens, or gradually spread from other parts of France, where it had been similarly introduced, is uncertain.

The weeds of cultivation of ancient introduction are undoubtedly numerous; but the additions within the last three centuries are limited to six species, viz., *Amarantus albus* and *A. retroflexus*, *Xanthium spinosum* and *X. macrocarpum*, *Erigeron canadense*, and *Bidens bipinnata*, all (except, perhaps, *Xanthium macrocarpum*) of American origin, and all now abundant in vineyards and other cultivated and waste places. Of these, the *Erigeron*, the *Bidens*, and the *Xanthium spinosum*, appear to have been first noticed in the last century, the three others in the present one, the precise mode of introduction, whether as escapes from the Botanic gardens, where they had all been previously cultivated, or introduced with cultivated seeds, cannot now be ascertained.

A cause of introduction of exotic plants into the Montpellier territory which has of late years excited much interest amongst French botanists, is that of the Port Juvenal ground, where foreign wools are washed and spread for drying. These drying grounds have long existed. The first legal document by which they were devoted to the purpose is dated the 6th January, 1700; but even before that they were probably so used. The attention of botanists was, however, not called to them till early in the present century. The first published mention of plants so introduced is in De Candolle's Flore Française. Since then Millois, head gardener of the Botanic Garden, has collected many, which were introduced into Loiseleur's Flora Gallica, and Delile and Touchy have perseveringly applied themselves to completing the list, which Godron published in 1853 under the title of Flora Juvenalis. To this list further additions have been made, especially by the botanists assembled at the meeting of the Société Botanique de France in 1857, and the total number, as since recorded by Cosson, has been carried to 458 species, including, perhaps, a few which we should be inclined to consider only as marked varieties.

Up to the year 1830, the wools imported were almost exclusively from the Mediterranean region, and accordingly none of the exotic plants mentioned in the earlier records, as found on the locality in question, were from more distant countries; but since 1830 the importation has been chiefly, and of late years almost exclusively, from America, especially from Buenos Ayres and Rio de la Plata, and the origin of the total number of 468 species found up to the present time, is thus given:—

Mediterranean region	356
Europe, exclusive of the Mediterranean region	20
North America	10
South America	28
Central Africa	1
Australia	1
Cosmopolite species	1
Origin unknown	51
	468

But this Port Juvenal Flora is eminently adventitious; the idea which some entertain that it is a kind of botanic garden where the botanist may at any time make a rich herborisation, is quite erroneous. The 458 species are the result of repeated collections, made during more than forty years, of plants, of which the greater part only subsist a single season, or have been known only in single individuals. These are chiefly annual Papilionaceæ, Cruciferæ, Gramineæ, &c. A few such as *Centaurea iberica, C. diffusa, Verbascum cuspidatum, V. mucronatum, Ægilops cylindrica, Æ. ventricosa,* &c., are annually renewed in the same locality. One of these, *V. mucronatum,* was supposed to have spread to Gramont, where, however, it has now disappeared. One only of the whole number, *Onopordon virens,* DC. (*O. tauricum*) has become generally dispersed along the river, and has all the appearance of a definitive naturalization. In the wool-washing grounds of Bessan, which lasted but a few years, six species were found, all of which have now disappeared.

The ballast-heaps about the ports of the Lez, and of Cette, were specially examined in the years 1856, 1857, and 1858, when thirty-three exotic species were found, of which three only have become permanent, *Onopordon virens* (also introduced as above, with wool), *Ambrosia tenuifolia,* and *Asclepias curassavica,* the two latter occupying only a very limited space.

After having thus shown in detail what have been within the last three centuries the exotic species purposely sown or planted, or unintentionally scattered in the region, Dr. Planchon, in summing up the effect on the vegetation of the country, concludes that of the numerous germs thus confided to the soil, the greater number have perished without any result; others, to the amount, as far as observed of five or six hundred species, have risen and gone through their different stages of development, and then passed away, without taking definitive possession of the soil.

A few (among which three—*Anemone coronaria, Tulipa oculus-solis* and *Nigella sativa*—are specially mentioned) have shown more persistence, and are still found, but only in the midst of certain cultivations, changing place with them, and constantly liable to disappear.

Four or five escapes from cultivation have established themselves repeatedly on the banks and ditches of the fields in which they originated, but without any tendency to invade fresh spaces.

Sixteen species have become really naturalized, although even these show it in different degrees, for six of them are only to be found within the enclosures or limited spaces where they were first planted; three, of which two are American, spread slowly over suitable stations, but may probably never become very general; and seven, all American, have established themselves over large spaces as weeds of cultivation very difficult to extirpate, so as to form a prominent feature in the vegetation of the country.

Finally, this preponderance of American species in the new introductions is explained by the consideration that those from other countries (chiefly the Mediterranean region) having availed themselves of frequent opportunities of introduction offered to them for ages previous to the period under consideration, cannot, if now again brought in, be distinguished from the natural vegetation, of which they have become a part, whilst the introduction of American ones can only have commenced with the sixteenth century.

It might not be uninteresting to devote a short space to the consideration of how far the above general conclusions may be compared to what is taking place in our own country—to what extent the same general laws prevail in a region so very different from that of Mediterranean France, as well as to climate and other physical conditions, as in the degree to which it is affected by human agency. We all hear of the "vast changes" alluded to by Hewett Watson, as "gradually wrought in the vegetation of Britain by the conversion of forests into wastes, and of wastes into cultivated lands." We know that within Dr. Planchon's period of three centuries, on the one hand, the efforts directly or indirectly applied to the extirpation as well of native as of involuntarily introduced species; and on the other, the opportunities afforded by an extended commerce, and a varied and general cultivation of exotics, for the introduction of new ones, have been infinitely greater in Britain than what has taken place at Montpellier. There may be some difficulty in collecting all the data recorded in various works which might guide us in the inquiry; and we have as yet no history of the British Flora which should, in the words of Hewett Watson, "trace out each species back to the earliest records of its occurrence in Britain, and also, when possible, to its still earlier relics in peat mosses and elsewhere." Yet a few facts which may be considered as well authenticated, may be sufficient to show that the operations of nature in this respect are as slow in Britain as at Montpellier, and that, independently always of the plants actually and intentionally under cultivation, the spontaneous vegetation of our country has been much less affected by the vicissitudes of three centuries than many may have imagined.

The comparison of Great Britain with the Montpellier district may in one sense be thought to be somewhat unfair, for the one region is five times as broad from east to west, and above ten times as long from south to north, as the other; but, on the other hand, the number of species contained in the former is, we believe, not two-thirds of those of the latter; and, moreover, after deducting the widely-spread species common to both regions, the proportion of species of limited general areas is much smaller in Britain than in Montpellier; the area of a species in Britain is, *on an average*, a much smaller portion of its general area than at Montpellier. Thus the British region, although so much larger when measured in miles, is in fact smaller in its botanical relations. And, in climate, the contrast between the Aigoual and the Esperou, and the scorched arid wastes about Montpellier, is almost as great as between the Scotch highlands and the southern counties of England.

The direct or intentional extirpation of rare plants by man does not appear to have been much more effective in Britain than at Montpellier. Collectors of various descriptions have indeed been very much more numerous, but the real botanist has generally some feeling that the rare species should remain *in situ* for future visits, or as evidence of his discovery, which restrains him from utterly destroying; the mere tourist amateur or occasional visitor does not take sufficient pains to hunt out every individual; and the interested dealer, the only one really to be feared, has, we believe, acted rather differently with us than at Montpellier. Those we have there met with have endeavoured to destroy every plant they could not make a specimen of, in order to prevent others from collecting and interfering with their own sale, our own local dealers and botanical guides have rather directed their efforts to conceal and preserve stations only known to themselves. Such, at least, is said to be the case with the *Lloydia* of Snowdon and the *Cotoneaster* of Great Ormes Head, which the ordinary tourist searches for in vain, but of which we are told individuals *in situ* are still known to the guides. It has been stated even that old stations have been artificially re-established or new ones created in our mountains for *Trichomanes radicans*, and some others. We cannot, indeed, recall any species which have actually become extinct from the depredations of collectors, except perhaps *Cypripedium calceolus*, now sought for in vain at its old station near Settle, in Yorkshire, although some believe it to be still there, and the Cheddar Pink, specimens of which we are told can now only be obtained from cultivated plants. It may be observed also that (with the exception of trees) the utmost efforts man bestows upon the destruction of a wild species possessing ordinary means of reproduction, are as nothing compared to the havoc made by the animals of every description, beasts, birds and insects, that feed upon it at every stage, from the seed to the perfect plant, and to the effect of the innumerable diseases, injuries, and accidents it is exposed to from physical causes.

The indirect agency of man in the destruction of spontaneous vegetation, by cultivation, drainage, &c., within the three centuries, has been very much more active in Britain than in Mediterranean France, but as yet with scarcely more absolute results, except in restricted regions. With the drainage of bogs and fens, and the breaking up of heaths, especially in the eastern and southern districts of England, the plants of those localities are necessarily more confined in their areas, and some may have been entirely expelled from particular counties, but the only authenticated record we can find of losses to our Flora by this means, are those of *Eriophorum alpinum*, "discovered in the Moss of Restennet, about three miles eastward of Forfar, in the year 1791 by Mr. George Don and Mr. (Robert?) Brown, but subsequently lost there by drainage," (Cybele, iii. 81), and of *Carex Davalliana,* from Lansdowne, near Bath, also reported as "lost by drainage." In neither case do we know how far the species were previously abundant in the stations given. The destruction of our woods took place chiefly before the period in question. Within the last century a greater extent has been planted than broken up, although such new homes are scarcely an adequate compensation to the native plants for the loss of their old ones. In a given district new plantations can generally be at once distinguished from old woods of the same apparent growth and species by the want of such sylvestral plants as *Melampyrum pratense*, &c., which swarm in the former. Wood and heath plants are very slow in invading new stations, although they cling very long to their old ones wherever there may remain a bank or corner where they are comparatively undisturbed.

The gradual contraction of the area of species, the diminution in the average number of individuals, and the tendency to a final extinction from a combination of natural causes difficult to appreciate, some as yet unrevealed to us, and but very slightly and indirectly aided by man, are probably going on in Britain as in the South, but their operation is here again so slow as to be scarcely appreciable within the short period of direct and positive botanical history. Three centuries are as nothing in the long life of a species which usually preserves its powers of reproduction to the last, so as under favourable circumstances rapidly to regain any ground it may have lost. But whether it may be that in some instances these powers of reproduction do become weakened by time, or that new enemies, animated or physical, arise, or the old ones increase in number or power, a period arrives when the balance is destroyed, the area of a plant is gradually restricted, its numbers diminish; as it becomes rare its position is more and more difficult; it is restricted at last to a single station, where a final blow extinguishes it.

Three species, none of them as yet showing any approach to a general extinction, are nevertheless supposed to have finally withdrawn from Britain, or very nearly so, within the last hundred years, without their destruction being traceable in any considerable degree to human agency. *Senecio paludosus* is believed to have quite disappeared from the fens of East England, and the same has been recently said of *Sonchus palustris*. *Menziesia cœrulea*, from the Scotch Highlands, was also confidently reported as extinct, but Dr. Balfour, as we learn, exhibited at the last meeting of the British Association at Bath, recently gathered specimens. That this species has great inherent specific vitality is shown by its endurance in an isolated, unfrequented spot in the heart of the Pyrenees, and that the *Senecio* and the *Sonchus* have considerable powers of reproduction is equally proved by their occasional abundance in some parts of the Netherlands and adjoining countries, but neither of these qualities is sufficient without the other. The *Menziesia* appears not to regain the footing it has once lost, whilst the two others have equal difficulty in retaining the territory they have recovered. The above mentioned *Arum arisarum* of the South belongs probably to the first of these categories.

We have also a few species, as, for example, *Lobelia urens* and *Simethis bicolor*, which, like *Globularia*, *Alyssum* and *Anthyllis barba-Jovis* at Montpellier, although still tolerably abundant in restricted localities, may be gradually disappearing from among us by the same slow course of nature—that is, by a combination of causes weighing down the balance against them. But it may take many centuries yet to extinguish them altogether. The *Simethis* is, we believe, a long-lived plant, whose grass-like leaves are lost for a great portion of the year, and it may exist in small numbers, unnoticed and uninjured for very long periods. The *Lobelia* produces a large quantity of seed, and on the Continent will vary much in number of individuals in different years. Most probably the seed does not always find meteorological or other conditions favourable for germination at the time it is shed, and is often destroyed or loses its powers of germination before these conditions occur.

If human agency has been much more active in Britain than at Montpellier in the destruction of spontaneous vegetation, it has been infinitely more so in the facilities afforded to the introduction of new ones, as well by direct importation and cultivation as by our extended commerce with all parts of the world, our importations of foreign grain and other agricultural seeds, of foreign wools, timber, and other goods, by our heaps of ballast from various countries; independently of the ocean currents, winds, bird-flights, &c., which, much more than at Montpellier, may, without the aid of man, keep up a seed communication not only with the opposite Continent, but even with more distant lands. The result is accordingly in some respects greater than at Montpellier, but not in proportion to the greater means; partly in consequence of our climate imposing narrower limits on the sources whence plants can be successfully imported.

The subject of species introduced into Great Britain has been largely treated of by A. De Candolle in his Géographie Botanique, and by Hewett Watson in the fourth volume of his Cybele. We learn from the latter: "It appears that the Flora of Britain must now include upwards of three hundred species (320 to 330 by the lists before printed), which are believed or conjectured to have been introduced to this island by the agency of mankind, either intentionally or accidentally. The foreign ingredient thus constitutes nearly one-fifth of the Flora, reckoned by species, after striking out of the long list several of the least suspected, and of the least established species."

On looking through the long list we find that, with the exception of nine or ten North American species, the whole are European plants, which even if now occasionally reintroduced, may be and probably are, with few exceptions, the same as those introduced and established long before the sixteenth century. The cultivation of simples, medicinal and officinal plants, was much more prevalent in the middle ages than in the present day, and has left its traces in many a "denizen" lingering around the ruins of castles and monasteries and about our old retired villages. Most of the "colonists," or weeds of cultivation, must have come over even with our earliest importations of grain. The ornamental escapes from cultivation established are comparatively few, but even among these scarcely any can be fixed upon as belonging to our recent horticultural importations. Whilst we have inundated many distant regions with our own weeds and waste plants, no Japanese nor Californian plant, none from the extra-tropical regions of the southern hemisphere have as yet sufficiently spread from our gardens, to be entered in any of the lists of naturalized plants, and scarcely any as yet show any tendency towards it. The only extra-European species which our steady intercourse of three centuries has given us, are:

On the seacoast, *Spartina alterniflora*, and possibly *Senebiera didyma*.

Along river banks and analogous waste places: *Impatiens fulva*, *Œnothera biennis* and *Mimulus luteus*; to which may, perhaps, soon be added *Eschscholtzia californica*.

Along roadsides, railway banks, etc.: *Erigeron canadense*.

As weeds of cultivation: *Oxalis stricta*, *Claytonia perfoliata*.

In rivers and canals: *Elodea canadensis*.

To these is added *Gnaphalium margaritaceum*, but we are unacquainted with the stations or circumstances in which it is found.

The most remarkable of the above is the *Elodea canadensis (Anacharis alsinastrum*, Bab.), of which the sudden appearance a few years since, and the extraordinarily rapid dispersion without seeding (only one sex being in the country) are so well known. None of the others have taken so prominent a place in the spontaneous vegetation of the country as the two Xanthiums and the two Amarantuses at Montpellier. Even the *Erigeron*, which, with its enormous powers of reproduction, infests whole districts on the Continent, remains very local with us. It appears to propagate well; we know of instances where one or two plants one year have the following season covered a considerable extent of railway embankment, but it has almost disappeared again after a few years; and long as it has been known among us, it is not a common weed of the country.

A few of our "colonists" from European sources may be altogether recent additions. *Cuscuta epilinum* is supposed to be among the number. The Alfalfa clover, *Trifolium hybridum* has certainly spread very much in some counties within the last few years, and we believe that *Galinsoga parviflora*, an American plant, but probably brought to us from Germany, is establishing itself in some of our corn fields.

The oriental *Rhododendron ponticum* sows itself so freely in the parks and plantations of some of our southern and western counties, that it may perhaps be classed as a naturalized species of modern introduction.

Dr. Planchon could find only six species which had maintained themselves in the spot or limited grounds where they had been planted, although they had not spread further. We have many such, but we do not usually include them in our Floras. A few hedge shrubs, such as *Spiræa salicifolia*, in North Wales, may not have been of ancient introduction, but we cannot ascertain that here any more than at Montpellier, a single species introduced within the last three centuries, has gained a footing in our natural woods, heaths, moors, or pastures; the period is too short for any very perceptible change in the vegetation of uncultivated districts.

In the Memoir on the calcareous tufas of the neighbourhood of Montpellier, of which we have given the title above, Dr. Planchon takes up the history of the vegetation at a much earlier period as supplied to us by evidences derived from the impressions of stems, leaves, flower, and fruits found in these deposits.

The early portion of this Memoir is devoted to the geological description of the nature, extent, and position of the tufas, and to a description of the different theories propounded on their formation and period. This is followed by an enumeration of the species of plants of which impressions have been traced, discussing in the case of each the evidences upon which its determination has been founded; and in conclusion, the general aspect of the vegetation they exemplify is compared with that of the present day. The essay includes a list of terrestrial and freshwater shells which have left their remains or moulds in the same deposits, and, in an Appendix, an account is given of a *Rhyacophila*, the larva of which has left in them tubular incrustations which had been mistaken for impressions of roots.

The tufas of the neighbourhood of Montpellier are nearly all grouped in the valley of the Lez; the largest and richest in remains are below the village of Castelnau, spread over a space of at least 100 hectares (about 250 acres) from about a mile to a mile and a half from the town, and near Gasconnet, occupying about 23 hectares (nearly 60 acres) a mile and a half higher up the river. Several smaller deposits further on have much fewer remains.

The author refutes the theory of M. Taupenot, that these tufas were deposited at the bottom of an ancient lake, and concludes that they were formed by running waters, issuing from numerous springs, charged with calcareous matter which formerly rose in the valley, and gradually encrusting the mosses, leaves, or other fragments which grew or became arrested in their course. The arguments in support of this hypothesis are given with considerable detail and clearness. From the various forms and stratifications observed he traces the origin and course of the principal streams; and he exemplifies his views by the encrustations now taking place in the park of Castries, along the channel and aqueduct conveying the water of a neighbouring spring to the chateau, and which supply him amongst others with two remarkable facts: that these encrustations have taken place along the steps of a cascade to the extent of sixty centimetres (nearly two feet) in eight years; and that the more rapid is the current the greater is the deposit. In point of time, he considers the relation of these deposits to the quaternary period as exceedingly obscure, but believes them to be much more recent than has been generally supposed.

Dr. Planchon's determinations of the species found are amongst the most satisfactory we are acquainted with. He has more or less certainly established the presence of the following thirty species, or marked varieties.

Clematis vitalba, *L.*
Acer monspessulanum, *L.*
—— opulifolium, *L.*
—— —— *var.* neapolitanum
Vitis vinifera, *L.*
Rubus discolor, Weihe (R. fruticosus, *L.*)
Cotoneaster pyracantha, Pers.
Hedera helix, *L.*
Cornus sanguinea, *L.*
Viburnum tinus, *L.*
Rubia peregrina, *L.* var. angustifolia
Fraxinus excelsior, *L.*
—— ornus, *L.*
Phillyrea media, *L.*
—— angustifolia, *L.*
Laurus nobilis, *L.*
Buxus sempervirens, *L.*
Ficus carica, *L.*
Alnus campestris, *L.*
Quercus sessiliflora, *Sm.* (Q. robur, *L.*)
—— ilex, *L.*
Salix cinerea, *L.*
Alnus glutinosus, *Linn.*
Pinus Laricio *Poir*? (or *var.* Salzmanni?)
Smilax aspera, *L.*
Typha angustifolia, *L.*
Sparganium ramosum, *L.*
Pteris aquilina, *L.*
Scolopendrium officinale, *Sm.*
Marchantia conica, *L.*

besides *Rosa sempervirens*, *Populus alba* and *Celtis australis*, of which the determination is uncertain.

Every one of the above species is still living and abundant in central and southern Europe. Twenty-one of the thirty are still common in the immediate vicinity of the deposits. Three, *Laurus nobilis*, *Viburnum tinus* and *Marchantia conica* are in the district, but not now in the valley of the Lez, one, *Acer opulifolium*, is no nearer than the Cevennes, four, *Acer neapolitanum*, *Fraxinus ornus*, *Cotoneaster pyracantha* and *Rubia angustifolia* have withdrawn to Provence or Italy. The ninth is either *Pinus laricio*, which is abundant in Corsica, or *P. Salzmanni*, Dun. probably a variety of the Laricio still found above St. Guilhem-le-Désert on the Hérault.

From these data Dr. Planchon gives the following sketch of what he conceives to have been the general aspect of vegetation at the period of the formation of the tufas, and the principal changes which have since taken place.

"The Baytree with its evergreen foliage must have been the predominant shrub. By its side flourished the *Acer opulifolium*, the Montpellier Maple, the common Oak, and the Ilex. The Laurustinus grew on the garrigues covered with Phillyrea, Box and thickets of Brambles. The Clematis, the wild Vine and the Smilax entangled the bushes with their festoons of verdure. The wild Fig hung then as now suspended from the crags. A grove of Laricio crowned the eminence on which now lies the cemetery of Castelnau, the Pyracanth with its bunches of coral adorned the Bel-Air hill. On the water's edge grew the Willows, Alders and Abeles, overshadowing the Brake-fern and the Harts-tongue, there also the flowering Ash mingled its foliage with that of the common Ash. The swamps were studded with Typhas and Sparganiums, and the dense fronds of Marchantia covered as with a carpet the moist sides of the cascades.

"But since that time the picture has undergone many a change. Several species then very common have disappeared from the basin of the Lez; others are become rare, they have given way to the invading plants which are now predominant in the country and give it its special character.

"The Baytree has taken refuge on the northern declivity of the Pic de St. Loup, and in the rocks of St. Martin-de-Londres, where it forms a few tufts lost in the general landscape. In Magnol's time, two centuries since, some specimens were still to be seen near the village of Castelnau; these were the last remains of the thickets formerly so flourishing in the valley.

"The Laurustinus is more prevalent in our neighbourhood. Its splendid bushes still adorn some of the ravines of the Gardiole and the picturesque rocks of the Capouladoux, but it is no longer to be seen on the banks of the Lez.

"Other species have abandoned the low country. *Pinus Salzmanni* only grows in our neighbourhood on one of the bulwarks of the Sérane range above St. Guilhem-le-Désert. The *Acer opulifolium* is only on the main range of the Cevennes.

"Some plants have become quite strangers to our country. The flowering Ash, the Laricio pine, the *Acer neapolitanum* now inhabit more southern regions, such as Italy, Corsica and the Balearic islands. The Pyracantha, less exclusively southern, has left traces of its former existence in the country. Authors give several French stations, even on the borders of the Montpellier district . . . . . .

"These losses have been compensated for by the new arrivals which have invaded the country and now predominate in it. At the present day *Quercus coccifera* characterises our garrigues, to which it has given its name (*Garouille*, in the local patois). Cistuses, *Genista scorpius*, Thyme, Rosemary and Lavender remind every southern botanist of these vast spaces scorched by our burning sun. None of these plants are represented in our tufas. Nor do those of Provence and Italy contain any trace of them. Had they existed at the epoch when these calcareous masses were being deposited, they must have been rare, they could not have escaped the encrustation of these springs if they had been scattered with the same profusion as at the present day."

In the above sketch there are some striking points, much that is very probable, a few facts that must be considered as demonstrated, but some also, especially the negative points, which appear to us purely hypothetical, without any evidence on which to found them. That the majority of the species comprised in the above list existed on the spot at the period of the formation of the tufa must now be taken as a proved fact; that the climatological condition of the country has not materially altered since that epoch may also be safely concluded from the fact that the plants known to have withdrawn from it are still found in nearly similar regions; if some have retired somewhat southward others again have retreated in a contrary direction, and all will now flourish in the vicinity if brought there; but to deduce from the fragments of these thirty species and from their relative abundance, any idea of the general vegetation of the country which probably included fifty or sixty times that number, or to conclude that a plant was not in the neighbourhood or even was not abundant because its remains have not been there found, is what we can by no means admit. Supposing, as is most likely to have been the case, from the scanty evidence at hand, that the spot in question was broken ground mostly covered by a dense mass of wood and thicket in the midst of which arose these springs, with perhaps here and there some bold rocks around them; what would be the leaves and fragments most likely to fall into the streams thus formed before leaving the woods? Surely those only from the immediately surrounding trees or bushes, or the very few herbaceous plants which would grow under them. The droppings of those which covered the country even at a hundred yards from the encrusting fluid would have very little chance of finding their way to it. Winds would not carry them far into a wood; rains would wash them into the beds of torrents which almost always eat their way into a lower level than the springs of a rocky valley; and the fragments that might be brought by birds or other animals would be very few and far between. Let us imagine one of our own wooded Welsh valleys with a copious spring issuing from the side of the hill, let us follow this from its rise for a few hundred yards, picking up here and there along its course a basket of dead leaves, sticks and other rubbish caught in its eddies. Suppose that in sorting out our booty, we can detect representations of twenty different species (taking this number as proportional to the general vegetation of the country) what would they most probably be—leaves of oak, ash, wych-elm, alder, sallow or osier, ivy, bramble—perhaps a wild rose or hawthorn leaf—a fragment of dead rush or of brake fern, and a few other such. Should we be likely to find any traces of heath or furze, any wild thyme, bilberry, cranberry or club-moss, and if not, should we at once conclude that there were no such plants in Wales? and yet the chances that these should be among our twenty species are quite as great, as that Cistuses, *Genista scorpius*, thyme, rosemary, and lavender, should be among Planchon's thirty, although they may have been as common as they are now. He has found one single leaf of each of two oaks *Q. robur* and *Q. ilex*, he has found none of *Q. coccifera*, from that he concludes that the two former were then in the country, and the latter a more recent invasion. But supposing them all three to be equally abundant and at no great distance from the spot, among the millions and millions of leaves they must annually shed over a few acres of land, the difference in the chances of a single one finding its way among the 30 species, and of not one doing so, is surely the smallest possible.

Among the conclusions drawn by Dr. Planchon from the consideration of these remains, there are some which are of considerable importance in the determination of a much disputed question in vegetable biology. There are four plants of most ancient cultivation in southern Europe, the vine, the fig, the olive, and the bay (or ancient laurel), which are also found wild in the same countries under conditions which have rendered it doubtful how far they are really indigenous, at least in the south of France. The wild vine is now not uncommon about Montpellier, and indeed much further north in hedges, bushy ravines, and here and there in open woods, the wild fig in waste and rocky places, especially in or near ruins and abandoned rocky patches of cultivation; the wild olive, less frequent in warmer rocks or close to plantations, each of these in the wild state presenting differences from the cultivated ones in foliage, habit and produce, which have given rise to three different hypotheses, each of which has its warm supporters. 1. That the wild individuals are the degenerate offspring of the introduced cultivated races. 2. That they are really indigenous and represent the native origin of the cultivated races. 3. That they are indigenous and specifically distinct from the cultivated ones. The cultivation of all three, especially of the vine and the fig, is connected with the earliest records of the human race in the Mediterranean region. That of the Baytree is also very ancient; it certainly appears to have been frequently planted by the early Greeks. Pliny tells us that in his days "Conservari alitem et sobolem jussere aruspices, ramumque ejus seri, ac rite custodiri. Quod factum est in villa Cæsarum .... mireque silva provenit." It was also much planted in the south in the middle ages, probably more than at the present day; but it is also wild, in a form not distinguishable from the cultivated one. In many parts of Italy it is generally believed to be truly indigenous, but in France its occurrence chiefly about old habitations has led to an opinion frequently expressed that it is everywhere a remnant of cultivation, sown perhaps by birds in the vicinity of the originally planted bushes. Dr. Planchon, however, classes it amongst the old indigenous species, gradually withdrawing from the Montpellier district. "In Magnol's time (the 17th century), it reckoned still some specimens near Castelnau. It is now only found on the northern declivity of the St. Loup, and in the gorge of

Les Arcs, near St. Martin-de-Londres." The Castelnau locality is just one of those stations where it might have been anciently planted; the lofty precipices of the Pic St. Loup, where we have ourselves gathered it, are certainly now in a wild enough country, far from all gardens; but even there, one of the summits is crowned by the extensive remains of the middle-age chateau of Montferrand. Whether there are any such in the still wilder region of Les Arcs, we do not now recollect, but still the proofs of the aboriginal nativity of the species are as yet far from complete.

All doubts, however, as to the bay, the vine, and the fig being truly indigenous must now be considered as settled, by the discovery of their traces in unmistakeable abundance in tufas formed probably before the advent of man, and consequently long before his agency could have had any influence on the vegetation. Of the olive, however, there is not a vestige, neither here nor in the apparently older tufas of Provence and Italy. This, as we have said before, is no proof that it was not in the country, yet from its affecting localities similar to those of the fig, we see presumptive evidence of its absence.

There is only one supposition—a far-fetched one indeed—which might still open the way to further argument. Is it quite certain that the formation of these tufas, evidently, as shown by Planchon, posterior to the settling down of the country into its present general configuration, was really not witnessed by man? May he not indeed have already tampered with its vegetation? A short time since the idea would have been scouted as absurd, but the recent theories of the antiquity of man have brought it within the verge of possibility, and, although highly improbable, it may be deserving of further inquiry and record.

We trust, however, on all accounts, that Dr. Planchon will continue the researches he has so well commenced, and complete the series of memoirs on the various questions connected with the history of Montpellier botany, of which we are told to consider the two present ones as a first instalment. Especially would it be desirable in connection with the investigation of the tufaceous deposits that comparisons should be instituted between the tufas of these lower regions of the south of France, and those occurring in subalpine situations, as, for example, the deposits immediately under the Hospice of the Lautaret.

XXI.—Species and Subspecies.

Diagnoses d'espèces nouvelles ou méconnues, pour servir des materiaux à une flore reformée de la France, et des contrées voisines Par Alexis Jordan. Paris, 1864.

Twenty, or even ten years ago, the publication of a work such as that which we now propose briefly to notice, would have attracted little attention in the botanical world. By all botanists engaged on a general survey of the vegetable kingdom, and therefore accustomed to broad views of the nature of species, it would have been regarded as a mere puzzle. They would have felt that they had little or nothing in common with an author whose opinions were so different from their own. The school of local botanists, as it has been called, of men who devoted themselves to the minute observation of a limited number of plants, inhabiting a confined area, was becoming more and more separate from that of general botanists. The views of the two schools on the nature and limitation of species, were indeed utterly at variance, with little or no prospect of their being reconciled. The general botanist, trying to grasp the whole range of plant forms, and thus accustomed to deal with large numbers, came to overlook or under-estimate the importance of minute characters. From the very nature of his studies he had a bias in favour of combination, rather than separation. The local botanist had a smaller number of objects of study. He, therefore, looked at them more closely, and became familiar with points of difference which escaped the other, but, at the same time, lost sight of the points of resemblance, which at once caught the attention of the general observer. Each of these two classes of naturalists was right from his point of view, but each had something to learn from the other.

Fortunately for the progress of science, the current of thought on the question of species, has, within the last few years, received an entirely new direction, and acquired new vitality, by the publication of the admirable speculations of Darwin and Wallace. Whether we adopt or reject the Darwinian hypothesis, we must equally appreciate the great mass of new and unexpected facts, which its originators and supporters have brought forward in its favour. It would be premature to say that it has put an end to the differences between the two classes of observers, but there can be little doubt that it has bridged over the chasm which separated them, and that by enabling both to look at the question from a new point of view it will, in the end, lead to agreement.

Darwin's marvellous observations have of late set all the world thinking about variation and variability, and have already stimulated to an enormous extent the observing faculties of naturalists. It is, therefore, a matter of interest, at the present time, to know what a zealous advocate of the immutability of species, and the champion of the school of minute observers, has to say for himself. M. Jordan's views, on both these subjects, are well known to be extreme. He not only believes in the permanence of species throughout all time, but looks upon this rather as a postulate to be taken for granted, than as a matter to be proved. Those who differ from him on this point are too heterodox to be reasoned with. Strange pantheistic phantoms flit before his eyes when he thinks of their plausible but dangerous heresies. With such fears and fancies we need not meddle. Fortunately, when we abstract them, we find him, in many respects, an acute, patient, and careful observer, and withal, as we believe, perfectly conscientious. A firm believer in his own results, and isolated in a great measure by their peculiar nature, he is sadly disappointed that they are not universally adopted, regards himself as a martyr to science, looks forward to the appreciation of posterity as a recompense for the neglect with which he is treated by the present generation of naturalists; compares himself, of course, to Galileo, and applies very hard names to all who refuse to accept his conclusions. It is no doubt a pity that he cannot bring himself to give to others the same credit for good faith which he so emphatically claims for himself, and that he should go out of his way to impute improper or unworthy motives to those who differ from him in the inferences to be drawn from observed facts. Unappreciated discoverers are however, as a rule, susceptible, and we must be content to take the abuse, and, at the same time, to glean what we can from a work which contains, along with much that is improbable and unsatisfactory, a great number of curious observations, and from the very faults and mistakes of which we may learn a valuable lesson.

M. Jordan has been in the habit for many years of cultivating in his garden a great variety of plants, introduced from various parts of France, or raised from seeds collected by himself, or sent to him by his correspondents. Annual plants he often sows broadcast in the fields or pastures near his house, where many become perfectly naturalised, and reproduce themselves year after year. He has thus (he thinks) excellent opportunities of observing the permanence or variability of forms. He tells us that these experiments and observations have been carried on for twenty five years. In one case he takes us back to the year 1829, often for ten, twelve, or fifteen years, but in some cases only for three, four, or five years. He was led to this course of study by observing that, in a state of nature, plants, comprehended under the same name, presented differences which, though not very conspicuous, seemed to him certainly not merely individual. On inquiry, he found that the leading botanists of the day explained these differences by variability of type, an explanation which did not satisfy him, and which, therefore, made him wish to observe for himself the existence of the variability thus taken for granted. He therefore repeated his observations on more numerous individuals in their native places of growth, selecting them in all states and of all ages. As he still got the same result, he proceeded to cultivate the several forms in his garden, or in some other easily accessible place. Finding that they always remained constant year after year, it became evident to him that they were more than casual forms. He then raised each separate form repeatedly from seed, and as they still retained all the characters of the parent plant, any remaining doubt was changed to certainty. It became evident that each form was a distinct species, and it was then a matter of necessity to give it a name, so that it might be known from other species, from which nature itself had distinguished it.

In the broadest and most positive terms M. Jordan gives it as the result of his experience, not only that wild plants when transplanted into his garden retain their characters unaltered throughout a long succession of years, but that their seeds produce year after year, invariably, the same form as the parent plant. Once only, so far as we have observed, does he give a hint of slight variation in the offspring. In describing the species (ten in number) allied to *Erysimum Bocconei*, he tells us that they are all so closely related to each other that, without good specimens and great attention, they cannot be distinguished in the Herbarium. At first therefore, he says, one would be inclined to regard them as modifications of one common type; but this, though specious, would be wrong, as he has raised them many times from seed since 1840 and 1841, in which years he collected the greater number of them. Slight variations were sometimes observed in the size of the flowers and leaves, and in the length of the pod and style, dependent on the season and on the condition of the plants, but their distinctive characters have, on the whole, remained constant, and at the time he wrote, young plants of each of the ten species were growing in his garden, and were all readily recognized by the leaves alone. Even such trifling deviations as these, from a fixed type, are, however, it is evident, rare in his experience.

In the case of annual plants, M. Jordan has, during a long series of years, seen closely allied forms of *Papaver*, *Erophila*, *Viola*, *Geranium*, *Erodium*, &c., growing intermixed with each other in a wild or naturalised state in his own neighbourhood, and invariably coming up true from seed by hundreds and thousands, or sometimes, tens of thousands. Each form, during the whole time, has retained its special distinctive character, though all were under exactly the same external conditions. These forms, however closely allied, are therefore to him true unities, perfectly limited and distinct, constant and invariable in their differences, and completely irreducible one to the other. In a word, they have all the characters of true species, in the ordinary meaning of that word. To call them varieties would, in his opinion, imply that they are now different from what they were created, a gratuitous and improbable hypothesis as much opposed to facts as to reason. Even when the differences, though quite definite, are too minute to attract the attention of ordinary unskilled observers, or to be detected at the first glance, they are, for our author, not the less of specific value.

It is well to observe that by the phrase *unskilled observers*, we are not to understand one who is entirely ignorant of natural science. The term is meant to include every botanist, however learned and experienced, who is without the special training necessary for the appreciation of minute differences. We need scarcely say that no one but M. Jordan will accept an induction based upon observations continued during 25 years (or a less number), as an infallible proof of invariability. It is evident that M. Jordan has approached the investigation of the question, with preconceived ideas of the duration of the world and of the original mode of the creation of species, which have given a bias to his modes of observation, and unconsciously led him into error. With the light which other observers have, of late years, thrown upon the subject, it is more important to notice that there is not in any part of the book before us the slightest mention of cross-impregnation, or of insect action in plant fertilization. It would appear that the possibility of either has never for a moment been present to his mind. With the recognition of the powerful influence of insect agency, the whole edifice, raised with so much pains, tumbles to the ground. The facts may stand, but they acquire a different meaning, and lead to quite different conclusions. Every one knows how little reliance can be placed on the results of experiments, in the course of which a great number of closely allied forms are grown together. We are all familiar with the effects of the "visits of bees," and know how difficult it is, even with a net, "to keep out small diptera."

The conclusions drawn from observations on seedling plants grown promiscuously must therefore be set aside altogether, as at the best unsatisfactory and unconvincing. We are quite willing to believe, on M. Jordan's authority, that the different closely allied forms re-appeared year after year. How and why this was so is a curious matter for enquiry, but there is nothing at all to show that it was because each form was fertilised by the pollen of the same kind and no other. When a peculiar variety is cultivated alone, with no nearly allied race or species near it, general experience confirms the result obtained by Jordan, of the retention of the characters during a certain number of generations, as many as twenty-five in the experiments before us, a number considerably less than infinite. The third result, the permanency during a short series of years of forms removed from their native place to a garden is also conformable to observation. We are aware that it was at one time thought that such variations were accidental and not hereditary, and that change of locality by removing the cause would effect a return to the normal state of the species. The permanence of slight variations under cultivation has therefore been often appealed to as a proof of specific difference. No doubt any modification of character produced by external causes would disappear with the removal of the cause, just as the changes produced by excess of nutriment, affecting only the luxuriance of the plant, continue only as long as the rich food is supplied. Even these slight varieties are, however, now commonly believed to have a tendency to become hereditary, without being therefore necessarily of specific value.

On the whole, a careful study of M. Jordan's work leads us to conclude that its greatest fault is a want of precise details of the experiments and of the observed results. In a question of the permanence or mutability of forms, we may safely reason from analogy after a few cases have been fully proved. A much greater effect would, therefore, have been produced by a few detailed numerical statements, than by hundreds of vaguely reported observations. Though we are assured in the introductory part of the work that it contains nothing hypothetical, but is based on facts that cannot be disputed, when we come to investigate details we do not, in any single case, get satisfactory information regarding the conditions under which the observations were made. The results are in many cases opposed to our ordinary experience, and to the observations of other careful observers. For this reason the conditions under which they were obtained should have been precisely stated, so that any one might have had it in his power to repeat them. The great number of plants simultaneously observed is very perplexing, and makes the results still more doubtful.

In criticising some results published by M. Caspary, on the forms of some species of *Biscutella*, M. Jordan lays great stress on the importance of taking all the precautions necessary to avoid the possibility of error. We may, therefore, infer that he is in the habit of taking every precaution which he thinks needful, but it would be much more satisfactory to have some details, so that we might judge for ourselves of their sufficiency. The results of M. Caspary's experiment are so little in accord with M. Jordan's results in similar cases that he altogether refuses to accept them. He quotes from the "Flora," but we find the original account of these experiments in the 4th volume of Walper's "Annales." M. Caspary collected the seeds of six different forms of *Biscutella* in the autum of 1853 with great care. Sown in the spring of 1854, in the Berlin Botanic Garden, each set of seeds produced a glabrous, or almost glabrous, and a hairy fruited form. The smooth and hairy sorts are therefore not distinct species, but are reduced by M. Caspary to three. M. Jordan, on the other hand, has continued year after year to raise from seed the smooth and rough-fruited forms, and has found them to retain their character unaltered, as well as all the other distinctive characters peculiar to each form. Looking at the matter without bias, we may accept the results of both observers, the experiments of both, so far as we can see, being equally trustworthy; but instead of saying, with M. Jordan, that Caspary's result is insufficient to serve as a basis for conclusions, it seems to us that it goes far to negative any conclusions that can be founded on M. Jordan's.

The descriptive part of M. Jordan's work consists of 330 octavo pages, and contains diagnoses of 352 species, all but two (poppies), belonging to the families Ranunculaceae and Cruciferae. These 352 species are dismemberments of 58 Linnean types, so that on an average there are as nearly as possible six Jordanian species to each Linnean species. The extreme numbers are widely apart. *Draba verna* is divided into 53 species, but in a great many cases the Linnean species is divided into two only. The flora of France contains at least four times as many species of Ranunculaceae and Cruciferae, equal in value to the 58 here dismembered. We are not, however, to understand that the others are monotypic species. On the contrary, M. Jordan gives us clearly to understand that when all the species are investigated by competent observers, every one of them will be found to be composite, their apparent unity being the consequence of the superficial manner in which they have been looked at by botanists.

We cannot select a better illustration of the principles which guide our author in his subdivisions than *Draba* (or *Erophila*) *verna*, L. The genus *Erophila* is said to contain about five species, but in Europe it has hitherto been considered monotypic. The Asiatic species are little known, and as they are similar in habit and aspect to our common species, they will perhaps be found to be connected by a gradual series of intermediates with *E. verna*. This common little plant M. Jordan divides into 53 species, all but one (Corsican) natives of the south of France. He recommends the careful study of these forms to all observers, especially to those who are unwilling to adopt his views in their entirety, with the most complete conviction that no one can pay proper attention to them without at once becoming a convert. A little plant abundant every where, easily cultivated from seed, taking up little space and growing readily on any waste place, certainly offers every facility for observation. It would be too much to expect it to vary in England exactly in the same manner and to the same extent as in France; but we need not doubt that analogous variations will be met with, so that every one has an opportunity of judging for himself of the value of the species thus instituted. According to M. Jordan, they should be observed in autumn, their distinctive characters being most evident in the young leaves before they are injured by the winter frosts. The leaves which accompany the flowering scapes are not characteristic either in shape or colour. The points which it is most important to observe are the simple or forked hairs (on which character M. Jordan divides the genus *Erophila* into two sections), the amount of pubescence, the shape of the pod, the shape, size and colour of the leaves, the size and colour of the flowers, and the general habit. The number of species of *Erophila* in France, he believes to be at least twice as many as those to which he has already given names, and if we consider the wide range of *E. verna* from temperate North America to the Himalayas, and its extreme abundance throughout the whole of its range, in the old world at least, we may fairly infer that with proper opportunities of observation the number of species would amount to at least two hundred. It is interesting to note the fact that these supposed species are all local forms. Not more than three or four of the fifty-three are usually found growing intermixed, and very frequently millions of individuals of a single form are found growing together without intermixture of a single specimen of any of the others. Each year too the same forms re-appear in the same places absolutely unchanged in character.

What then do we learn from M. Jordan's observations? We think that they may be considered to establish the fact that a practised observer can divide the assemblages of individuals commonly considered as species (using that word in the widest of the senses in which it is employed), into a greater or less number of forms to which definite characters can be given. These forms can, under favourable circumstances, be recognised with facility in a growing state, less certainly and often doubtfully in a dried state. In some cases, at least, they transmit their characters unaltered to their offspring during a certain number of years. The existence of these differences does not imply their permanence, nor does the transmission of slight characters by descent during a few generations prove that such characters will never vary. Whether, with M. Jordan, we call these distinct forms species, or with most other naturalists, races, depends on theoretical considerations which every naturalist must work out for himself, and on which, as is well known, there are at the present time the greatest possible differences of opinion.

Though M. Jordan is, as we have seen, fully convinced that these slightly distinct forms are permanent, and are therefore rightly regarded as species and admitted into our Floras, he does not, on that account, the less recognise the existence of the old species of which they are fractional parts, as distinct entities, to use a word introduced into our science by Bentham. Indeed, he not only sees no objection to their recognition as such, but considers it advantageous to unite all the allied forms into groups, corresponding to and bearing the name of the original type. In the book before us, he invariably notices these groups or types, and gives the number of species into which each is separable according to his observations. The Linnean type, from his point of view, loses its rank as a species, but remains as an assemblage of true species all closely allied one to the other, and constituting a natural sub-division of the genus. No true species, in the sense in which M. Jordan understands that word, is distinguished by a single conspicuous character. There is, for him, no such thing as a well marked species (éspèce tranchée). Such characters distinguish groups of species. It is only in a certain number of cases indeed that the true species have hitherto been accurately distinguished from each other, but as in every case in which a Linnean type has been studied with due care it has been analysed into several, it is perfectly legitimate to conclude that it will be so in every instance.

We follow M. Jordan in his use of the expression *Linnean type*, more for the sake of convenience than as intending to express our belief that the Linnean species are in every case true to nature. Every working botanist is well aware that, in the great majority of cases, species as described in books are and must be empirical. Their value varies in the case of each describer, with the nature of his definition of a species, and perhaps in many cases according to his estimate of the importance, or possibility, of accuracy of diagnosis, and the consequent greater or less pains bestowed on them. In the case of exotic plants, the descriptive botanist has rarely an opportunity of examining more than a few specimens, so that their specific distinctness must be an inference from his knowledge of the relative constancy of characters derived from the various parts of the plants. This knowledge is acquired, in the first instance, by the teaching of others, and by the study of their works, and afterwards by the observation of the small number of species which it is possible to study in detail. When Linnæus had a sufficiency of materials, as in the case of the plants of his own country, and of other parts of Europe visited by him, he seems to have applied his great powers of generalization as successfully in this as in other things, and to have brought together, under a common name, or as varieties of one species, forms which the less experienced authors who preceded him had kept asunder. Now and then, no doubt, he united very distinct species; but, on the whole, we may with M. Jordan regard the Linnean species as definite groups, and not passing by gradual transitions one into the other.

The progress of botanical science since it received its first great impulse from the labours of Linneus and Jussieu has been so rapid and continuous that it has, till quite lately, been impossible to stand still to review the question of species. In all branches of natural history there has been a gradually increasing tendency to their multiplication from the greater precision which has of late years been introduced into the modes of observation. This is most the case in local Floras, which, as a rule, are the work of botanists who confine their attention to the areas regarding which they publish, or at the most extend their range only to neighbouring countries, which possess a similar Flora. There are, of course, exceptions, and it will almost always be found that the more general the range of a botanist's studies the more wide his opinion of the specific limit. That the increase in the number of species in each Flora has been continuous, and at the same time extremely gradual, will be evident to any one who examines and compares the local Floras of the present day with those of older date. Each generation of botanists avails itself of the observations of its predecessors as a foundation from which to advance further in the same direction. Believers in the permanence of species will require no proof that the forms of *Rubus*, or *Rosa*, or *Ranunculus aquatilis*, which are now recognised, were much the same a century ago as they are now, and the advocates of the mutability of species, knowing the great lapse of time required to produce even a small modification, will readily admit the fact. Little or no change has taken place since that time in the external circumstances under which these plants grow, and no modifying causes can be suggested which are likely to have produced a sudden tendency to variation in these genera. If the possibility of this in a single case be contended for, it will, we suppose, be certainly conceded that it cannot have happened in all the variable genera. And yet while there has been during the period mentioned a gradual increase in the number of forms regarded as of specific value, there is nothing like a common consent among botanists of the same period as to the particular forms which are to be considered as species or varieties. No two authors, nay no two editions, agree with one another. Again, no independent thinker can for a moment suppose that the progress of the analysis or division of types has reached its limit. M. Jordan's work shows how far it has already been carried, and he admits that it must be carried further. It is as certain as anything in the future, that the number of book species in local Floras will go on increasing year after year, till the current of thought among naturalists has completely changed its direction.

This want of agreement among botanists as to what is to be considered a species, and what a variety, is a matter of common notoriety, as well as of the greatest importance. It goes far to prove that the forms, about which there is so much uncertainty, are of trivial importance in comparison with the general types of which they are a part. The subject may be illustrated by the comparison of any two local Floras, and for our purpose it may be well to select as examples the two British Floras, which take the most opposite views regarding species. Bentham's Handbook approaches, we conceive, as nearly as possible to the Linnean canon in its estimate of the value of species, while Babington in his Manual, taking a narrower view of the definition of a species, has a considerably greater number, though not nearly so many as some continental botanists. According to Bentham the number of British flowering plants is 1228, of which 1057 correspond exactly to the same number of species in Babington. It is only with respect to the remaining 171 species of Bentham's estimate that there is any difference of opinion. Of that number, 116 are divided by Babington into two, twenty-six into three, thirteen into four, eight into five, two into six, three into seven, one into eight, one into twelve, and one into forty. In no case does a single type in Babington represent two in Bentham. The tendency towards synthesis in the Handbook, and towards analysis in the Manual, is without exception. We may further remark that there is never, or so seldom as to be as good as never, any interlacement of forms, but that a single type of Bentham corresponds to two or more of Babington's. One or two exceptions in *Ulmus* and *Rumex* may be explained by the fact that Bentham has in these cases not gone far enough in the direction of synthesis to arrive at the true specific type.

If our space would permit of our extending this comparison to other local Floras, we should find everywhere the same want of agreement among botanists. The more the species are what is called critical, the less the chance of unanimity. In every case too it will be found that there is a point, symbolised by the Linnean type, beyond which synthesis cannot be carried. The number of elements into which these varieties are divided varies indefinitely from the extreme sub-division advocated by Jordan, to the smallest possible number of parts, but whatever the number, it is (it may be said) invariably co-extensive with the Linnean type, the existence of which is recognised, if not as a species, at least as a group of species, or as a section or sub-division of a genus. The conclusion to which we are thus led has already been arrived at in another way by Dr. Hooker, who of all botanists at home or abroad, has given most thought to the question of the limitation of species. In his essay on the Arctic Flora in the 23rd volume of the Linnean Transactions, he tells us that every attempt to carry out his investigations regarding the distribution of Arctic plants was unsatisfactory so long as he kept before him the critical species, which are perhaps more numerous in that Flora than in any other, in consequence of the wide area over which most of the species are spread. It was only by having recourse to synthesis, by bringing together as much as possible, into one whole, all the closely allied forms and regarding them as one, that he was able to arrive at any clear views on the distribution of Arctic plants.

The considerations which we thus urge upon naturalists do not apply to systematic botany alone, but with equal force to Zoology. Till naturalists have acquired a thorough conviction that the increase of sub-division is necessarily progressive, and almost infinite, there will be no change in their mode of working. A complete change in the mode of looking at the general question of species is therefore an essential preliminary to a change of practice. For the present anything like unanimity in such matters is out of the question. It is, however, worthy of enquiry whether it be equally impossible to make some alteration in the mode of naming plants (and animals) which shall enable all schools of naturalists to compare their results more readily than they now can. At present there is an absolute want of a common medium of communication between those botanists, who take a comprehensive view of the value of a species, and those who restrict its meaning. The binomial system of Linneus was undoubtedly an enormous boon to science. The cumbrous nomenclature in previous use made it difficult to talk of plants. The phrases which took the place of a specific name varied according to the caprice of the namer, and when alike did not necessarily denote in the book of one naturalist the same plant as in that of another. Linneus for the first time gave precision to the terminology of the science, and made progress possible. It is evident, however, that the precision thus imparted to science depends on the fixity of the meaning applied to the term species. With the gradual change in our views on this subject, and still more in consequence of their uncertainty, no one now knows in any case what meaning to attach to a name. It has lost its connection with a definite subject, and means now one thing and now another. The inconvenience of this uncertainty has been felt by all working botanists, and there can be no doubt that its removal would be a greater benefit to science than anything since the introduction of the binomial system of nomenclature.

In the case of genera the baneful effects of the gradually increasing tendency to sub-division have been well pointed out by Bentham. As the number of known species increased with the advance of science, and as each individual species became better known, it became possible to form groups lower in value than the original Linnean genera. For a time these groups were defined as sub-genera; but this has been done more effectively, or, at least, more systematically in Zoology than in Botany. In the latter science the sub-division of genera, notwithstanding the efforts of a few far-seeing men, has been carried to so great an extent that a reaction has now set in. Each sub-division, of greater than specific value, being considered a genus, is thought entitled to a name, and in conformity with the principles of the binomial nomenclature, the old generic name disappears, or remains only as the name of a section or sub-order, intermediate between the genus and the order, and as such is soon forgotten by all but a few systematists.

The case is exactly the same with regard to species. Mr. Bentham has argued, and we quite agree with him, that the old genera are far more natural than the modern sub-divisions. He has further dwelt upon the importance of making the names in common use conform to the most natural sub-divisions. In like manner, if it be admitted that the old Linnean species, whether rightly or wrongly so called, be groups natural in themselves, and much more natural than the sub-species into which they are divided, it must be a matter of regret that their names should disappear entirely from our nomenclature. In the case of the fifty-three Drabas, which M. Jordan describes, all of which he regards as dismemberments of the old Linnean *D. verna*, but to each of which he gives a distinct specific name, all sense of proportion, when compared with the other species of *Draba*, is entirely lost with the disappearance of the original name. Even if we refer them all to *Erophila*, as a genus or sub-genus, unless we regard that genus as monotypic we have no clue to the relative value of the specific name. So long as the section *Batrachium* of the genus *Ranunculus* consisted of one species, it was fairly comparable with *R. muricatus*, but now that it is sub-divided in Britain into twelve species, each of the sub-species is to appearance commensurate with the whole of *R. muricatus*, which in the British Flora is kept entire, whereas it is in fact only comparable with one of several forms into which that common European and Asiatic species may be analysed, and into which it is in fact divided in Oriental Floras.

To a certain extent Linneus had foreseen and provided for this difficulty by sub-dividing his species when necessary into varieties, marked by one of the letters of the Greek alphabet, and generally also with a special Latin name. In this manner the relative importance of the species and the variety was made manifest, the name of the species being most prominent. The Linnean nomenclature is still retained in theory, but it has been more or less abandoned in practice; forms which he regarded as varieties, being now very frequently regarded as species.

There have not been wanting here and there naturalists who have been sensible of the inconvenience of this state of things, and who have attempted to provide a remedy. Mr. Hewett Watson, in particular, in the course of his valuable investigations into the distribution of British plants, was of course a continual sufferer from the present lax system of nomenclature, and has recorded in the pages of his Cybele a vigorous protest against it. As is well known he has proposed to recognise three classes of species, each representing a fundamentally different idea, viz:—aggregate species, true species, and segregate species; designating by the first those species which are divisible into a certain number of types capable of recognition and definition, and presumably capable of transmitting their characters for a limited number of generations to their offspring. The third term, segregate or subspecies, he applies to the units of which the aggregate species is made up. Modifying these definitions a very little so as to regard the second or true species as equal in rank with the first, except in so far that it has not yet been resolved into sub-species, though capable of being so, when examined with sufficient minuteness, we find these terms quite in accordance with ur views.

In the new edition of English Botany too we are glad to see at Mr. Syme has directed his attention to this subject, and like ery one who does so is fully sensible of its difficulties. He very uly observes that the real point of difference among botanists is at some give the name of species to Hewett Watson's two first groups, namely, the aggregate species and true species, while others apply it to the true species and segregate or sub-species. In a few cases Mr. Syme has gone some way in the direction of synthesis, though not so far as we should be glad to see him do. For instance, he divides Bentham's *Ranunculus aquatilis*, not into twelve, but into seven species, six of them true species, that is to say having no sub-species, while one only, to which he restricts the name *R. aquatilis*, is an aggregate species, and is divided into sub-species. If it were at all likely that this mode of grouping the forms would meet with general acceptance it would be satisfactory to adopt it, but it will assuredly find little favour in the eyes of others, and will at the best be only one of many ways of grouping together a multitude of forms. Mr. Syme may depend upon it that when once he has turned his steps into the direction of synthesis, he will find no fixed resting place out of the pale of the Linnean canon. Indeed, we think that in assigning the rank of species to so many forms of the section *Batrachium*, he goes against his own excellent definition of a sub-species, as a form characterised by slight but constant differences, which are transmitted by descent for an indefinite period. In the case of *Ranunculus circinatus*, he tells us that it can be distinguished by the practised eye without hesitation from all the other forms. This is an expression familiar to us from the pen of M. Jordan, from whose example we at once learn that it may be used to prove anything. Surely it is a fallacy to assume that the eye can only detect differences, and that it may not also be applied to the discovery of resemblances. The same eye can be applied to the most minute micrometrical measurement, and to the study of the widest panorama. Pity that it should be restricted in its use to one or the other only.

In Mr. Syme's book, however, we are glad to see the introduction of a mode of naming plants, which will perhaps be available as a remedy for the present state of chaos. It is used, indeed, vaguely and hesitatingly, but seems capable of universal application. When he divides species or sub-species into varieties we find the name of the more general group retained, and qualified by a second adjective to denote the variety. Thus, t. 18 of the first volume represents *Ranunculus peltatus floribundus*, and t. 22 *Ranunculus Baudotii vulgaris*. *R. peltatus* is for Mr. Syme a sub-species of *R. aquatilis*, and *R. Baudotii* a substantive species. If this mode of nomenclature were modified, so that the second name represented that of the species, while the minor divisions into which it is separable are denoted by a third name added to the other two, we should have a system of nomenclature combining the generalisation, which is the most important characteristic of the old system, with the superior accuracy of the new. It will be convenient (as Mr. Syme does) to drop, as cumbrous and unnecessary, the Greek letter now commonly used to denote a variety. The name *Ranunculus aquatilis* by itself would be understood to represent a composite or aggregate species, while names of three terms, like R. aquatilis *circinatus*, R. aquatilis *normalis*, R. aquatilis *tripartitus*, would denote segregate or sub-species. The second or specific name must necessarily be applied in the widest sense, and as in the great majority of cases, there would be perfect agreement as to its value, our nomenclature would regain that precision which was imparted to it by Linnæus when he remodelled the system in use in his time. Many differences of opinion would remain as to the proper limitation of the sub-species, but the presence of the second term in the name would make these of little practical moment.

Lastly comes the question, whether these minute details are sufficiently important to bring this trinomial system of nomenclature into general use. Though it may probably be true that every species of plants includes within it a greater or less number of races capable of definition, it does not necessarily follow that these races are deserving of study in all cases, and by every one. It is commonly argued that as they exist in nature it is wrong to neglect them. Carried to an extreme the same argument would lead to the conclusion that, because individuals exist in nature, and no two are in all respects alike, it is therefore the duty of systematists to investigate and record the differences between them. Were we to attempt this, of course all generalisation would be lost in the mass of details. In a less degree it is the same with regard to races. As a matter of high scientific interest, towards the solution of the recondite problem of genetic biology, accurate observations on the races of animals and plants are invaluable, and in this sense no observation can be too minute, no description too precise, no character too trifling, provided it exist in nature. For the ordinary student of nature it seems to us that these minute details are unnecessary, because they are doubtful, fluctuating, and uncertain. To put into the hands of beginners an elementary work in which these forms are elevated to the rank of species, without at the same time drawing his attention to their uncertainty, seems to us to convey an erroneous impression of the state of our knowledge. We get a more accurate picture of the British flora, by restricting it to the Linnean types, than we shall possess when it is worked out in all its details, on the principles of M. Jordan.

Original Articles.

XXII.—On Synostosis of the Cranial Bones, especially the Parietals, regarded as a Race-character in one class of ancient British and in African Skulls.* By John Thurnam, M.D.

Obliteration of the sutures of the skull and *synostosis* of the cranial bones has of late received much attention, more especially from those distinguished German anatomists, Virchow, Lucæ, and Welcker; by whose labours the progress of a rational and scientific craniology has been so much promoted.

I propose to consider this subject in reference especially to one class of ancient British skulls, viz. those from the chambered and other long barrows of the *stone period*. I may here observe that the general form of these skulls is elongated or dolichocephalous, and that they are strikingly distinguished from the brachycephalous skulls from the circular barrows of the *bronze period;* not only by their general form, but also, as would appear, by their greater tendency to early and premature obliteration of the sutures. The mere fact of such a distinction in the skulls derived from two classes of ancient British tombs is of sufficient interest to deserve notice; but

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* Read at the Meeting of the British Association at Bath, Sept. 1864; and here printed with additions and corrections.

TABLE OF MEASUREMENTS OF 75 SKULLS, AFFECTED BY SYNOSTOSIS OF THE PARIETAL BONES.

Number.	Nation or Race	Known or Probable: Sex.	Known or Probable: Age	I. Cubic Capacity	II. Circumference	III. Length.	IV. Breadth	V. Height	VI. Face: Length.	VII. Face: Breadth	A. Breadth · Length = 100.	B. Height · Length = 100	Museum or Collection
	A **I. Scaphocephali.**												
1.	German.	M	25	..	20·3	7·5	4·9	5·			65	67	Berlin, 12714.
2	German?	F	55	78	20·1	7·5	4·8	5·			·64	·66	Halle, 111.
3	Dane.	M	25	..	21·3	8·	5·	5·2	..	..	62	65	Gottingen.
4	Croat.	M	50	..	21·4	7·9	4·9	5·3			62	67	Dresden, 515.
5	Illyrian.	M	35	..	20·5	7·3	5·	7·1	.		68	73	Dresden, 512.
6	Tartar.	M	25	..	19·7	7·3	4·7	5·1		.	·64	74	Göttingen.
	Averages			..	20·6	7·6	4·9	5·3	..	..	·64	·69	(*By Prof. Welcker*).
7	European	M	35	108	23	8·7	5·06	4·9	4·2	5·2	·57	56	Edinburgh Univ., 117*a*.
8	Scotch?	M	65	..	22·	8·3	4·75	..	..	..	57	..	Edinburgh Univ., 117. *
9	Scotch?	F	18	..	20·8	7·9	4·6	4·7	.	4·4	58	·59	Edinburgh, R.C.S., 27.
	Averages			..	21·9	8·3	4·8	4·8	4·2	4·8	57	·57	(*By Dr. W. Turner*).
10	Irish.	M	31	..	19·1	7·2	4·7	4·9		..	·65	·68	Dublin, R.C.S. (*Daniel B.*)
11	Irish	M	30	..	21·8	8·2	4·8	5·6		..	58	·68	Dublin, R.C.S. 26.
	Averages			.	20·45	7·7	4·7	5·2	..	.	61	·68	(*By Dr. H. Minchin*).
12	English?	M	50	..	22·	8·5	4·8	.	..	.	·56	.	London, R.C.S. 5732 A. *
13	English?	F	11	..	17	7·7	5·2	5·5	4·?	4·2	67	·71	London, St. Barth., E. 1.
14	English	M	19	.	20·9	7·9	4·9	.	..	..	·62	..	London, Guy's, 1055^{80}. *
15	English	M	31	..	22·7	8·6	5·4*p*	6·	..	5·4	59	·69	Netley, A.M.D., 61.
16	English	M	70	96	22·4	8·	5·5	5·7	..	5·4	68	·71	Barnard-Davis, 69.
17	Scotch	M	60	93	21·1	7·9	5·2*t*	5·7	..	5·2	·68	·72	London, R.C.S., 5732.
18	Scotch	M	50	..	22·	8·2	4·9*t*	5·7	4·4	5·	·59	·69	Glasgow Univ. †
19	French	F	.	.	.	7·5	5·1	.	..	..	60	..	London, Guy's, 125. †
20	Gentoo	F	20	..	19·7	7·7	4·5*p*		..	.	·58	..	London, R.C.S. 5557.
21	Negro, *Mozambique*	F	10	76	19·2	7·3	4·5*t*	5·4		4·7	61	·73	London, R.C.S., 5373.
22	Australian, *N. S. Wales*	M	50	88·5	21·8	8·3	4·8	5·3	4·3	5·4	57	63	Barnard-Davis, 1122
23	Australian	M	35	88	21	7·7	5·2*t*	5·2	4·9	5·6	67	67	Mr L. N. Fowler
24	Esquimaux	M	25	87	21·1	7·75	5·2*p*	5·4	.	5·25	67	69	Oxford Univ. 823.
	Averages in Cubic & Linear Inches, English	M		93·5	21·17	8·	5·	5·5	4·15	5·27	62	67	*Number of Adult Male Scaphocephali* 17 ‡
	Averages in C. Cent. & Linear Millimeters	M		1532	515	203	127	139	113	134			
	B **II. Sub-Scaphocephali**												
1	Ancient Briton (*Five Wells*).	M	30	94	21	7·7	5·3*p*	5·3			68	68	Bateman, 89 T
2	Ancient Briton (*Bowl's Barrow*).	M	25	99	21·3	7·9	5·3*p*	5·5	4·4	4·9	67	69	J. Thurnam, 210
3	Ancient Gaulish (*Du Val*)	M	15	.	20·8	7·2	5·5	5·8	.		76	80	Paris, '*Hist. Nat.*' 169
4	Ancient Greek	M	70	92	21	7·5	5·4	5·	4·6		72	66	Barnard-Davis, 978.
5	English	M	60	90	21·3	7·9	5·2*p*	5·2	..	4·95	65	65	Oxford Univ. 771.
6	English.	M	40		20·7	7·8	5·2	5·			66	·64	London, St. Thomas', 580
7	English	M	25		21	7·6	5·4*p*	5·2		4·8	71	68	Birmingham, Queen's C.
8	English	M	50	.	22·7	8·1	6·4*p*	5·3	.	5·2	75	·65	Salisbury.
9	English	M	22	..	20·5	7·2	4·7		.		65	.	Mr. T. Annandale *
10	English	F	33	72	19·8	7·3	4·9		4·3	4·8	67		J. Thurnam, 216. *
11	Scotch?	M	70	.	22	7·8	5·	.	.		64	..	Edinburgh Univ. 117^{6} *
12	Scotch	F	18	89	21·	7·4	5·2	4·7	4·	4·4	70	63	Edinburgh Univ. 85. *
13	"European" (?)	M	45		20·2	7·4	5·2*p*	5·4	..	5·3	70	73	Bristol Infirmary, *b* 23
14	Lapp	M	30		20·5	7·3	5·5*t*	5·3	5·	5·6	75	72	Barnard-Davis, 1146
15	"Mahommedan"	F	20	77	20	7·1	5·	5·1	..	4·4	70	·71	Edinburgh Univ.
16	Hindoo	F	60		19·8	7·4	4·8*t*	4·9	..		64	66	Barnard-Davis, 884
17	Negro	M	40	..	..	7·7	5·2*p*	5·3	5·	4·7	67	·68	London, Guy's, 130^{50}
18	Negro, *African*	F	30	88	20·2	7·3	5·3*p*	5·2	4·8	4·9	·72	·71	Barnard-Davis, 100.
19	Negro, *West Coast*	M	40	.	21·1	7·6	5·25	5·75	..	.	69	·75	Netley, A.M.D. 37 *App*
20	Negro, *Dahoman*.	M	30	98	20·8	7·7	5·2*p*	5·9	..	5·5	67	76	Barnard-Davis, 1229.
21	Negro, *Dahoman*	F	30	83	19·5	7·1	4·9	5·1	..	..	69	·71	Barnard-Davis, 1234
22	Negro, *Eboe*	F	50	79	19·6	7·	5·*p*	5·3	..	4·9	·71	75	Barnard-Davis, 294.
23	Negro, *Yoruban*	F	35	89	19·9	7·3	4·8*t*	5·5	..	5·2	65	·75	Barnard-Davis, 1128.
24	Negro, *Osekum*	F	35	83·5	19·9	7·2	5·2*p*	5·	4·3	4·9	72	·69	Barnard-Davis, 1072
25	Negro, *Congo*	F	35	..	20·	7·	5·3*p*	5·2	..	5·1	·75	·74	Haslar Naval Hospital.
26	Hottentot	M	30	..	20·2	7·4	5·1	5·5	.	..	·68	74	Netley, A.M.D. 49 *App*
27	Bosjesman	F	18	84	20	7·1	5·3*p*	5·2	..	4·65	74	·73	London, R.C.S. 5358.
28	Zulu.	M	50	88	21·	7·7	5·2*p*	5·6	..	5·1	·67	·72	Oxford Univ. 785*c*.
29	Zulu	F	18	80·5	19·7	7·1	5·2	5·2	..	4·9	·73	·73	Oxford Univ. 785*d*.
30	Negro, *Zanzibar*, (*Wahiou*)	F	25	70	19·2	7·	4·8	5·1	..	4·8	68	·72	London, R.C.S. 5378, P
31	Negro, *Zanzibar*, (*Wahiou*.)	F	7	71·5	18·8	6·8	4·7*p*	4·9	..	4·4	·69	·72	London, R.C.S. 5378, S.
32	Negro, *Zanzibar*, (*Wahiou*)	M	30	84	20·5	7·4	5·3*t*	5·2	..	5·2	71	70	London, R.C.S. 5378, U
33	Javan	F	.	..	19·7	6·65	5·15	5·3	..	.	·77	79	Van der Hoeven, 89.
34	Javan	M	..	..	20·5	7·1	5·5	5·6	..	.	77	·79	Van der Hoeven, 97.
35	Dyak, *Borneo*	M	25	86·5	19·7	7·	5·3*t*	5·2	4·5	4·9	·75	·74	Barnard-Davis, 281.
36	Timorian	M	30	..	21	7·	5·	5·8	.	..	·71	·82	London, St. Thomas'.
37	Kanaka, *Sandwich Islands*	F	22	75	19·2	6·8	5·2*p*	5·1	3·8	4·9	76	·75	Barnard-Davis, 434
38	Australian	F	20	71	19·2	6·8	5*p*	5·1	4·1	4·9	·73	·75	London, R.C.S. 5306 A
39	Australian	F	17	67	18·7	6·6	4·9	5·1	4·1	5·	74	77	Barnard-Davis, 915 *a*
40	New Zealander	M	45	76	20·	7·2	5·2*p*	5·4	4·3	4·9	·72	·75	London, R.C.S. 5398.
	Averages in Cubic & Linear Inches, English	M		89·7	20·85	7·5	5·3	5·4	4·6	5·08	70	·72	*Number of Adult Male Sub-scaphocephali* = 23 ‡
	Averages in C. Cent. & Linear Millimeters	M	.	1470	529	190	131	137	117	129			
	C **III. Klinocephali**												
1	Italian, *Lucca*	M	35	89	20·2	7·1	5·2	5·1	4·7	5	73	71	Barnard-Davis, 1178.
2	Gentoo	M	5	.	18·1	6·8	4·8	4·8		..	70	·70	London, R.C.S. 5556.
3	Negro, *Guinea*.	M	20	..	..	6·6	5·7*p*	.			86	..	Cambridge Univ. 1166.
4	Kafir	M	40?	94	20·8	7·4	5·4*p*	5·5	.	..	·73	·74	Barnard-Davis, 510.
5	Fatuhivan, *Marquesas*	M	35	95	20·6	7·3	5·3*p*	5·5		5·5	·72	·75	Barnard-Davis, 784.
6	Fatuhivan, *Marquesas*.	M	17	111	21	7·4	5·6*p*	5·9	.	5·3	75	79	Barnard-Davis, 789
7.	Kanaka, *Sandwich Islands*	M	60	96	20·4	7·	5·8*p*	5·8	4·4	5·3	·82	·82	Barnard-Davis, 441.
8.	Kanaka, *Sandwich Islands*	F	50	74·5	19·9	7·	5·6*p*	5·6	4·4	5·1	·80	·80	Barnard-Davis, 628.
9	Kanaka, *Sandwich Islands*.	M	70	95	20·3	7·1	5·4*p*	5·4	5·	5·7	·76	·76	Barnard-Davis, 634
10.	Kanaka, *Sandwich Islands*	F	14	94	19·3	6·6	5·5*p*	5·1	4·1	4·5	·83	·81	Barnard-Davis, 619
11.	Kanaka, *Sandwich Islands*.	M	65	88·5	20·	7·1	5·4*p*	5·7	4·7	5·5	·76	·80	Barnard-Davis, 658
	Averages in Cubic & Linear Inches, English	M	..	95·5	20·4	7·1	5·55	5·55	4·7	5·4	77	76	*Number of Adult Male Klinocephali* = 8. ‡
	Averages in C. Cent. & Linear Millimeters	M	.	1564	518	180	141	141	119	137			

* The asterisk implies that the specimen consists simply of a "skull-cap" or *calvaria*.
† The dagger signifies that the measurements have been taken from a cast.
‡ The three series of Average measurements (I—VII), are deduced from the adult male skulls only. The mean relative proportions (A, B) are calculated from the entire series of 75 skulls, male and female.

I am the more induced to direct attention to it, as I think there is danger of a greater influence being assigned to this obliteration than is consistent with a true interpretation of the facts. This, I think, is done when the dolichocephalism characteristic of these skulls is regarded as the effect of the premature obliteration of their sutures. No doubt synostosis is a cause of dolichocephalism, as in cases of *scaphocephalus*, produced by the fusion of the two parietals, and obliteration of the sagittal suture. But in order that synostosis of the cranial bones should be the cause of an abnormal form of skull, it must commence at a very early period of life, if not indeed during the fœtal condition. The forms of synostosis described and classified by the celebrated Virchow, as shown in his wood engravings, are altogether abnormal or teratological. They are, however, chiefly the skulls of cretins, idiots, epileptics, or insane persons; in whom a defective or irregular development of the brain is of frequent occurrence, and has probably an equal if not greater share in the production of the deformity of the skull than the premature ossification of the sutures which is associated with it. In his observations on the effects of synostosis as a cause of cranial deformities, Virchow expressly limits its influence to "the disturbances which the sutures undergo in early periods;" and adds the important words, "for *with senile obliteration of them, or even their fusion in adult age after perfect formation of the cranial bones, we have naturally nothing to do.*"* As shown by Professor Welcker, "the containing and contained parts—the skull and brain—grow with each other," though the special form into which the skull is moulded is "conditioned by the mechanical operations of the growing and living brain."† There can indeed be no doubt that the form of head proper to the race and to the individual is innate in the embryo, though liable to deviations both during intra-uterine and the earlier periods of independent existence.

The dolichocephalism of the Britons of the long-barrows and stone period is no more to be regarded as pathological than that of the African races, in whom there is likewise a great prevalence of premature synostosis. Neither is this last, as it ordinarily occurs after the period of puberty has been attained, pathological. On the

* *Ueber den Cretinismus, und ueber Pathologische Schädelformen*, 1851; Ges. Abhandlung. 1856, p. 899. It was long since observed by Otto, that obliteration of a suture "can only be properly considered as morbid, if observed previous to birth, or before the perfect development of the head."—*Pathological Anatomy*, by South, 1831, p. 160.

† *Wachsthum und Bau*, 1862, p. 20, 139.

contrary we may regard it as strictly a race-character ; just as we may regard the same phenomenon in the Negro. In both it seems due to the same cause, defined by Welcker, as "a luxuriant bone-growth" in the still growing suture margins.* It is not improbable that in dolichocephalous peoples, the great longitudinal sagittal suture (in the same way, though in a much less degree than the frontal suture), may be more prone to early obliteration than the transverse ones, in consequence of the suture margins being more early brought into apposition, from the growth of the brain being more active in the longitudinal direction than in the tranverse. However this may be, it is an observation of the late distinguished French anatomist Gratiolet, that in the inferior races, especially Africans and Alfouras, the sutures close much earlier than in Europeans, and likewise in a different order; the lambdoid closing first in the White, the coronal in the Negro and Alfoura, and *vice versa.*† M. Pruner-Bey also insists on the premature obliteration of the sutures as characteristic of the Negro. The frontal and lateral parts of the coronal suture are, he says, uniformly obliterated in early youth. Ossification next extends to the middle of the coronal and the sagittal, the lambdoid being the last to close.‡

It is well known that the *frontal* suture, which usually ossifies

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* *Ibid.* p. 139. The same appears to be implied by Dr. Humphry, when he observes, "the sutures are commonly obliterated earliest in those skulls in which a heavy hard condition of the bones evinces a preternatural activity of the ossifying processes."—*Human Skeleton*, 1858, p. 191.

† *Comptes Rendus de l'Acad. des Sciences*, T. xliii. 1856, p. 428. "Dans l'homme blanc, les sutures s'ossifient d'une manière tardive. Cette oblitération se développe dans l'ordre suivant : 1, la suture sagittale ; 2, la suture lambdoide ; 3, la suture fronto-pariètale. Dans les races Ethiopiennes et Alfourienne, au contraire, l'oblitération des sutures est précoce ; et la fronto-pariètale se soude avant la lambdoide. Ainsi, chez le Blanc, le crâne se ferme d'abord en arrière ; chez le Negre et chez l'Alfouroux, il se ferme d'abord en avant. On observe souvent le même fait sur les crânes d'idiots appartenant à la race blanche. En outre, les récentes recherches de M. M. Baillarger, Cruveilhier et Vrolik, ont mis hors de doute le fait de l'ossification prematurée des sutures chez les idiots microcéphales, et sur l'absence de fontanelles chez eux au moment de la naissance." In a later memoir M. Gratiolet observes, "La persistance et la complication des sutures sont en général un signe favourable, et peuvent etre considérées comme les indices d'une perfectibilité plus ou moins étendue."—*Mém. de la Soc. Anthrop.* T. i. p. 394. See also *Bull. de la Soc. d' Anthrop* T. ii. p. 178, 243. Dr. Meigs was unacquainted with M. Gratiolet's observations, when he remarked on "the periods at which the different cranical sutures are closed in the various races of men ;" and when he asked, "To what extent are race-forms of the cranium dependent upon the growth and modifications of the sutures ?"—Nott and Gliddon, *Indigenous Races*, 1857, p. 238.

‡ *Mém. sur les Nègres.—Mém de la Soc. d' Anthrop.* 1860-63, T. i. p. 328, 336. M. Pruner-Bey also observes, "En général, la marche des soudures me paraît différer aussi selon la forme du crâne dolichocéphale ou brachycéphale."

within the first year of life, in a certain proportion of cases never closes, except with the other sutures in advanced age. The difference in the liability to the persistent frontal suture in different races must be known to all who are in the habit of examining skulls. In most Europeans it is by no means rare, and seems to occur in the proportion of about one in ten, in English, German, and French skulls.* Professor Welcker, who has devoted much attention to this subject, tells us that the open frontal suture is much less common in the inferior races; that in Mongols it is about as one in fourteen, in Malays about one in twenty, and in Americans and Negroes about one in forty or fifty.† Welcker indeed barely admits its possibility in the Negro, and says he has never seen an instance. M. Pruner-Bey tells us he only saw it once in the large number of African skulls which he examined. There can be no doubt that it is extremely rare. In Dr. Barnard Davis's collection, there are about ninety Negro and Negroid skulls, and in not one is the frontal suture seen. On the other hand, in the series of 166 of such skulls in the Museum of the Army Medical Department, there are four (Ibo, Krooman and Ashantee), in which it is persistent.‡ Altogether, its great rarity is clearly a race-character in the Negro. In a less degree, the same seems to have been the case with the dolichocephalous Britons of the stone period. Out of about 100 or 120 skulls and calvaria, which I have examined from the Long Barrows, I have found traces of the frontal suture in only four adult specimens.§ This gives a proportion of one in twenty-five or thirty. In the brachycephalous skulls from the Round Burrows, the open state of this suture is much more common; or according to my observations, about one in fifteen, which approaches that in modern Europeans.

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* In the Museum of the Army Medical Department at Netley, out of 169 skulls of English soldiers, (natives of England and Ireland) I counted sixteen in which this suture is persistent, or nearly one in ten. In Germans, we learn from Professor Welcker, that it occurs as often as one in nine. (*Wachsthum und Bau*, p. 99-100). In the immense collection of French skulls in the catacombs of Paris, Dr. Leach counted it in numerous instances, and in the proportion of at least one in eleven. (Clift, *Catal. Mus. Coll. Surgeons*, part iii, 1831, p. 7).

† *Wachsthum und Bau*. p. 99-100, 143.

‡ G. Williamson, M.D. *Human Crania in Mus. Army Medical Department*, 1857, p. 78.

§ One is from the chambered barrow of West Kennet (No. 137); another from that of Rodmaton (No. 166, see woodcut, *Cran. Brit.* Pl. 59, p. (4); two others are from the long barrow at Dinnington. There are also two infant skulls, one from Tilshead, the other from Charlton Abbots, in which the same is seen; though the last seems to have belonged to a secondary interment.

Though the great liability, in the Negro, to premature obliteration of the sutures in general, and the almost infallible closure of the *medio-frontal,* is insisted upon by French and German anatomists, and anthropologists, no one appears to have pointed out that the posterior division of the median-longitudinal suture, or the *sagittal,* is especially liable to complete obliteration, both during the fœtal and the infantile period. That this, however, is the case, I shall be able to adduce sufficient evidence to prove. It is a just observation of M. Pruner-Bey, that the order of obliteration of the sutures differs according to whether the skull-form is dolicho- or brachy-cephalous; a law altogether confirmed by the different state of the sutures in the dolichocephalous skulls from the Long, and in the brachycephalous skulls, from the Round Barrows. In the dolichocephalous Negro, as in the dolichocephalous Briton, it may be concluded, (from the researches of Welcker, on the growth of the cranial bones by their borders), that the special liability of the median-longitudinal (frontal and sagittal) sutures to obliteration, is due to the opposed suture margins coming sooner into contact than in brachycephalous peoples, in consequence of the growth of the brain being chiefly in the longitudinal, and much less energetic in the transverse and vertical directions. In addition to this anatomical cause, it may be surmised, as pointed out at the meeting at Bath, by Dr. John Davy, that physiological influences may contribute to the same result, and that a tendency to exuberant ossification may be produced in the Negro as also (it may be added) it may have been in the Ancient Briton, by a diet of a highly animalized nature, consisting chiefly of milk and flesh.

It is concluded that in order that synostosis of the cranial bones should be the cause of any peculiar form of the skull, it must be one of two descriptions. Either it must be of *intra-uterine* origin, when it is most efficient in the production of monstrous, or teratological forms; or *infantile,* and occur during the period of growth and development; when it produces deviations more moderate in extent, though still abnormal.* By the ossific union of the two parietal bones, and consequent effacement of the sagittal suture in fœtal life is produced that very abnormal skull-form, now known as

* As Dr. Humphry observes, "After indigitation (of the sutures) has taken place, the interlocking of the bones is so intricate that I question whether growth can take place at their edges much more easily than in other parts of their extent." *loc. cit.* p. 190.

the scaphocephalic. The most marked examples of *scaphocephalus* seem to be those which are met with in Europeans, in whom the frontal lobes of the brain are largely developed, and produce perhaps by their displacement, and by the needful compensatory growth, that prominence of the frontal region which is so marked a

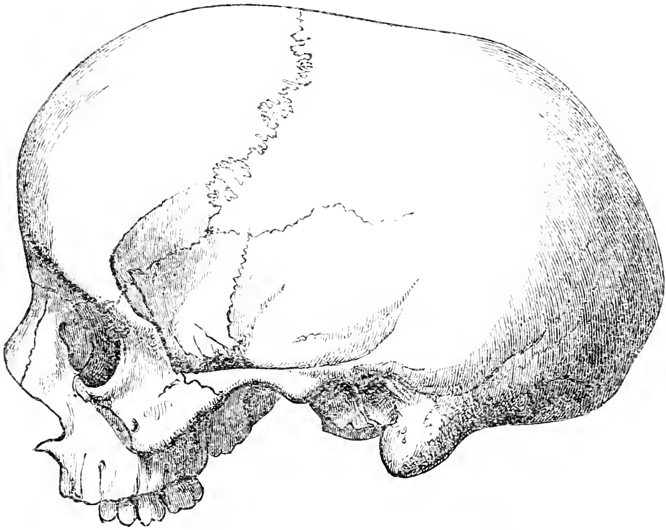

FIG. 1. *Scaphocephalic Skull of a Woman.**

feature in many of these cases. In the Negro, in whom the cerebral development, especially of the anterior lobes, is of a lower type, the more marked features of true scaphocephalus are more rarely seen, even when the synostosis may be presumed to have been congenital. The abnormal scaphoid skulls of the African races, as compared with those of Europeans, may be termed sub-scaphocephalic. They seem to fall very much under the definition of what is termed by Welcker, *synostotic dolichocephalism.*† This less

* For the sake of comparison with the Sub-scaphocephalic and Klinocephalic forms of Synostosis, more particularly treated of in this paper, I have, with the approval of Dr. W. Turner, repeated from his memoir the figures of two decided scaphocephalous crania. Fig. 1 is the profile of a skull, No. 27 of the Museum of the College of Surgeons, Edinburgh; Fig. 2 is the vertical view of a skull-cap, No. 117 of the University Museum; which last is remarkable for the large "beak" of its biparietal, and for the breadth of the frontal, which is greater than usual in scaphocephalus.

† "*Dolichocephali ex synostosi sagittali,*" (*Wachsthum und Bau*, p. 15, 53).

marked sub-scaphoid form is likewise not uncommon in the higher races, though in them it may be supposed usually to originate after

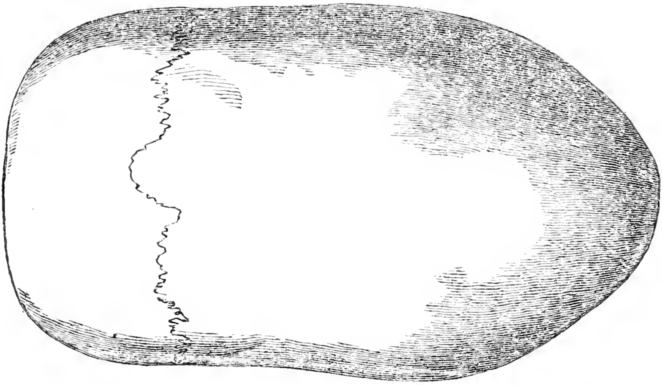

FIG 2. *Vertical View of the Scaphocephalic Skull of a Man.*

birth, and not during intra-uterine life. A pathological abnormal form of skull, of less frequent occurrence, but which likewise appears to depend on fusion of the parietals during the fœtal state, or the earliest period of independent life, is the saddle-shaped skull, or *klinocephalus.* According to Virchow, this deformity usually arises from ossification of the spheno-parietal sutures. In some cases, however, klinocephalism, combined with prominence of the supra occipital, is developed in skulls in which the spheno-parietal sutures are open, but in which the sagittal is entirely obliterated.* This is the case in the remarkable skull of a Gentoo child, in the Museum of the College of Surgeons (No. 5556).† It may be suggested that

" There are also intermediate forms between marked scaphocephalus, and the more ordinary forms of *dolichocephalus synostoticus*, which may owe their rise to a fusion of the sagittal suture in the later fœtal period, and in earliest childhood."—*Zwei seltnere Difform.* 1863, p. 7.

* Virchow, after defining the cause of klinocephalus, tells us that " in an example in his collection, the fusion of the spheno-parietal sutures is combined with synostosis of the parietal bones, so that a prominence of the occipital scale is added to the usual deformities of klinocephalism."—*Ges. Abhandl.* p. 900.

† In the Museum of Anatomy, at Cambridge, is the skull of a Negro of Guinea, aged about 20 years, in which the same combination of klinocephalism with synostosis of the parietals is seen. I am able to say positively, that the spheno-parietal sutures are quite open, and that the sutures in general, with the exception of the sagittal and apex of the lambdoid, are quite as distinct as usual, perhaps rather more so. In this skull, as in that of the Gentoo, both the parietal foramina are well marked. The brachycephalous proportions of the former, (·86)

the klinoid form of this skull, which, according to the ordinary view, ought rather to have been scaphoid, may depend upon the activity of the growth of the middle lobes of the brain, in the direction outwards, or of the parietal tubers; whilst in scaphocephalus, the compensatory cerebral growth is forwards and backwards, in the axis of the anterior and posterior lobes. This view is confirmed by observing that in many cases of the second, or sub-scaphoid form of synostotic dolichocephalus, there is a considerable saddle-shaped contraction in the coronal and temporal regions; though not enough to constitute klinocephalus, as usually understood. In this way, a sort of gradation is to be noted between scaphocephalus and klinocephalus, depending on synostosis of the parietals. In both the cases of the first of these deformities in ancient British skulls from Long Barrows, which are figured and described in this paper, a certain tendency to klinocephalism is to be observed.

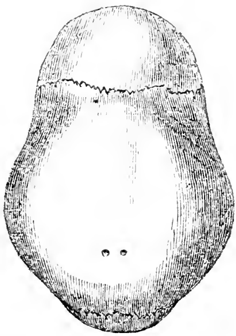

FIG. 3. *Vertical view of the Klinocephalic Skull of a Gentoo child.— Quarter Diameter.*

In the Table of Measurements appended hereto, I give all the examples of abnormal synostosis of the parietals which I have had

are no doubt due to the synostosis of the apex of the occipital with the biparietal. A tendency to klinocephalism is especially observable in the skulls of Kanakas, when affected by synostosis of the parietals. In the large series of about 135 Kanaka skulls in the Barnard-Davis collection, there are six instances of this form of synostosis, only one of which is sub-scaphocephalous, whilst in the others a greater or less degree of saddle-shaped contraction, and in one complete klinocephalism, is to be observed. Measurements of these skulls are given in the Table. With other synostotic skulls in this rich collection they are described by Dr. Davis in a memoir now being printed in the Transactions of the Society of Sciences of Haarlem. My attention was more especially drawn to this subject by the opportunity afforded me of perusing part of this memoir whilst in manuscript more than two years ago.

the opportunity of examining; classed as accurately as may be, under the three heads of, I. SCAPHOCEPHALI; II. SUB-SCAPHOCEPHALI; and III. KLINOCEPHALI.

As is well known, the African peoples are naturally dolichocephalic. In them also the bones are of remarkable density, and a great disposition to exuberant and redundant ossification is observed in them. Of all peoples, I believe abnormal obliteration of the sagittal suture with complete synostosis of the parietals is most frequent among them. Out of twenty-four cases of complete synostosis of the parietals, which I had measured when this paper was read, seven are instances of scaphocephalus; but in the others the cranial form, though elongate, does not present that flattening of the sides, prominence of the frontal and of the supra-occipital, or that fully scaphoid or keel-shaped form of the biparietal, which are necessary to the idea of scaphocephalus properly so called; different degrees of which however are to be observed. Of the whole number of twenty-four skulls, as many as twelve are of Africans; one of these, that of a negro of Mozambique, being truely scaphocephalic.* The frequency

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* Of the twenty-four skulls here referred to, twelve are in the Museum of the Royal College of Surgeons, London; two in that of Guy's Hospital; four at Oxford; three at Netley; one at Haslar; one at Bristol; and one at Salisbury. I have not altered these numbers, nor the passage in the text with which they are connected. Since the paper was read, however, I have added to the Table of Measurements of Skulls with Synostotic Parietals, many further examples. Especially, must be noticed those in the rich collection of Dr. J. B. Davis, who has obliged me with access to their measurements in his Catalogue, as yet in manuscript. It appeared also expedient to embrace in the table, measurements of the six scaphocephalic skulls given by Professor Welcker in his latest memoir on this subject (*Zwei seltn. Difform.*); and likewise those of others given by Dr. W. Turner in his paper already referred to; the former being from the museums of Germany, the latter from those of Edinburgh. Dr. Turner has obliged me with some additional measurements; and I am also indebted to Dr. H. Minchin, of Dublin, for measurements of the two skulls described by him in the memoir by which in this country attention was first drawn to this kind of cranial malformation. With a few exceptions, for which I am indebted to friends, the rest of the measurements are by myself.

In the division II. SUB-SCAPHOCEPHALI, a few of the skulls are not strictly entitled to this designation. In these, the relative length is simply more or less increased, and no distinctly scaphoid tendency is seen. These *synostotic dolichocephali* pass by such insensible gradations into the subscaphoid form, that unless the whole could have been brought together for minute comparison, their separation into two sub-classes could not have been satisfactorily carried out.

To some extent, though with no certainty or precision, the table may indicate the liability of different races to this form of synostosis. The cases in Europeans have no doubt been selected for preservation, in consequence of their abnormal form; but as regards those of other races there has probably been little or no selection.

of synostotic parietals in Africans is very remarkable, and few collections are without one or more examples. In passing, for another purpose, through the Gallery of Anthropology *(Salle Cuvier)*, in the Museum of Natural History of Paris, my eye was attracted by a series of skulls of Hottentots, five or six in number, one of which I found presented no trace whatever of a sagittal suture. Adjoining these, was another small series of skulls of Namaquas, one of which presented the same form of synostosis. In the series of twenty skulls brought from Kilwa in East Africa by Captain Burton, now in the Museum of the College of Surgeons, three exhibit obliteration of the sagittal, one of them (No. 5378 P) in a most complete form.* In a series of twelve Dahoman skulls from West Africa, recently added to the collection of Dr. Barnard Davis, two have the sagittal suture completely obliterated and the form elongate—·67, ·69. The former (No. 1229) is that of a man, the other (No. 1234) that of a woman, each of about 30 years of age.

The most remarkable instance, however, is that afforded by the capture of two schooners, laden with about 100 slaves from Cape Lopez, Congo, on the west coast; who were carried to Fernando Po, where several of them died. Four were examined after death, and in each instance, "the sagittal suture was wanting;"—the conclusion adopted by the navy surgeons, Mr. Ballard and Mr. Wallace, being "that in this race of blacks such is the usual cranial conformation." A different view was taken by the late Dr. Graves, who regarded "the obliteration of the sagittal suture as a mere accidental variety;" and by Dr. Prichard, who added his belief, "that the want of this suture is not characteristic of any particular race."† Our additional knowledge of this subject appears to justify some modification in the

* They are the skulls numbered 5378 P, S, and U. The first, that of a man, is a good example of *synostotic dolichocephalus* or of the *subscaphoid* skull. The second is that of a girl of about seven years, and is important, as showing the order in which the different portions of the sagittal undergo infantile obliteration. This would seem to have commenced in the 4th, or inter-foraminal division of Welcker, and to have extended on the one hand to the 5th, and on the other to the 3rd, and so to the 2nd. The 1st, or coronal division, with a small part of the 2nd, remains open. In the skull U, that of a man aged about 35, the anterior division likewise remains open. I am informed by Captain Burton, that the whole of these skulls are those of persons who died of cholera, chiefly slaves of the *Wahiou* tribe,—somewhat Semiticized Africans.

† *On the Supposed Want of the Sagittal Suture in Certain Tribes of Negroes.* Studies in Physiology and Medicine, 1863, p. 344. Med. Chir. Review, 1836, N.S. No. 49, p. 285. One of the skulls is in the Museum at Haslar Hospital, where I have had the opportunity of measuring it.

views adopted by these two eminent men; and to warrant the inference that a great relative frequency of congenital obliteration of the sagittal suture, and consequent synostosis of the parietals, is, in fact, a characteristic of the African races, as it may be of others likewise, which have naturally a dolichocephalous form of skull.

That the premature obliteration of the sutures is in part due to a tendency to exuberant ossification, is confirmed by the fact, that though in the dolichocephalous races the sagittal is more liable to be effaced than the others, obliteration is by no means confined to it; but that several sutures in the same skull, both longitudinal and transverse, are often implicated. In such instances, the concurrence of both the longitudinal and transverse forms of synostosis—if we adopt a term which it might be better to restrict to obviously abnormal and pathological conditions—ought to be compensatory the one of the other, and no particular dolichocephalism be observed. This would accord with the celebrated law established by Virchow, "*that by synostosis of a suture the development of the skull is always retarded in the direction perpendicular to the synostotic suture.*"* In the dolichocephalous skull from the long barrow at Winterbourn Stoke described more fully hereafter, the coronal and sagittal sutures are almost equally obliterated, and though the lambdoid is well marked externally it is completely effaced within, so that the calvarium is converted into a solid osseous box. The spheno-parietal and spheno-frontal sutures are moderately distinct. It would be impossible from any thing which appears in their present state, to attribute the dolichocephalism of this skull to the premature ossification of the sutures. In other skulls from the long and chambered barrows distinguished by their elongate form, I find the sagittal suture open: whilst contrary to what would be found were Virchow's law applicable to them, the lambdoid and coronal are quite obliterated.

It is very possible, as observed by Dr. Wm. Turner, "that through the action of the premature union of adjacent bones, aberrant forms of crania may arise in individuals of any given nationality, possessing a shape quite different from that of the race to which

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* *Loc. cit.* p. 936. The sutures of the skull are divided into three classes; 1. *Median-longitudinal*; 2. *Transverse*; and 3. *Lateral-longitudinal*; the first allowing growth in the direction of breadth, the second in that of length, and the third in that of the height of the skull. Welcker, *loc. cit.* p. 13, Taf. IV.

they belong."* In the very nature of things, however, it may be remarked that such cases must be exceptional. To suppose that entire families or even tribes may be the subject of an abnormal tendency to ossification of the sutures, by which the natural form of the skull becomes changed, it may be from a brachycephalous to an elongate type, appears contrary to probability.† The largest collection of dolichocephalous British skulls is, I believe, that in my possession, having been procured by myself and friends from chambered and other long barrows in the counties of Wilts and Gloucester. After a minute examination and comparison of more than fifty of such skulls and calvaria, I am unable, except in the few evidently abnormal cases described and referred to in this paper, to infer any connexion between the situation and extent of effacement of the sutures and the particular forms which the skulls present. In some the median-longitudinal, in others the transverse sutures, are those principally obliterated; in all however the form is more or less dolichocephalous. The long form of skull and the premature obliteration of the sutures, thus appear to be coincident phenomena, not standing to each other in the relation of cause and effect, though they are probably both of them characteristic of the race.

Let us now examine the evidence as to the tendency to obliteration of the sutures, and especially to synostosis of the parietals in the dolichocephalous Britons of the Long Barrows, which forms one distinction between them and the brachycephalous Britons of the later Round Barrows. No case of true scaphocephalus has come to light; but out of from one hundred to one hundred and twenty skulls and calvaria of this class which are known to me, there are two well-marked examples of the sub-scaphocephalic variety of synostosis, both of which have some tendency to the klinocephalic form.

In the Bateman collection, the skull 89 T. is that of a young man from a galleried tumulus at Five Wells Hill, near Taddington, Derby-

* On Cranial Deformities, and more especially on the Scaphocephalic Skull. By W. Turner, M.B.—*Natural History Review*, Jan. 1864, Vol. iv. p. 105.

† Something like this is seen when the very rare case occurs of scaphocephalus in a skull of brachycephalous race-form. An instance of this is met with in the remarkable skull of a Lapp (No. 1146, and No. II. 15, in the Table appended hereto), in which a scaphoid bi-parietal is combined with normally brachycephalous characters.

shire,* which I am enabled to describe and figure, through the kindness of Mrs. Bateman, of Youlgreave. All the sutures are quite distinct and open, with the exception of the sagittal, which is com-

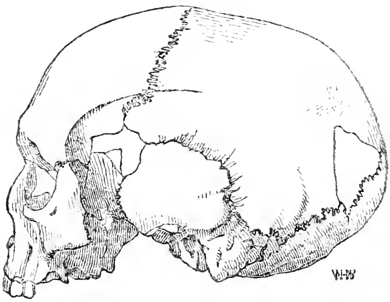

FIG. 4.—*Sub-scaphocephalic Skull from Long Barrow, Five Wells Hill, Derbyshire.*

pletely obliterated. The frontal region is somewhat narrow and high; the supraoccipital full. Behind the coronal suture there is a considerable saddle-formed contraction, and the parietal tubers are

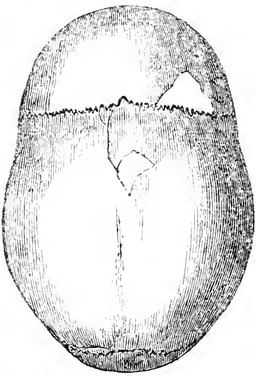

FIG. 5.—*Vertical View of the same Skull.—Quarter Diameter.*

round and prominent. It cannot be said there is any trace of a formerly existing sagittal suture; but near the coronal end of the

* Bateman. *Vestiges*, 1848. p. 91; *Ten Years' Diggings*, 1861. p. 262. *Journal British Arch. Assoc.* 1852. vol. vii. p. 211, 213. *Cran. Brit.* p. 232. Pl. XVI, 33, p. (4).

central line of the biparietal is the commencement of a very slight carina, which is continued along the median line of the frontal. In the line where the sagittal suture ought to be, in the third, fourth, and fifth divisions of Welcker, a slight groove or depression may be perceived; and around this for some distance the surface of the bone has an appearance of roughness and porosity, with many minute openings studding it. Among these I detect no certain trace of either of the parietal foramina. The upper maxillaries are short, the supranasal and supraciliary bosses of the frontal prominent. There is no lower jaw with the skull.

Whilst preparing this paper in September, 1864, I excavated a remarkable long tumulus near Imber, in South Wiltshire, called Bowl's Barrow, and obtained from it a fine specimen of the same form of synostotic cranium.* The skull, No. 210 of my collection, is that of a man from 20 to 25 years of age. It is a massive skull, having a thickness which reaches $\frac{5}{8}$ of an inch, or fifteen millimeters, in the frontal bone. The forehead is narrow, elevated and smooth, the supranasal prominence full, the face narrow, the upper maxillaries short; all the sutures except the sagittal appear distinct and unossified, and the central part of the coronal is widely open. Around the junction of the biparietal and occipital, is a considerable opening, in consequence of the posthumous decay of the bones. It follows that only the anterior half of the line of the sagittal suture can be traced; but, as this portion of the suture is the last to ossify, there can be no doubt that the whole was obliterated.† There is no trace whatever of any suture; but where it should have been, a somewhat rugose and thickened condition is detected, though more distinctly by the touch than by sight. A considerable and wide saddle-shaped contraction behind the coronal suture loses itself in the temporal fossæ. The parietal tubers are full; but not being so prominent as

* For a description of this Barrow, and of the other skulls obtained from it, see Memoirs of the Anthropological Society, vol. i. 1865, p. 472.

† To the right of the line of the sagittal, and running parallel with it, is a sharply-defined crack extending to the coronal suture. From its appearance and from a peculiar perforation at its further end, I conjecture that the skull may have been cleft at or before death, and may be that of a slave slaughtered at the burial of his lord. On this subject see Memoirs of the Anthropological Society, vol. i. p. 146-8, 480. *Cran. Brit.* pls. XXVI, 50, XXVII, 59. Archæologia, vol. xxxviii., p. 419.

in the skull last described, the tendency to klinocephalism is less apparent. As in that specimen, there are slight traces of a "beak" in the centre of the biparietal. Both in the vertical and profile view, especially the former, the narrow and abnormally elongate form

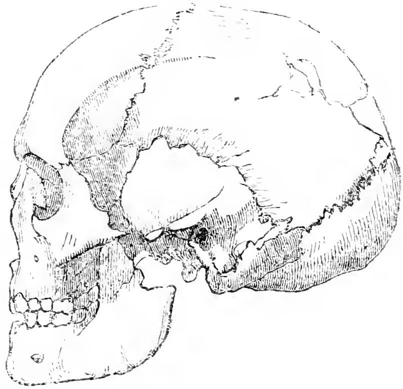

FIG. 6.—*Sub-scaphocephalic Skull from Bowl's Barrow, South Wiltshire.*

of this skull is well seen. It is a very characteristic specimen of sub-scaphocephalic synostosis.

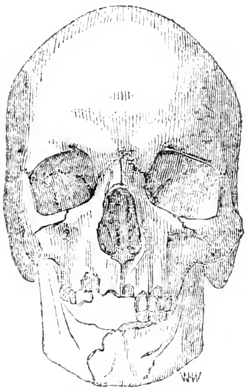

FIG. 7.—*Front view of the same Skull—quarter Diameter.*

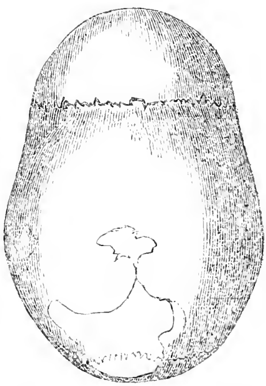

FIG. 8.—*Vertical view of the same Skull—quarter Diameter.*

The above are the only examples of complete fusion of the parietals which have come to my knowledge in the skulls from the Long Barrows of the ancient Britons.* There is, however, one cranium figured and described in the *Crania Britannica* (Pl. XXVI, 50), which was obtained by me from the chambered Long Barrow at West Kennet, the narrow and keel-shaped roof of which, as in two or three others I have seen, may be in part due to obliteration of the sagittal suture, commencing after birth. After describing this, I may call attention to two other skulls which have been thought to be deformed by synostosis, but which seem to me to owe nothing of their dolichocephalism to that effacement of the sutures which is present in them. This I believe to be of the prematurely senile description, and to date from a time long after the brain- and skull-form have been fixed and determined.

The skull from the sepulchral chamber at West Kennet is that of a young man of about 30 years of age. With the exception of the terminal parts of the coronal, the coronal, squamous, and lateral longitudinal sutures are open and even gaping; whilst the sagittal and apex of the lambdoid are almost completely ossified. Dividing the sagittal suture into the five portions described by Professor Welcker, the obliteration is most complete, and leaves scarcely a trace in the fourth or interforaminal; most nearly approaches the same degree of effacement in the third or central division; is less complete in the fifth or occipital, though still far advanced; less still in the second; and least of all in the first or frontal division, where it abuts on the gaping coronal, and is quite distinct. A *carina* corresponds to the line of the sagittal suture, especially in its three central divisions, where the obliteration is most complete. The summit of the parietals on each side of the obliterated sagittal has a nodose, eburneated character indicative of a certain degree of hyperostosis such as is observed in many scaphocephalic and other synostotic crania. The right parietal foramen is alone present, and is of

* In an ancient Gaulish skull from the dolmen of Du Val (Oise), preserved in the Gallery of Anthropology of the Museum of Natural History at Paris (No. 169) I detected complete synostosis of the parietals apparently congenital. The skull is that of a man of about 45 years. The coronal suture is distinct and open, the lambdoid much obliterated; there is no trace whatever of the sagittal, but considerable rugosity in the line where it is usually seen. The traces of the left parietal foramen are trifling in extent; there are none of the right. The form of this skull is more dolichocephalous than that of the other male skulls found with it, and relatively to their average type it may be regarded as a long skull (·76). The ancient Gaulish skulls differ from the British, in usually presenting a mixture of the two types, long and short, in the same tomb.

unusual size. The breadth of the skull is as ·67 to the length, which is very disproportionately narrow. Though this exaggerated dolichocephalism may in part be due to infantile synostosis of the parietals, comparison with another cranium from the same chamber (No. 138), proves that the elongation and narrowness of the first is very partially dependent on the synostosis, and that its form has been naturally, and from the first dolichocephalic. In this last skull, perhaps that of a brother, the form is quite dolichocephalic, the breadth being in the proportion of ·71 to the length. The parietal eminences are however well expressed, and there is no trace of any sagittal ridge or carina. On the internal surface *all* the sutures (except the squamous) are obliterated, but they are quite distinct and beautifully marked externally, excepting the fourth division of the sagittal, which, in accordance with Welcker's law, is partially effaced. There are two small parietal foramina in the usual situation. This skull presents a tendency to prematurely senile obliteration; that last described is the subject of infantile and abnormal synostosis.*

The skull already referred to from the Long Barrow near Winterbourn Stoke (No. 159), which is that of a man of perhaps not more than 25 years, presents even a greater amount of prematurely senile obliteration.† "The coronal and sagittal sutures are almost entirely effaced, so that the synostosis of the frontal and parietal is nearly complete." The proportion of the breadth of this skull to its length is ·75; so that it does not belong to the exaggeratedly dolichocephalic class, but is sub-dolichocephalic, or indeed rather orthocephalic. It is clear there is no relation between the degree of dolichocephalism and the synostosis, which in this instance is so complete as to leave but slight traces of the affected sutures. A general tendency to ossification appears to be shown by the considerable exostotic growth on the *linea aspera* of the right femur, of which the obliteration of the sutures is another symptom.

* Professor Welcker insists much on the distinctions between infantile and senile obliteration of the sutures. "*Infantile obliteration* solders the bones mostly through the entire thickness; the ossification has sharply defined borders and makes no flaws. *Senile obliteration* cements at its commencement here and there some of the suture teeth, so that open chinks or interspaces remain; frequently the growing together of the *tabula vitrea* is already complete, whilst externally spots still open are visible." *Loc. cit.*, p. 139.

† The skull is fully described, with the barrow whence it was obtained, in Memoirs of the Anthropological Society of London. Vol. i. p. 140, Plate I.

Agreeing to this, is the nodulated and rugose character of the upper halves of the frontal and two parietals, the latter of which especially are studded with fine perforations. The right parietal foramen is alone present. As in extreme age, the entire calvarium is converted into a solid box of the hardness of ivory, the whiteness of which is simulated by that of its internal surface.

Another dolichocephalic British skull from the chambered barrow at Rodmarton, Gloucestershire, lithographed and described in the *Crania Britannica* (Pl. XXVII, 59),* is that of a man of about 50 years of age. The proportion of the breath to the length is ·72. "Externally, the great sutures are tolerably distinct, though, with the exception of the squamous, they appear to be obliterated internally. Of the fronto-sphenoid, the lower parts of the coronal, and the left occipito-mastoid there is scarcely a trace within or without." Here, the ossification of the sutures is very general; the transverse the median, and lateral-longitudinal, are all affected by it; so that the dolichocephalism can hardly be conceived as being produced by the synostosis. In this skull the obliteration is doubtless of the prematurely senile description; but though the cranium of a man more advanced in life than that from Winterbourn Stoke, it is instructive to observe that the obliteration is less advanced than in that more youthful specimen.

In a recent paper by Dr. J. Barnard Davis, the doctrine of synostosis appears to me to be carried beyond its just limits, with a view of explaining the peculiarities of the now-celebrated Neanderthal skull. That it is synostotic is not to be doubted, though how far its peculiarities have been produced by the obliteration of the sutures appears doubtful. However this may be, there is one passage in Dr. Davis's paper on which I desire to make a few observations. "In cases," says Dr. Davis, "in which the sagittal suture is not closed, the obliteration of the spheno-frontal, -parietal and -squamosal sutures, which often carries that of the sides of the coronal with it, I am satisfied, gives rise to an elongation of the calvarium. * * * * This ossification has a material influence (sometimes with that of the

* This skull has been presented to the cranial collection of Dr. J. Barnard Davis, in which it is No. 1210. A second skull from the same chamber of very similar form, and with the sutures almost equally obliterated is figured in the Memoirs of the Anthropological Society of London, vol. i. p. 153, figs. 12, 13.

sagittal suture, where it operates most potently, and sometimes without) in producing the dolichocephalism of the skulls, derived from the long and chambered barrows of the ancient Britons; for it is a remarkable fact, not yet explained, that these skulls are found to be specially obnoxious to synostosis."* Of the four sutures named, which occupy a limited space in each temporal region, the obliteration of the spheno-frontal and spheno-parietal, if originating during the period of growth and development, may indeed produce a narrowness and depression of the anterior part of the skull. Supposing the lambdoid and occipito-mastoid to be at the same time unossified, and yielding within and without (though this very frequently is not the case, the last-named suture, as shown by Welcker, being particularly liable to premature obliteration†), then some degree of compensatory growth in the direction of the occiput, may be allowed, though by no means sufficient for "producing" a dolichocephalism not naturally inherent in the brain and skull. As regards the lower parts of the coronal and the spheno-temporal sutures, these belong to the transverse order, and their obliteration would rather have the effect of detracting from the length of the cranium. There is no doubt that the sutures referred to are often obliterated in skulls from the long and chambered barrows; though whether so frequently as in other dolichocephalous skulls, and especially those of Negroes, is very uncertain. The early period at which two of them, viz., "the spheno-frontal and the lowest parts of the coronal," are usually obliterated is pointed out by Welcker, who observes, that they "form one of the earliest seats of senile synostosis;" which he explains by the mutual pressure to which the opposed inverted squamous edges of

* *The Neanderthal Skull: its Peculiar Conformation Explained Anatomically*, p. 7. Memoirs of Anthropol. Soc. of London, vol. i. Comp. Bull. de la Soc. d'Anthrop. de Paris, t. v. p. 716. I quote from the English memoir, as "printed for private distribution." Dr. Davis adds in a note, 'There is a probability that the earliest examples of human crania obtained from these barrows were synostotic, and also deformed in the same way as the Neanderthal calvarium. At all events, one of the most striking peculiarities, which impressed Sir Richard Colt Hoare and his friends with the greatest force, was the '*frons valde depressa*.' "

Sir Richard however, though no anatomist, observed that the skulls were "totally different in their formation from any others which his researches had led him to examine." Archæologia, vol. xix. p. 48; Comp. *Cran. Brit.* pl. XXIV, 5, p. 151. These researches had been chiefly confined to the circular barrows; it was his coadjutor, Mr. Cunnington, who opened eleven of the long barrows. The long barrows which have been excavated of late years have produced skulls remarkable not only for their length, but likewise for their depressed (platycephalic) form.

† *Wachsthum und Bau*, p. 18.

the bones forming these sutures are subject;*—a pressure, which it may be observed, must be greatly increased by the action of the temporal muscles in speech and mastication. Now as premature senile obliteration, according to the same distinguished observer, may occur as early as the twenty-fifth year,† it will scarcely be possible, in crania of a mature or moderately-advanced period of life, to assign any high value to the connection between the obliteration of the sutures and any peculiarity in the form of skull,—especially as regards the slighter deviations from what is normal. Indeed, for such a purpose, observations on the skulls of the young can alone be depended upon.

It is proposed to explain the post-coronal depression which is observed in so many of the ancient British skulls from the long barrows, as well as the dolichocephalism proper to these skulls, by the obliteration of the sutures in the temporal region, and the synostosis of the cranial bones in this spot.‡ That synostosis of the parietals and alisphenoids, when originating before the "perfect formation of the cranial bones," will, as explained by Virchow, produce the saddle-shaped contraction in the post coronal region, which, as we have seen, is named by him *klinocephalus*,§ there can be no doubt. But, that the slighter grades of this peculiar form, such as are commonly observed in dolichocephalous British skulls, can be thus explained, I am by no means convinced. In the imperfect skulls

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* *Ibid.* p. 18. Professor Virchow also observes on the frequency with which "ossification of the spheno-frontal suture is combined with that of the spheno-parietal and coronal sutures." *Ueber den Cretinism. Ges. Abhandlung*, p. 900.

† *Loc. cit.* p. 17. "Unter 74 Schädeln 25-70 jähriger individuen, deren Pfeilnaht von seniler Obliteration betroffen ist." * *

‡ "The constantly recurring depression running across the calvarium immediately behind the coronal suture, in these skulls, is another of the results of the obliteration of the sutures situated in the temporal region. The synostosis of the cranial bones, in this spot, has the effect of contracting the whole of the pre-temporal and pre-parietal circumference of the calvarium in a similar manner to the operation of a constricting bandage. So that the *tête annulaire* of Gosse, or *sattelformige Einschnürung* of Virchow, is not always the consequence of artificial compression, as has been supposed. * * * It is a frequent phenomenon in these synostotic crania, and premature ossification of the sutures is its true cause."—*Cran. Brit.* chap. ix. p. 231; where Dr. Davis explains his views as to the long-barrow skulls at greater length.

§ "Synostosis of the parietal and sphenoid bones, through ossification of the spheno-parietal suture, produces a saddle-shaped contraction, which courses more or less completely over and around the head in the temporal region, and causes an almost biscuit-shaped form of the skull-roof, because the forehead projects forward and the parietal eminences towards the sides."—*Ueber den Cretinism. Ges. Abhandlung.* p. 900.

and calvaria, such as are usually obtained from the long barrows, the alisphenoids, with the adjoining edges of the parietals are very commonly broken away, so that the condition of the sutures in the temporal regions cannot be ascertained. This especially applies to the skulls of children and of the young, which we have seen to be essential for any just conclusion. I am able, however, to refer to two youthful skulls sufficiently perfect in this respect, in which there is well marked post-coronal, or saddle-formed contraction, but which present no obliteration of these sutures.

In a large series of upwards of twenty dolichocephalous British skulls from Winterbourn Monkton, North Wilts, which, though not from a tomb of that description, are probably to be referred to the same period and people with those from the long barrows, the post-coronal depression is more or less obvious in almost every instance, and in about half the number exists in a comparatively marked degree. It is important to observe, that in the calvarium of a boy of about five (No. 42), and in another of a girl of about seven years (No. 41), this is quite as apparent, or even more so, than in any of the adult skulls. In one of the latter (No. 40), the form approaches more closely to the *klinocephalus* of Virchow, than in the rest. Here the coronal depression is trivial, and is before rather than behind the suture so called. There is, however, a marked contraction in each temporal region, and the parietal eminences are full and prominent: there is no particular fulness of the forehead. Of the coronal and sagittal sutures there is no trace internally, and it is probable that the obliteration of the left spheno-parietal (on the right side the ali-sphenoid has been broken away) is but a part of the general premature obliteration so observable in the series. In the girl's skull, in addition to that in the post-coronal region, there is a parallel depression across the posterior third of the parietals, producing a sub-globose dilatation of the intermediate parietal region, approximating to that observed in the macrocephalic crania from the Crimea and in those from Peru. The same skull is, moreover, a curious example of the "obliquely contracted (wry) skull," and "posterior variety" of Virchow. The right frontal eminence is about half an inch in advance of the left, whilst the left half of the occipital projects to the same extent beyond the right. The synostosis is confined to the left side of the lambdoidal suture. There were originally two interparietal bones, the suture separating which remains distinct.

At an early period, the right interparietal became united to the right supra-occipital, and the left to the upper and posterior angle of the

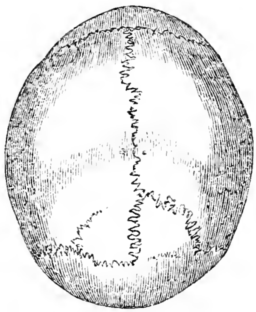

FIG. 9. *Obliquely-vertical View of Synostotic Skull from Monkton.—Quarter Diameter.*

left parietal. The bizarre and, at first sight, puzzling outline of the occiput is explained by this unsymmetrical and rare form of synostosis. In nearly all the skulls of this series the sutures are more obliterated than usual. Three calvaria of men, of 50 to 65 years, present considerable rugosities in the line of the obliterated sagittal, which in two assumes the form of a *carina* continued along the frontal. The synostosis may perhaps be of the infantile description; but if it had any influence in the production of the lengthened form, this must have been trivial in extent; the dolichocephalism being obviously original and proper to the series.*

In the Museum at Guy's Hospital are two skulls from the chambered barrow at Uley, Gloucestershire; one of which, that of a man far advanced in life, has been described in the pages of *Crania Britannica* (Pl. XXIV, 5). The other, that of a girl of nine or ten years of age, is of much interest, in connection with the present inquiry.† Like its companion adult skull, it is very dolichocephalous, having the proportion of breadth as ·73 to the length taken as 100. There is a somewhat saddle-formed contraction, which extends along the

* These skulls, with the circumstances under which they were discovered, are described in *Cran. Brit.* Pl. XXVIII, 58.

† No. 3201. Mus. Guy's Hospital. The skull is briefly described *Cran. Brit.* Pl. XXIV, 5. p. (5).

parietals through the two first-fifths of the sagittal suture. This and the sutures generally, inclusive of the spheno-frontal and spheno-parietal, are quite distinct, so far as can be seen both within and without. There is only one exception, viz., the left occipito-mastoid, which is completely effaced, so that the left temporal bone is ossified to the occipital; whilst on the opposite side, the two bones are separated by a distinctly open suture. Neither the dolichocephalism nor the post coronal depression in this skull can possibly be explained by synostosis.

A skull from a very ancient interment, which was discovered about a mile and a half from Bath, in December, 1863, is perhaps of some importance, in reference to the question before us. In digging for a reservoir in a valley at Charlcombe, the workmen exposed a rude cist of oolitic stone, containing the skeleton of a girl or young woman, not more than 17 years of age, as shown by the separated epiphyses of such of the bones as were preserved. The strata covering the cist are described as consisting of,

	ft.	in.
1. Turf and surface mould	1	0
2. Drift of oolite and clay	1	0
3. Peat, containing fragments of fossil coral, pieces of hazel, bones of Red-deer or Elk	1	6
4. Blue tenacious clay	5	0
Total depth	11	6

The body had been interred in a partially-upright or sitting posture, in a small cist; which was about three feet in depth, and had a capstone of fossil coral, which rested immediately on the skull. Nothing whatever was found with the skeleton. Though not covered by a long barrow, this interment must have been within the limits of the British tribe of Dobuni who bordered on the Belgæ, in the neighbourhood of Aquæ Solis, and in whose district long and chambered barrows so much abound. It probably belonged to the very people by whom those peculiar tombs were raised.

The skull is smooth, thin, and delicate; is of decidedly elongate or dolichocephalic type, the greatest breadth (5·3 in.) being to the length (7·2 in.) as ·73 to 1·00. The height (5·4 in.) is in the proportion of ·75 to the length. The greatest length is in a line from the glabella to the centre of the upper scale of the occiput. In the brachycephalic class of British skulls the greatest length is usually in a line from the glabella to the *inion*, or "tuberosity" of the transverse occipital spine. In the skull from Charlcombe this line measures only 6·4 inches, and falls short of the greatest length by as much as eight-tenths of an inch, or 20 millimeters. This implies an unusual backward prolongation of the posterior lobes of the brain and of the corresponding part of the occipital bone. The lengthened form of skull is that which we have learned from M. M. Gratiolet and P. Broca to distinguish as *occipital dolichocephalism.* Turning to the upper part of the calvarium, the frontal region is narrow, though not particularly low. The supraciliary ridges are slightly marked, but the glabella is full, and the frontal and parietal eminences are well expressed. There is a broad but very shallow depression behind the coronal suture which is prolonged downwards and backwards across the occiput, in the line of the transverse spine, where the depression is most pronounced and is quite considerable. As all the sutures, including the sphenoidal, are open and gaping, synostosis can have had nothing to do with any of the peculiarities in the form of this skull. Is it probable that this depression has arisen from the distorting effect of some form of head dress, similar perhaps to that which is still applied to the heads of infants in various parts of France, as described by Drs. Foville and Lunier? This consists of a neckerchief passed twice round the head from the corona either to the back of the neck, when the resulting deformity (which is that of the Charlcombe skull) is designated *annular* by Dr. Gosse; or is carried under the chin and jaw, when it is termed *bilobed* by the same writer.* The question just asked must I believe be answered by a negative.

Rejecting the idea of these slighter deviations from a regular form being produced by obliteration of the sutures, and consequent synostosis of the sphenoid with the frontal and parietals, we are led to search for some other cause. And here we inquire whether they are not to be regarded as original and natural, and to be referred to the form and course of development of the brain; such as may be peculiar to individuals and families, to tribes and races. The very eminent Professor von Baer observes, that in dolichocephalic skulls regarded by him as undistorted, there is often a shallow depression behind the

* Foville, *Déform. du Crâne resultant de la Mèthode de couvrir la Tête des Enfans*, 1834. Lunier, *Déform. du Crâne, dans le Département des Deux-Sèvres Annales Med. Psychol.* 1852, tom. iv. pp. 42, 56. Gosse, *Déform Artif. du Crâne*, 1855. (*Tête annulaire*) p. 62, pl. v. fig. 1 (*Tête bilobée*), p. 66. pl. v. fig. 2, pl. ii. fig. 3., pl. iv. fig. 9.

coronal suture, which he thinks may depend upon an unusually strong development of the anterior and posterior *genu* of the *corpus callosum*.* Professor Rolleston appears to take a similar view of the "broad and shallow depression in the line of the coronal suture often seen in well-developed crania."† We require a test to distinguish a normal depression of this sort, from that artificial one in the same situation produced by bandaging. It is not to be supposed that all transverse depressions of the calvarium are independent of artificial agency. The macrocephalous skulls of the Crimea and the constricted and flattened skulls of Peru and other parts of America afford ample proof that this is not the case. We must also refer (as is admitted by von Baer) those slighter deformities in the modern French skulls which have been alluded to, to the same cause; though we should distinguish the latter as undesignedly and the Crimean and Peruvian skulls as designedly distorted.

Obliteration of the sutures may no doubt arise from the long continued pressure on the growing skull of bandages, ligatures, pads, and boards, such as are employed in the deforming processes of so many peoples. Professor Dr. D. Wilson, in common with many previous observers, has remarked on the premature ossification of the sutures as very common in the diversely-distorted flat-headed skulls of America. That external pressure "not infrequently" produces obliteration of the sutures in the points where it is applied, has the support of the distinguished anatomist and cautious observer, Professor Welcker of Halle. In a Peruvian (Huanca) skull, Professor Welcker says, "the coronal suture in its middle, where the ligature crossed, which was applied in the moulding of the skull, was obliterated, whilst in the normal situation of commencing obliteration in the neighbourhood of the *angulus sphenoidalis* it was perfectly open."‡ Dr. William Turner also observes, that in artificial deformation, "the form into which the head is thrown by the pads, bandages, and other apparatus employed, is in some measure preserved by the premature synostosis induced by their application for a considerable period. So that when the compressing agents are removed, the head still retains the form into which they had thrown it. What they have initiated the premature synostosis induced by them has

* *Die Makrokephalen der Krym*, &c., 1859, p. 11. Comp. pp. 9, 17.

† *Brit. and For. Med. Chir. Review*, April, 1863, p. 508.

‡ *Wachsthum und Bau*, p. 15.

kept up. I have now examined seven artificially flattened crania of Chinook and other flat-headed Indians, and in all of them the sagittal and coronal sutures are in a great measure obliterated. The lambdoidal suture is not so frequently affected. The lateral lines of sutures (the spheno-frontal, spheno-parietal, and squamous) not being subjected to the pressure, are but little altered."*

My own observations of the state of the sutures in skulls distorted by artificial means are quite in agreement with those here quoted. But though bandaging does cause obliteration of the sutures concurrently with the annular deformations which immediately result from it, it does not appear to have been the cause of either the one or the other in the dolichocephalous skulls from the Long Barrows. Since the publication, ten years ago, of Dr. Gosse's work "On Artificial Deformations of the Skull," there has been too much disposition to attribute every peculiarity of cranial form to that cause. I have myself, on different occasions, and up to a somewhat recent period, fallen into this error. Minor degrees of saddle-formed contraction in the coronal and temporal regions, are not only to be observed in the ancient British crania, which are more particularly considered in this paper, but likewise in those of Negroes and in many other races, especially such as are naturally dolichocephalous.

After much consideration and inquiry, the conclusion I have come to is that this contraction is altogether normal, and connected with the natural form and course of development of the brain. It corresponds almost precisely with the situation of the great fissure of Rolando, which divides the anterior from the middle cerebral lobes; and just in proportion as these neighbouring lobes may tend to assume a full and rounded form, so must be the amount of the corresponding intervening depression which is communicated to the surface of the skull. In like manner, other depressions which are observed on the cranial surface may represent the interspaces between other lobes of the brain; as that between the temporal and the posterior and the upper surface of the cerebellum. Such, I think, is the explanation of certain depressions on several ancient Gaulish skulls, from the cavern of Orrouy (Oise), which are preserved in the Museum of the Society of Anthropology of Paris, and of which casts, through the liberality of M. P. Broca, have been presented to several collections in this country.

* Cranial Deformities, &c. Nat. Hist. Review, 1864, p. 106.

XXIII.—Description of an Ovo-viviparous Moth, belonging to the Genus *Tinea*. By A. W. Scott, Esq., M.A.*

I am induced, from the novelty of the subject, to lay before the Society a short description, accompanied by illustrations, of a Moth recently found on Ash Island, which possesses the remarkable, and, I believe, unique quality of being ovo-viviparous; a quality hitherto known to exist only in some few groups of the Insecta, but never attributed to any species of the Lepidoptera. Those admirable writers, Kirby and Spence, in the 3rd Volume of their "Introduction to Entomology," page 63, express themselves thus, "By far the larger portion of Insects is oviparous in the ordinary acceptance of the term. The Ovo-viviparous tribes at present known are scorpions; the flesh-fly, and several other flies; a minute gnat belonging to Latreille's family of Tibulariæ; some species of *Coccus;* some bugs (*Geocorisæ,* Lat.), and most Aphides, which last also exhibit the singular fact of individuals of the same species being some oviparous, and others, ovo-viviparous; the former being longer in proportion than the latter." You will perceive that no mention is made by these scientific gentlemen in 1828, the date of the work from which I have quoted, of any Lepidopterous insect possessing the faculty of ejecting living larvæ; and I cannot find, on careful reference to many subsequent publications, some of recent date, any notice to the effect that this peculiar function appertains to any species of butterfly or moth. I, therefore, take the liberty to submit this singular fact for your consideration and future investigation, trusting that such information, however small in itself, but tending, nevertheless, towards the perfecting of that branch of Natural History, to which this Society exclusively devotes itself, will be received by the members with some degree of interest.

As my family takes an equal part with myself in all matters connected with Natural History, I will, with your permission, use the pronoun, *we*, as I now proceed to describe more accurately and at greater length the economy of this curious little creature.

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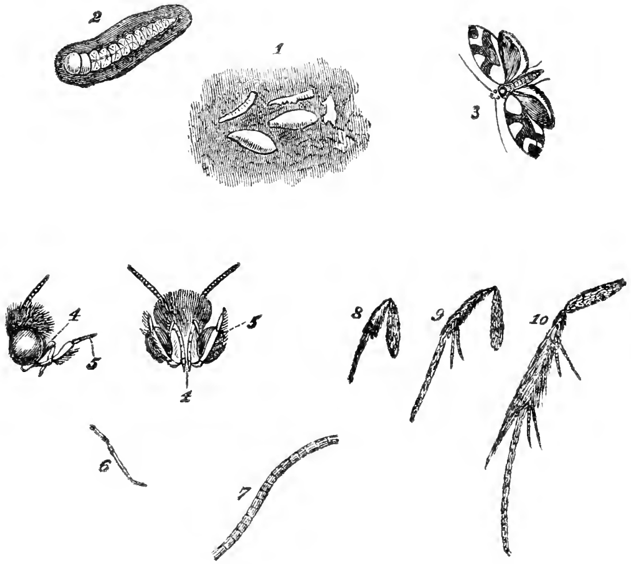
* Reprinted from the "Transactions of the Entomological Society of New South Wales, vol. I., part I., Sydney, 1863. This paper is of much interest, as recording a fact hitherto unique among the Lepidoptera, and one to which the attention of Entomologists for confirmation of Mr. Scott's observations should be directed.—Ed.

The Lepidopterous insect brought under your consideration is closely allied to the genus "*Tinea*" of modern authors, is of small size, and boasts of no outward singularity of form, nor extraordinary beauty of colouring to distinguish it from others of that group. It was after dark, in the early part of the month of October, 1861, that we first captured a specimen with the hand, being attracted at the moment by its elegant colouring, and wishing to secure it for the cabinet. Fearful that the plumage might be injured by the struggles of the Moth, while endeavouring to escape, it was gently compressed, and on opening the hand we observed numbers of minute, but perfect larvæ, being ejected from the abdomen in rapid succession, and moving about with considerable celerity, evidently in search of suitable shelter and food. This incident, so singular and new to us, required further confirmation, and consequently many more of a similar kind (of course all females) were caught and attached to corks previously covered with black paper, and subjected to the closest scrutiny. These Moths shortly commenced to deposit their living progeny with rapidity, the small white fleshy larvæ being seen with great distinctness on the black surface of the paper; thus affording clear and satisfactory proof that this Insect, the only one of its order at present known, is unquestionably ovo-viviparous, and will represent in future this peculiarity among the Lepidoptera; similar to those few species existing in the Hemipterous and Dipterous orders. This fact having been ascertained, our attention was incited to the care of the little strangers, and to procure suitable shelter and food for them, in the hope that we should be able to rear them, and thus to supply a correct account of all their metamorphoses. In this we were guided by the form of the perfect insect, and accordingly placed before them grains of maize, pieces of flannel and woollen cloth, shreds of partially decayed paper, some fungus and lichen, and other materials known to be the food of caterpillars belonging to the genus *Tinea* and neighbouring genera. Unfortunately, they turned with distaste from all these supplies, with the exception of the cloth and flannel, and even to these they attached themselves with reluctance. We, however, persevered and put them in a dark and roomy box, aware of the marked dislike to light of larvæ possessing depredatory habits, and left them undisturbed for a week; at the end of which we were pleased to find that small silken tunnels or tubes had been constructed on the surface of the brown cloth, and that the denuded appearance of several places exhibited signs of their ravages. From this cloth they shortly afterwards transferred themselves to the flannel, where they fabricated small portable cases, composed of two separate pieces, of an irregular oval form, joined at the sides, but leaving apertures at each end, and being thus comfortably housed, we entertained sanguine hopes of rearing them. These hopes, however, were not to be realized, for towards the end of November (nearly two months from their birth) they ceased to thrive, and eventually all perished.



The larva (Fig. 1., natural size; Fig. 2., magnified), attained to the length of 2½ lines, but this manifestly is under its full growth; the head large, somewhat depressed, and with the first segment of the thorax slightly corneous, and of a brownish colour, the rest of the body softly cylindrical and almost colourless, possessing a lateral row of small brownish points, emitting delicate hairs; sixteen feet, the thoracic ones being large compared with the others.

The imago ♀ (Fig. 3) measures in expanse of wings, nine lines, the fore wings are elongate, somewhat lanceolate, with the costal margins arched. A broad transverse, rather oblique, glossy brown bar, bifurcate towards the costal margin, occupies the centre and a triangular patch of the same colour the tips; the remaining portion, or ground colour, being silvery white. The inferior wings are pale brown glossed over with a golden tint; a deep marginal fringe surrounds all the wings. Head tufted in front with white; thorax brownish, having a white spot on the centre of the collar; abdomen and legs pale shining brown.

The under surface of the insect, pale golden brown, clouded with darker on the superior wings.

The male unknown to us.

Wings deflexed in repose.

Maxillæ	Very small, almost rudimentary.
Maxillary palpi	(Figs. 4 and 4) distinct, separated, composed apparently of several joints, and bending down in front of the mouth, which they almost conceal; partly clothed with scales.
Labial palpi . . .	(Figs. 5, 5, and 6, divested of hair) large divergent, porrected forwards and slightly upwards; 3-jointed, the middle joint being the longest, the whole covered with scales and with a few setæ on the 2nd joint.
Antennæ	(Fig. 7) long, filiform, scaly.
Legs	Differ greatly in size, the tibiæ and tarsi of anterior pairs (Fig. 8) being only about equal in length to the tarsi of the 2nd pairs (Fig. 9), which again bear the same relative proportion to the posterior pairs (Fig. 10), which are large and powerful. 2nd pair with two, and posterior with four large spurs, at apex of tibiæ, which is covered with longish hairs. Tarsi 5-jointed, slender, scaly.

We have retained in this instance the generic name of *Tinea*, as our Moth agrees in all its characteristics with that genus, with the exception of the labial palpi being larger than usual, and that our insect is ovo-viviparous. As we failed in affording proper nourishment to the larvæ, we think it probable that they exist in their natural state upon decaying animal or vegetable matter, as found to be the case with the *Sarcophaga carnaria* (or common Blow-fly), and some others, which produce their young in a living state.

XXIV.—Proceedings of the Scientific Societies of London.

1. Ethnological Society. (4, St. Martin's Place.)

December 27th, 1864.

The following papers were read:—1. 'On Flint Implements from Salisbury Hill, near Bath.' By Mr. John Evans, F.R.S. During the late meeting of the British Association at Bath, a paragraph appeared in the *Bath Chronicle*, stating that in the ancient earthworks at 'Little Salisbury Hill,' numbers of flint arrow-heads had been found. Amongst the additions to Camden's 'Britannia' (Gough's edition of 1806) is a passage derived from Collinson's 'History of Somerset,' referring the entrenchment (of an almost circular shape) to Saxon times. Mr. Lubbock, Mr. Galton, and the author paid it a visit. They found it to be an isolated hill of Inferior Oolite, the Fuller's-earth beds being capped by the Great or Bath Oolite, which formed a horizontal plateau some few acres in extent at the top. The vallum had in great part disappeared. On the top a seam of black mould was observed in the cutting of a small quarry worked into the side of the hill, and containing bones of the horse, ox, and pig. There were also several pieces of rude pottery, some of red clay ware, and others of more imperfectly burnt clay containing numerous particles of calcareous matter, and similar in character to the ware which was found a few years ago at Menney near Frome, containing ancient British coins of the first century. On the plateau a search for arrow-heads was made as well as for other objects of flint, which, as the natural soil contains no stones except oolitic débris, were readily observable, and a large number of flint chippings and flakes of various sizes and different degrees of perfection, but mostly small and rude, as well as several cores or nuclei, were collected. Besides the worked flints, several other implements of stone worthy of notice were met with. Of these the most remarkable was a rounded pebble of hæmatitic iron ore, with several deep scorings upon it, found by Mr. Lubbock. A piece of greenstone, apparently originally a smoothed or polished celt, but which had subsequently been used as a hammer, was also met with. Besides these were two stone implements of quartzite, presenting a rather singular character. They appear to have been formed of rounded pebbles, which had been broken in their longest diameter into rudely-shaped quadrangular prisms, with one end flattened, and the other left with the original contour. From the similarity of the two specimens the author considered it evident they were thus shaped with some design, but what it was difficult to conjecture. The author did not attempt to assign these relics to any definite age, though he considered it would be justifiable to refer them to the pre-Roman period, and that for the first occupation of Salisbury Hill a date might be claimed far earlier than those Saxon times to which Collinson has ascribed the encampment.

2. 'The Hairy Men of Yesso.' By Mr. W. Martin Wood. It often happens that in the isolated residue of any race its repulsive peculiarities become more strongly marked, and some effort of humane feeling is required in such cases in order to recognise those traits, in virtue of which the perishing fraction may claim its kinship with the great family of mankind. Such an outcast race still lingers in the island of Yesso, the most northern portion of the empire of Japan. These are the 'Ainos' or 'Mosinos'—the 'all-hairy people;' this last word being a Japanese term, marking their chief peculiarity. Yesso is only separated from Niphon by the narrow straits of Tsougar; but the climate of the island is unpropitious and its soil is barren, so that the Japanese have only occupied the southern portion. They number about 100,000, and dwell principally in the cities of Mato-mai and Hakodadi. Timid and shrinking in attitude, the Ainos seem utterly crushed in spirit by their long subjection and isolation. They are short in stature, of thickset figure, and clumsy in their movements. Their physical strength is considerable, but beside that peculiarity there is nothing by which an observer can recognise the possibility of the Ainos ever having possessed any martial prowess. The uncouthness and wildness of their aspect is calculated at first to strike a stranger with dismay or repugnance. Esau himself could not have been more hairy. The hair on their heads forms an enormous bunch, and is thick and matted. Their beards are very thick and long, and the greater part of their face is covered with hair which is generally dark in colour; but they have prominent foreheads and mild dark eyes, which somewhat relieve the savage aspect of their visage. Their hands and arms, and indeed the greater part of their bodies, are covered with an abnormal profusion of hair. The natural colour of their skin is

somewhat paler than that of the Japanese, but it is bronzed by constant exposure. The women, as if in default of the extraordinary endowments of their spouses, have a custom of staining their faces with dark blue for a considerable space around their mouths. The children are lively and intelligent when little, but soon acquire the downcast aspect of their elders. Yet these strange people have a history; and though its details are lost, they cherish the remembrance that their forefathers were once the equals, if not the masters, of the Japanese. This is supposed to have been in the sixth century before Christ at least.

January 10*th*, 1865.

The following papers were read. 1. "Contributions to the History of the Iranians by M. Khanikof." The author's conclusions were that the origin of this branch of the Aryan family must be sought for in the east of the lands occupied by them; that a difference exists now, as at very remote epochs, in the shape of the head in eastern and western Persians; and that the original Iranian type is best preserved by the Tadjiks. On the derivation of the term Tadjik, the author offered a very ingenious hypothesis, namely, that it means "bearers of tiaras or tadjs," and was used in the remotest periods to designate the Iranians who were fire worshippers,—the tadj being a sign of recognition, amongst the followers of Zoroaster, as the turban is amongst Mussulmans. Assuming the Tadjiks to be the aborigines of East Iran, it is natural to search among them for the primitive type of the Iranian family. M. Khanikof does this with much minuteness, the main features being—high stature, black eyes and hair, which is very abundant; head long and oval like those of the western Persians, but with frontal bone broader between the semicircular lines; the nose, mouth, and eyes very handsome, the first generally straight, rarely bent; the mouth and ears large, as also their feet. They are strong and can work long without weariness, but are not such good walkers as the Persians.

2. "On the Artificial Eyes of certain Peruvian Mummies," by Sir Woodbine Parish. Associated with the interments of ancient Peruvians there have been found certain hemispherical amber coloured objects, which the late Mr. Clifts, of the College of Surgeons determined from some specimens shown him by Dr. Wollaston to be desiccated eyes of cuttlefishes,—an opinion now confirmed by Professor Owen and Mr. Bowman. Lieut. Rising, R.N. who for-

warded the present specimens to the author of this paper, found them in the sockets of the eyes of some of the Peruvian mummies at Arica. The purpose to which they were applied is thus definitely settled.

January 24th, 1865.

The paper before the meeting was "On the Progress of Civilization in the Northern Celebes," by Mr. A. R. Wallace. Its principal object was to bring under discussion the system of coffee-culture established since 1822, through the intermediation of the native chiefs, and under the direction of European "controlleurs," by the Dutch government, and the beneficial influences it has had upon the native population. Up to a very recent period these people had been thorough savages, and there were persons still living who remember a state of things identical with that described by the writers of the sixteenth and seventeenth centuries. Now the coffee plantations and rice fields are cultivated in common—men, women, and children working together at weeding and gathering; an account is kept of the work done by each family, and when the crop is gathered each receives a proportionate share. A fixed price is established at which the government buys the coffee, and the village chiefs, who are dignified with the titles of "Mayors," receive 5 per cent. The duty of the "controlleurs" is to visit every village in succession once a month, and to report on their condition to the Government. The coffee plantations were established by the Dutch government at a considerable outlay of skill and capital; roads have been made, and education has been freely given to the people; and if in return the Government claims the monopoly of the produce as the most economical and least oppressive mode of taxation, what right have we to cry out against it whilst we maintain a salt-tax and an opium monopoly in India, neither of which can be shown to have been as directly instrumental in raising and elevating the people as this coffee culture? The author thought that there was great wisdom in treating uncivilized people for a while as children under a system of moderate tutelage, and that indeed it was necessary for their preservation to educate and protect them for a sufficient time before exposing them to the full contact with the wealth and energy of civilized Europeans.

February 7th, 1865.

The paper for the evening was, "On Human Remains and Works of Art at Gibraltar," by Professor Busk, F.R.S. These remains and relics were chiefly from two caves, the "Genista" and the "Judges' Cave." The human remains found in the first, together with the implements, articles of earthenware, and certain of the mammalian, fish, and most of the bird-bones, as well as the greater part of the marine shells, were all contained in the highest part of the cave above the uppermost of the several stalagmite floors noticed by Captain Broome. The space thus noticed varied in depth from the roof to the floor from 14 to 18 feet, the greatest depth in it at which human remains have been met with was little more than 10 feet. It would thus seem that the floor of this cavern had been covered to some depth with a deposit before any human bones had gained admission into it. Most of the mammalian bones immediately associated with those of man in it exhibit precisely the same general characters as the human bones themselves, and differ notably in this respect from the older, more fossilized bones procured from beneath the stalagmite floors and in the deeper parts of the fissure. The mammals thus referred to as bearing intrinsic evidence of their close association with man are a species of *Bos*, of the size and proportion of the common domestic ox, of different sizes; of *Capra hircus, Sus domesticus* (?) *Mus rattus, Lepus timidus, L. cuniculus, Meles taxus, Canis Vulpes, Phocæna*, sp. &c., whilst of fishes are numerous bones of the Tunny, and of other smaller forms not yet determined, and of several birds, which have also not as yet been gone into sufficiently to allow of the determination of the species. The remains of articles of earthenware are very abundant, though most are in a very fragmentary condition. Amongst them, however, is one quite perfect small urn. A large portion of them appear to have been made without the use of the potter's wheel, and these are also composed of a very coarse and imperfectly burnt black clay, though reddened to a little depth on the surface. Those articles which have been fashioned on the wheel are for the most part of a finer or more carefully prepared material, and they are also more thoroughly burnt. The implements of different kinds found in the cave, though not very numerous, are of considerable interest. With one exception, they are of stone or of bone. Human bones belonging to nearly every region of the body are found; but by far the larger portion of the collection consists of fragments of crania, and of the bones of the upper and lower extremities, the latter predominating. Though hardly any of these fragments can be fitted together, they suffice to show that the skull must have been of a large size and thickness, and with the muscular impressions strongly marked. The incomplete state of the only cranium that admits of any measures at all being taken precludes any accurate statement of its dimensions. One of the most remarkable parts of the collection of human bones is found in those belonging to the lower extremity. These are very numerous, and they may be computed to have belonged to at least thirty-five or thirty-six individuals. There are portions of about thirty thigh bones, and from eighteen to twenty tibiæ, but portions of only three fibulæ have been preserved. Not only are these bones very numerous, but some of them present such remarkable characters as to demand especial attention. In the first place, omitting the very young or immature bones, the long bones of the lower extremity exhibit great diversity in size, about one-half of the number being of a comparatively large type, and the others small, in which respect they correspond with many other bones above noticed. One of the most remarkable characters presented in the thigh bones is the enormous development of the *linea aspera*, which forms a sort of prominent ridge or keel of great height and thickness, and extending from one end of the bone to the other. In several of the bones this prominent keel is enormously developed, so as to give the bone an aspect altogether unlike the human. Five of the larger thigh bones are thus formed, and four of the smaller sized ones. But a still more remarkable character is presented in about one half of the tibiæ or leg-bones. These are so much compressed, though perfectly straight, as almost to have lost resemblance to the normal human tibia. To this peculiar conformation the term "platycnemic" might conveniently be applied. Mr. Busk remarked that bones of similar conformation had been met with in several places in France, in ancient tumuli and elsewhere, and that he had himself, in company with Dr. Falconer, noticed well-marked instances of it in some human bones in all probability belonging to the Reindeer period, and contained in the valuable collection of the Curé of Bruniquel. He had also noticed the same character in some bones from a limestone fissure at Mewslade in South Wales. The human and other remains found in the "Judges' Cave" were next described:—About twenty years ago, Sir James Cochrane, the present Chief Justice of Gibraltar, discovered in his own garden, under a considerable thickness of soil, the entrance into a vertical fissure, which, after descending to a depth of about forty feet, ended in a wide cavern, from which several narrow passages are said to have led in various directions. One of these passages, which opens into the cavern at a height of about six feet from its floor, was entered, and found to run to a length of about twenty feet, when it terminated in a second cavernous chamber. It was close to the termination of this passage in the second chamber that Sir James Cochrane came upon the remains which form the subject of this communication, and which were brought to this country by Captain Sayers. It would seem that since the cavern was partially explored by the learned judge, it had been but very rarely visited, and, so far as the author knew, never by any competent observer. The site in which the entrance to this cavern is placed is at a level about 200 feet lower than that of the Windmill High Flats. One of the most curious questions to be solved relative to this, the Judges' Cave, is as to the way by which human beings had gained access to its interior. The only external opening at present disclosed, like that of the Genista Cave, appears to be very narrow, and to have been covered from time immemorial with a considerable thickness of soil; and the internal passage above-mentioned is so constructed as with difficulty to allow of a man's creeping through it at full length The entrance, moreover, of this passage is so high above the floor of the first cavern, as to render a ladder necessary to reach it. How under these circumstances, or for what reason, the human beings whose remains were discovered by Sir James Cochrane made their way into the place where the bones lay, is at present shrouded in complete mystery. The principal human bones in the collection comprise a nearly perfect cranium, a lower jaw not belonging to it, tibiæ all more or less presenting the platycnemic character, one nearly entire, and portions of another; fibulæ of the same type, and belonging to different individuals; a nearly entire male *os innominatum;* some vertebræ, portion of a sacrum, &c. Most of these bones, but not all of them, were more or less covered with a hard, grey, calcareous concretion, containing numerous specimens of a *Helix* and one or two other land-shells, whilst others were merely coated with a uniform crystalline deposit of carbonate of lime of the same grey colour, however, as the indurated calcareous mud, of which the more massive matrix was formed. The cranium especially, and one of the tibiæ, were imbedded in a very thick and solid mass of this substance. The cranium is nearly perfect: the only important deficiency is the want of the lower jaw—that forwarded with it belonging, as has been said, to another individual. The cranium is of small size, and from its general aspect may be judged to be that of a female. It is symmetrical, brachycephalic, and orthognathic. The forehead is well arched, and the supra-orbital border very slightly elevated. The proportion of breadth to length is as 792 to 1000, and of height to length in the same proportion. The lower jaw which accompanied the skull is that of a much older individual, of larger size. Encrusted with a precisely similar matrix, and, when uncovered, presenting exactly the same colour and general appearance of surface, was a tibia of highly platycnemic conformation. Besides the human bones, the collection from the 'Judges' Cave' includes those of several species of Ruminants, some of which are apparently in much the same condition as the human bones, whilst others are evidently thoroughly fossilized, and belonging to a different epoch.

2. Geological Society, (Somerset House.)

December 21st, 1864.

The following communications were read:—1. "On the Coal-measures of New South Wales, with Spirifers, *Glossopteris,* and *Lepidodendron.*" By W. Keene, Esq. Communicated by the Assistant-Secretary.

1. The prevailing rock in New South Wales is a sandstone, which is called the "Sydney Sandstone" by the author, and is the most recent deposit in the colony. Its upper beds contain certain shales, called the "False Coal-measures" by Mr. Keene, and the "Wyanamatta Beds" by the Rev. W. B. Clarke, the position of which is 800 feet above the true Upper Coal-seam. On approaching the latter, *Vertebraria australis* and *Glossopteris* are met with; and these plants accompany the entire series of the Coal-measures, from the topmost to the lowest seam. The workable seams of coal were stated to be about eleven in number; and the author remarked that towards the two lowest seams, *Pachydomus, Bellerophon,* &c., were found; *Spirifer* abounds near the lowest seam, as well as *Fenestella* and *Orthoceras;* but the *Vertebraria* and *Glossopteris* occur throughout, while *Lepidodendron* has been found in coarse grits below the Coal-measures.

Mr. Keene then described a lower fossiliferous limestone unconformable to, and much older than, the Coal-measures; and gave a sketch of the geology of the Peak Downs Range, in Queensland. He concluded by referring to his large collection, sent to England some time ago, and now in the Bath Philosophical Institution, for further evidence of the age of the Coal-beds of New South Wales, which he believes to be as old as those of Europe.

2. "On the Drift of the East of England and its Divisions." By S. V. Wood, jun., Esq., F.G.S.

In this paper the author divides the Drift of the country extending from Flamborough Head to the Thames, and from the Sea on the East to Bedford and Watford on the West, as follows:—*a*, the Upper Drift, having a thickness of at least 160 feet still remaining in places. *b* and *c*, the Lower Drift, consisting of an Upper series *(b)*, having a thickness from 40 to 70 feet, and a Lower series *(c)*, with a thickness, on the coast near Cromer, of from 200 to 250 feet, but rapidly attenuating inland. *c* comprises the Boulder-till, and overlying contorted Drift of the Cromer coast, which along that line crop out from below *b* a few miles inland. *c* also, in an attenuated form, ranges inland as far south as Thetford, and probably to the centre of Suffolk, cropping out from below *b* by Dalling, Walsingham, and Weasenham, and appearing at the bottom of the valleys of central Norfolk. *b* consists of sands, which on the east coast overlie the Fluvio-marine and Red Crag, but change west and south into gravels, which pass under *a* and crop out again on the north, south, and centre of Norfolk, and west of Suffolk and Essex, extending (but capped in many places by *(a)* over most of Herts. The Upper Drift *(a)* consists of the widespread Boulder-clay, which overlaps *b*, for a small space, on the south-east in Essex, and again at Horseheath, near Saffron Walden, but overlaps it altogether on the north-west, resting on the secondary rocks in Huntingdonshire and Lincolnshire. The distribution of *b* indicates it as the deposit of an irregular bay, afterwards submerged by the sea of *a*, which overspread a very wide area. *a* now remains only in detached tracts, having been extensively denuded on its emergence at the beginning of the post-glacial age, so that wide intervals of denudation (separating the tracts) indicate the post-glacial straits and seas which washed islands formed of *a*. The author considers the so-called Norwich Crag of the Cromer coast as *not* of the age of the Fluvio-marine Crag of Norwich, but as an arctic bed forming the base of *c*, into which it passes up uninterruptedly. The author regards the beds *b* as identical with the fluvio-marine gravels of Kelsea, near

Hull, and the Kelsea bed not to be above *a*, as hitherto supposed, but below it, having been forced up through *a* into its present position. He also regards the Upper Drift (*a*) as the equivalent of the Belgian Loess, and the beds *b* as the equivalent of the Belgian *Sables de Campine.*

January 11*th*, 1865.

The following communications were read:—1. "On the Lias Outliers at Knowle and Wootton Wawen in South Warwickshire," &c. By the Rev. P. B. Brodie, M.A., F.G.S.

The author gave a description of the Liassic outliers at Knowle and Wootton in South Warwickshire. At Knowle, eleven miles S.E. of Birmingham, the Lower Lias is represented by limestone and shales containing *Ammonites planorbis*, Saurian remains, *Ostrea*, *Modiola*, &c.; below these beds with *Ammonites planorbis*, dark shales were seen resting on the New Red Marl; amongst the shales occurs a micaceous sandstone with *Pullastra arenicola*, which elsewhere prevails low down in the series, in close connexion with the bone-bed. The greater outlier at Wootton Park, near Henley, exhibited more clearly the succession of the deposits, from the beds with *Pecten Valoniensis* up to the limestone with *Lima gigantea*, &c.

2. "On the History of the last Geological Changes in Scotland." By T. F. Jamieson, Esq., F.G.S.

The history of the last geological changes in Scotland, as given in this paper, was divided into three periods, namely, the Pre-glacial, the Glacial, and the Post-glacial.

The absence of the later Tertiary strata from Scotland leaves the history of the Pre-glacial period very obscure; but the author considered it in some degree represented by some thick masses of sand and gravel (apparently equivalent to the Red Crag of England) on the coast of Aberdeenshire; and he stated that there were indications of the Mammoth having inhabited Scotland during this period.

The Glacial period was divided into three successive portions, namely, (1) the Period of Land-ice, during which the rocky surface was worn, scratched, and striated, and the boulder earth or glacier-mud was formed; (2) the Period of Depression, in which the glacier-marine beds were formed; and (3) the Period of the Emergence of the land to which belong the valley-gravels and moraines, and during which the final retreat of the glaciers took place.

To the Post-glacial period Mr. Jamieson referred that of the formation of the submarine forest-beds, which he considered was succeeded by a Second Period of Depression, and this again by the elevation of the land to its present position. It is in the old estuary beds and beaches formed during the Second Period of Depression that the author finds the first traces of Man in Scotland, while the Shell-mounds with chipped flints he referred to the same epoch as the blown sand and beds of peat, namely to the most recent period, during which the land was raised to its present level.

Mr. Jamieson described in great detail the deposits representing each of these periods, and concluded his paper with lists of shells from the different beds, showing the percentage of the species that are now found in the British, Southern, Arctic, N.E. American, and N. Pacific regions.

January 25th, 1865.

The following communications were read:—1. "Notes on the Climate of the Pleistocene epoch of New Zealand." By Julius Haast, Ph.D., F.G.S.—The main feature in this communication was a notice of the remains of *Dinornis* in the moraines of the extinct glaciers of New Zealand. In support of the author's opinion that the extinction of that bird was due to the agency of man at a somewhat recent date, it was observed that the present Alpine flora furnished a large quantity of nutritious food quite capable of sustaining the life even of so large a creature; and as the fruits of these plants were at present applied to no apparent purpose in the economy of nature, the author argued the former existence of an adequate amount of animal life to prevent an excessive development of vegetation. This part, he considered, was played by the *Dinornis*.

2. "On the Order of Succession in the Drift-beds in the Island of Arran." By James Bryce, M.A., LL.D., F.G.S.—In a paper read last year before the Royal Society of Edinburgh, the Rev. R. B. Watson described all these beds as Boulder-clay, and did not assign the Shells which he had discovered in them to any particular part of the deposit. Dr. Bryce dissented from this view, and in this paper pointed out the various causes of error likely to mislead an observer in examining such accumulations. He then described the various sections of the deposits, and showed that the lowest bed is a hard tough unstratified clay, full of striated, smoothed, and polished stones of all sizes, but totally devoid of fossils, and that it

is, in fact, the true old Boulder-clay of the geologists of the West of Scotland. The Shells are entirely confined to a bed of clay of open texture, containing a few small stones; it rests immediately on the Boulder-clay as above defined, and is succeeded by various drift-beds consisting of seams of clay and sand intermingled, containing stones that are rarely striated, and without Shells.

Dr. Bryce then discussed the probable origin of these drifts, and the amount of depression which the land had sustained before the Shell-bed was deposited over the Boulder-clay, which he considered to have been formed by land-ice emanating from central snow-fields, and covering the whole surface of the country.

3. "On the Occurrence of Beds in the West of Scotland in the position of the English Crag." By James Bryce, M.A., LL.D., F.G.S.—In consequence of the results arrived at from the investigation of the Drift-beds of Arran, Dr. Bryce determined to examine all the recorded cases of fossils occurring in the Boulder-clay, the Chapel Hall case having, however, been already undertaken by the Rev. H. W. Crosskey. The most celebrated case is that of the occurrence of Elephant-remains at Kilmaurs, near Kilmarnock, in Ayrshire; and the author showed, from a section of the quarry exposed for the purpose by Mr. Turner, of Dean Castle, which corresponded exactly with one already furnished to him by an aged quarryman, that the Elephant-remains, the Reindeer's horn, and the Shells, all occurred in beds below the Boulder-clay, and not *in* that deposit, as has always been stated. The same conclusion was arrived at respecting the occurrence of Elephant-remains at Airdrie and Bishopbriggs, and of Reindeer's horn with Shells at Croftamie; and the author concluded by discussing the question whether the fossils belong to the Upper Crag period, or merely indicate a downward extension of the Arctic fauna which characterizes the beds directly above the Boulder-clay, as described in the last paper.

4. "On the *Tellina proxima* bed at Chapel Hall, near Airdrie." By the Rev. H. W. Crosskey. Communicated by Dr. Bryce, F.G.S. —One of the most perplexing cases in Scotland, upon any theory of the formation of Boulder-clay, has been the alleged occurrence at Chapel Hall of a clay-bed containing *Tellina proxima* intercalated between two masses of true Boulder-clay. The Shells were first found by Mr. James Russell in sinking a well; and the case was made known by Mr. Smith, of Jordan Hill, in a paper laid before the Geological Society in 1850. At the author's request Mr. Russell

had sunk another well seven yards from the former, from an examination of which Mr. Crosskey satisfied himself that the bed above that containing the Shells is not the true Boulder-clay, but an upper Drift, and that the Shells occurred in a hollow of the lower clay, or true Till, filled up with a clay-deposit of an age intermediate between that of the other two. He therefore considers that this can no longer be regarded as one of the fossils occurring in the true Boulder-clay.

February 8*th*, 1865.

The following communications were read:—1. "On the Sources of the Mammalian fossils of the Red Crag, and on the Discovery of a new Mammal in that Deposit allied to the Walrus." By E. Ray Lankester, Esq. Communicated by Professor T. H. Huxley, F.R.S., F.G.S.

The Mammalian fossils of the Red Crag were stated to belong to three groups:—(1) the teeth of *Coryphodon*, &c., derived from Lower Eocene strata; (2) the other terrestrial Mammalia; and (3) the Cetaceans. The *Molluscan* fauna of the Red Crag was cited in proof of its identity in age with the Upper or Yellow Crag of Antwerp, which contained none of the Red Crag Mammals. The underlying Middle and Black Sands of Antwerp contain far larger percentages of extinct forms and very abundant Cetacean remains. The deposits at Darmstadt and in the South of France, containing terrestrial Mammalia similar to those of the Red Crag, are also anterior to the Yellow Crag of Antwerp. The Red Crag was thus shown to include Mammalian fossils found nowhere else excepting in strata of an earlier age. The probabilities therefore were, that these various Mammalia were not indigenous to the Red Crag, but were derived from the breaking up of earlier strata; and this supposition was supported by lithological evidence, which the author gave in detail, and discussed the chemical and the mineralogical questions involved. Further evidence of the extraneous nature of the Mammalian fossils was also adduced, in the fact that teeth of *Rhinoceros* and *Mastodon* occurred at the base of the Coralline Crag, and other less conclusive facts were cited. The great abundance and perfect condition of teeth of *Carcharodon* and Ziphioid Cetaceans in the Middle Crag of Antwerp, their absence in the Yellow Crag of that locality, and their presence in a much rolled, indurated and fragmentary condition in the Red Crag, often with portions of their previous sandy matrix adhering, was considered as conclusive evidence with regard to the Cetacean remains.

Mr. Lankester then described the tusks of an animal allied to the Walrus, but probably much larger, which he proposed to call *Trichecodon Huxleyi.* The minute details of form and structure were entered into, and the author stated that the teeth called *Balœnodon* by Professor Owen belonged really to two genera, *Ziphius* and *Squalodon*, as shown by the remains from the Middle Antwerp beds.

2. "Note on the Geology of Harrogate." By Professor John Phillips, M.A., F.R.S., F.G.S.

The cuttings on the North-eastern Railway, combined with sections exposed in several quarries, have enabled the author to trace the range of the Millstone-grit, Calcareous roadstone, and Yoredale Shales near Harrogate; and have also thrown some light on the relation of the Permian to the more ancient rocks. Professor Phillips was also enabled to refer the mineral springs, with greater confidence than heretofore, to a deep source along an axis of movement; and to suggest that the Harrogate roadstone probably corresponds to the Main, or twelve fathom, limestone at the top of the Yoredale series. These results, the arguments and facts in support of them, and the inferences obtainable from their consideration, were given by the author in this paper, which was illustrated by a horizontal section from Wharfe, on the S.E., through Harrogate, to Nid on the N.W.

ANNUAL GENERAL MEETING.

February 17th.

The Secretary read the Reports of the Council, of the Museum and Library Committee, and of the Auditors. The remarkable increase in the numbers of the Society and the condition of the Society's finances were stated to be very satisfactory.

The President announced the award of the Wollaston Gold Medal to Thomas Davidson, Esq., F.R.S., &c., for the highly important services he has rendered through many years to the Science of Geology by his critical and philosophical works on Fossil Brachiopoda; and, in handing the Medal to that distinguished Palæontologist, he commented on the valuable contributions to science furnished by him to the volumes of the Palæontographical Society, remarking that their value was much enhanced in consequence of the illustrations having been drawn by the author himself. Mr. Davidson, on receiving the Medal, requested the President to convey his sincere thanks to the Council for the great honour they had done him by this Award, which was the more welcome as it came to him from the hands of one who is at the same time the President of both the Geological and the Palæontographical Societies. The President then stated that the Balance of the Proceeds of the Wollaston Donation-fund had been awarded to J. W. Salter, Esq., in recognition of his valuable services in the elucidation of Palæozoic fossils, and to assist him in completing his Monograph on British Trilobites, and placed it, together with a diploma to that effect, in the hands of the eminent recipient. Mr. Salter briefly thanked the Society for this testimony of their approbation.

The President then proceeded to read his Anniversary Address, in which he discussed the progress of Geology during the past year, prefacing it with biographical notices of lately deceased Fellows of the Society, namely, Leonard Horner, Esq., Major-General Portlock, the Venerable Archdeacon Burney, Lord Ashburton, the Duke of Newcastle, Prof. B. Silliman, Prof. Hitchcock, the Earl of Ilchester, and Dr. Hugh Falconer; he also gave a sketch of the chief labours of the late Andrew Geddes Bain, Esq.

The Ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—*President:* William J. Hamilton, Esq., F.R.S. *Vice-Presidents:* Edward Meryon, M.D.; J. Carrick Moore, Esq., F.R.S.; Sir R. I. Murchison, K.C.B., F.R.S.; Prof. A. C. Ramsay, F.R.S. *Secretaries:* P. Martin Duncan, M.B.; Warington W. Smyth, Esq., M.A., F.R.S. *Foreign Secretary:* R. A. C. Godwin-Austen, Esq., F.R.S. *Treasurer:* Joseph Prestwich, Esq., F.R.S.

February 22nd, 1865.

The following communications were read:—1. "On the Lower Silurian Rocks of the South-East of Cumberland, and the North-East of Westmoreland."—By Professor R. Harkness, F.R.S., F.G.S. The district described in this paper consists of a narrow band of country on the western side of the Pennine Chain; it possesses external features which indicate a geological structure different from that of the Pennine escarpment, and from that of the adjacent country on the west, from which it is separated by the Pennine fault. Prof. Harkness described the Lower Silurian rocks occupying this narrow tract in some detail, and showed them to consist of Skiddaw Slates, with interstratified greenstone porphyry and ash, and a band of fossiliferous shale. He also gave, in illustration of the structure of the country, a section from Melmerley Scar to Romanfell, and one from Milburn to Dunfell, together with a geological sketch-map of the narrow lower Silurian tract in question. In conclusion the author described a fault which brings the Skiddaw Slates against the Coniston Limestone, and another, which cuts through the Lower Silurian rocks of the district, having a course at right angles to the former, and nearly parallel to that of the Great Pennine fault.

2. "Note on the Volcanic Tufa of Latacunga, at the foot of Cotopaxi; and on the Cangáua, or Volcanic Mud, of the Quitenian Andes." By R. Spruce, Esq. Communicated by Sir R. I. Murchison, K.C.B., F.R.S.—The Volcanic Tufa described in this paper is not only used for building purposes, but also by the smiths instead of charcoal, as when heated to redness it emits considerable heat, but very little flame. The author then described the large deposits of Volcanic Mud, called Cangáua, which are met with throughout the central valley of the Quitenian Andes. This mud is compact, slightly argillaceous, and more or less saline, and occurs in rock-like masses, yielding very slowly to atmospheric agency, or even to running water.

3. "On the discovery of Flint Implements in the Drift at Milford Hill, Salisbury." By Dr. H. P. Blackmore. Communicated by John Evans, Esq., F.R.S., F.G.S.—Since the discovery of Flint Implements in the Higher-level gravel at Fisherton on the west of Salisbury, a large number of very excellent weapons have been obtained from the Drift-gravel of Milford Hill. This deposit is of the same age as the Fisherton beds; but it is situated on the opposite side of the Avon, immediately to the east of Salisbury.

Dr. Blackmore described the materials composing the gravel of Milford Hill, and discussed the nature and power of the forces which had brought them together. He then described the position, thickness, and physical relations of the deposit, stating that the gravel is from 10 to 12 feet thick on the top of the hill, becoming thinner and gradually dying away on the sides. The hill itself is quite isolated, being separated from the surrounding higher land by river-valleys; its highest point is about 100 feet above the present level of the rivers.

In making a cutting on the south-eastern side of the hill, a bed of sand containing four species of land-shells was discovered near the base of the gravel. No other fossils have been found in the deposit, with the exception of a single tooth of a species of *Equus*. Dr. Blackmore concluded by describing the implements themselves, which nearly all belong to the long-pointed type, thus confirming the opinion of Mr. Evans, that this form is mainly characteristic of the Higher-level gravels.

3. Linnean Society, (Burlington House).

January 19th, 1865.

The following papers were read:—1. "Extract of a letter from Mr. W. H. Brewer, State Geologist to the survey of California, on the Forests of *Sequoia* (*Wellingtonia*) *gigantea*," addressed to Sir W. J. Hooker.—2. "On a new Banana from Tropical Africa," by Dr. Kirk. This plant, which was evidently closely related to *Musa Ensete*, was proposed to be called *Musa Livingstoniana*.—3. "On the Anatomy of *Doridopsis*, a genus of Nudibranchiate Mollusca," by Albany Hancock, Esq.

February 2nd, 1865.

The following papers were read:—1. "On the Movements and Habits of Climbing Plants," by C. Darwin, Esq. The author divided climbing plants into three groups, namely twining plants, leaf-climbers, and tendril-bearers, and detailed at great length his observations under each division. In his concluding remarks he observed that it might be presumed that plants become climbers in order to reach the light and to expose a larger surface of leaves to its action, and to that of the free air. This was effected by climbing plants with wonderfully little expenditure of organised matter in comparison with trees, which have to support a load of heavy branches by a massive trunk. Those plants which have a twining habit are furnished with revolving internodes. In the next group the possession by a plant of leaves with their petioles or tips sensitive, and with the consequent power of clasping any object, would be of very little use unless associated with revolving internodes, by which the leaves could be brought into contact with surrounding objects, though on the other hand revolving internodes without other aid suffice to give the power of climbing. Unless, therefore, we suppose that leaf-climbers simultaneously acquire both capacities, it seems probable that they were at first revolvers and could thus climb, and that subsequently they became capable of grasping a support. From analogous reasons it is probable that tendril-bearing plants were primordially twiners, that is, that they are descendants of plants having this power and habit; for in the majority the internodes revolve like those of twining plants, and in a very few the flexible stem retains the capacity of spirally twisting around an upright stick. With some tendril-bearing plants the internodes have lost the revolving power, which has passed into the tendrils. These tendril-bearers have undergone much more modification than leaf-climbers: hence it is not surprising that their supposed primordial revolving and twining habits have been lost or modified more frequently than in leaf-climbers. The three great tendril-bearing families in which this loss has occurred in the most marked manner are the Cucurbitaceæ, Passifloracæ, and Vitaceæ. There is abundant evidence in the whole group of leaf-climbers that an organ still subserving its proper function as a leaf, may become sensitive to a touch, and thus grasp an adjoining object. Thus true leaves may acquire all the leading and characteristic qualities of tendrils, namely sensitiveness, spontaneous movement, and subsequently thickening and induration. If their blades or laminæ were to abort they would form true tendrils; and of this process of abortion every stage may be met with. According to these views, leaf-climbers were primordially twiners, and tendril-bearers (of the modified leaf division) were primordially leaf-climbers. Hence the latter stand between twiners and tendril-bearers, and ought to be related to both. This proves to be the case, for the several leaf-climbing species of the Antirrhineæ, of *Solanum*, of *Cocculus*, and of *Gloriosa* are related to other genera in the same family, or even to other species in the same genus, which are true twiners. On the other hand the leaf-climbing species of *Clematis* are very closely allied to the tendril-bearing *Naraveliæ*, and the Fumariaceæ include closely allied genera which are leaf-climbers and tendril-bearers. Lastly, one species of *Bignonia* is both a leaf-climber and a tendril-bearer, and closely allied species are twiners. Tendrils consisting of modified flower peduncles likewise afford many transitional states. The common Vine gives every possible grade, from grandly developed tendrils to a bunch of flower-buds bearing the single usual lateral flower-tendril. Some tendrils are thus foliar and some axial in their nature, and it might have been expected that they would present some differences of function, but this is not the case; on the contrary, they present the most perfect identity in their several characteristics. The most interesting point in the natural history of climbing plants is their diverse powers of movement. The most different organs—stem, flower-peduncle, petiole, midribs of the leaf or leaflets, and apparently aërial roots, all possess these powers. Climbing plants, continued the author, are so numerous as to form a conspicuous section of the vegetable kingdom. They belong to many and widely-different orders. To gain some crude idea of their distribution in the vegetable series, I marked all the families in Lindley's "Vegetable Kingdom," which include plants in any of the sub-divisions of twiners, leaf-climbers, and tendril-bearers; and those (some at least in each group) all proved to have the power of spontaneously revolving. Lindley divides phanerogamic plants into 59 alliances, and of these 36 (above half) include climbing plants—hook and root-climbers being excluded. To these a few Cryptogamic plants must be added which climb by revolving. When we reflect on the wide serial distribution of plants having this power, and when we know that in some of the largest well-defined orders, such as the Compositæ, Rubiaceæ, Scrophulariaceæ, Liliaceæ, &c., two or three genera alone out of the host of genera in each, have this power, the conclusion is forced on us that the capacity of acquiring the revolving power on which most climbers depend, is inherent, though undeveloped, in almost every plant in the vegetable kingdom. The author thus concluded his remarks:—The perfection of the organisation of plants is forced on our minds by the study of the many kinds that climb. Let us look at one of the more highly organised tendril-bearing climbers. It first places its tendrils ready for action as a polype places its tentacula. If the tendril be displaced, it is acted on by the force of gravity and rights itself. It is acted on by the light, and bends towards or from it, or disregards it, whichever may be most advantageous. During several days the tendril or internodes, or both, spontaneously involve with a steady motion. The tendril strikes some object, and quickly curls round and firmly grasps it. In the course of some hours it contracts itself into a spire, dragging up the stem, and forming an excellent spring. All movements now cease. By growth the tissues soon become wonderfully strong and durable. The tendril has now done its work, and done it in an admirable manner.

2. "Note on the genera *Darwinia* and *Bartlingia*," by the President. In this paper, Mr. Bentham showed that the original genus *Darwinia* of Rudge ought to include the later ones, *Genetyllis* of De Candolle, *Hedaroma* of Lindley, *Polyzone* of Endlicher, and *Schuermannia* of F. Mueller. Owing to Rudge having overlooked the minute calyx lobes, and misunderstood some other points of the structure of his *Darwinia*, it was generally referred to Monochlamydeæ, and hence was overlooked by De Candolle when working up Myrtaceæ. The latter overlooked the staminodia, distinguishing his *Genetyllis* from *Chamælaucium* expressly by their absence, and hence Lindley established *Hedaroma*, giving to it characters which are really common to De Candolle's and to Rudge's species, although omitted in their descriptions. Of *Darwinia* thus extended, Mr. Bentham noticed twenty-three species, which he distributed under the sub-genera *Hedaroma* with eleven species, *Genetyllis* with six species, and *Schuermannia* with six species. *Barlingia* founded on specimens of Sieber's, and inexplicably retained in Myrtaceæ by Schauer, Mr. Bentham finds to be none other than *Pulteneya obovata*, with the buds in the young stage when the sepals and petals have not grown into the irregular form characteristic of Papilionaceæ.

February 16th, 1865.

The following were read:—1. "Notes on *Pueraria*, DC." By George Bentham, P.L.S.—The author states that the supposed articulation in the pod of *Pueraria* is only a contraction between the seeds where an ovule has failed, which appears to be frequently the case,—and that his genus *Neuctanthus*, which was established for *Dolichos phaseoloides*, Roxb. and some allied species, must now be merged in *Pueraria*. A short synopsis is given of the characters of the ten species which the author places in the genus *Pueraria*.

2. "Notice of some Vegetable Monstrosities." By George Dickie, A.M., M.D., F.L.S., Professor of Botany in the University of Aberdeen.—The monstrosities observed were 1. *Cheiranthus cheiri*, in which the six stamens were entirely changed into a compound ovary, each piece entirely adherent and concealing the ordinary seed vessel. In advanced stages this body gave way at the apex, opening on two sides between the parts representing the long stamens, thus allowing the true ovary to protrude. 2. *Plantago major*. In this case the entire plant is far more luxuriant than usual: most of the bracts are large; in some the length

is about four inches, in them the spike is usually very much shortened and most of the flowers abortive, but in others the spike has the usual form, and many of the flowers produce apparently perfect seeds. From the axil of some of these enlarged tracts there grows a peduncle supporting a spike which is nearer the natural structure as to length, size of bracts, and development of flowers. 3. *Trifolium hybridum.* This plant sometimes shows complete transformation of its ovary into a leaf resembling in miniature the ordinary leaves of the plant. Sometimes the change is incomplete, the leaf remaining conduplicate with edges partially adherent near the apex, with a gradual prolongation resembling styles and stigma.

4. "Descriptions of some new and remarkable species of *Aristolochia* from Western Tropical Africa." By J. D. Hooker, M.D., F.R.S., V.P.L.S., &c.—This paper contains descriptions of three new species of *Aristolochia*, called by the author *A. Goldiana*, *A. triactina* and *A. Mannii.* The first of these is remarkable from the number of its stamens which amounts to about 24, and the number of styles which is about 12, each being bifid.

5. "The Diatomaceæ of Otago, New Zealand," by W. Lauder Lindsay, M.D., F.R.S., Edin., &c.—This is a short list of Otago Diatoms, containing 110 species, 30 genera, and 12 families. It includes only three new species, called respectively *Cymbella Lindsayana*, Grev., *Stauroneis scapuliformis*, Grev., and *S. rotundata*, Grev. The collection was made in 1861 in the Green-island district of Otago, round the station of Fairfield, Saddlehill. It is confined to freshwater forms.

6. "Note of Observations and Experiments on Germination," by G. Dickie, M.D., F.L.S.—Dr. Dickie's attention having been drawn to Dr. Hooker's observations on the singular phenomena of the apparent persistence of the cotyledons in *Welwitschia*, and to Mr. Crocker's no less curious observations on the mode of germination in some species of *Streptocarpus*, he was induced to experiment upon germinating seeds, with the view of testing the nature of the primary axis, and the physiological value of the cotyledonary leaves, as organs of nutrition, &c. His results are very curious. In one species of *Streptocarpus* he found that the cotyledons, which were at first opposite and equal, became alternate, the lower decaying, and the upper being persistent,—he attributes this to the development of an internode between the two cotyledons. This leads him to the consideration of the descending axis, which has been regarded as

the first internode of the plant. Experiments made with Castor oil seeds and those of a species of *Ipomæa*, showed that by removing the plumule after the expansion of the cotyledonary leaves, and pinching off all succeeding buds as they formed, a considerable accession of growth in all dimensions was induced in the cotyledonary leaves, and the descending axis became proportionately increased in length and diameter. In the case of the *Ipomæa* the axis increased as much as that of another specimen in which the ascending axis was allowed to grow on till the flower-buds were formed.

4.—Zoological Society, (11, Hanover Square.)

January 10th, 1865.

The Secretary called the attention of the meeting to the fine male example of the Mantchurian Deer (*Cervus mantchuricus*) in the Society's Gardens, which had been received from Mr. Swinhoe, and read an extract from a letter from Mr. Swinhoe, giving further details respecting this animal.—Dr. Crisp made some observations on the anatomy of the Water Ousel (*Cinclus aquaticus*), with reference to its mode of feeding, and to its power of remaining under water. Dr. Crisp also called attention to and exhibited specimens of the os penis of the Chimpanzee (*Troglodytes niger*), and of the Orang (*Simia satyrus*), remarking that the existence of this bone in these two species had not been before observed.—Mr. Francis Day read the first part of a Memoir on the Fishes of Cochin, on the Malabar coast of India. The present communication, which was devoted to the *Ancanthoptergii*, enumerated upwards of 120 species of this order as having been collected or observed by the author in Cochin, amongst which were several considered to be new to science. Mr. Day's notes embraced many particulars as to the times of the year at which the various species were met with on the coast of Cochin, and as to the uses to which they were put by the natives.—Mr. St. George Mivart read some Notes of the myology of the Green Monkey (*Cercopithecus sabæus*), in which the conditions presented by some of those muscles which show such interesting variations in the Order Primates, were recorded.—Dr. Gray gave a notice of an apparently new form of whalebone Whale, proposed to be called *Eschrichtius robustus*, founded on a specimen stranded on the coast of Devonshire, in 1861, portions of the skeleton of which had been obtained for the British Museum by Mr. Pengelly.—Dr. Gray communicated a Revision of the family *Mustelidæ*, founded on the specimens contained in the collection of the British Museum. This group of carnivorous animals, according to Dr. Gray's arrangement, contained forty-seven species, divisible into twenty-three genera, ten of which were stated to be peculiar to the New World.—Mr. G. French Angas read descriptions of ten new species of Mollusks, chiefly from the Australian seas.—A paper was read by Messrs. H. Adams and G. F. Angas, entitled "Descriptions of Two New Species of Shells in the Collection of Mr. G. French Angas."—Two Communications were read from Mr. W. Harper Pease, Corr. Mem. The first of these consisted of a note "On the Synonymy of *Sistrum cancellatum*." The second contained descriptions of a new species of Mollusk of the genus *Latirus*, together with remarks on other species of the same genus inhabiting the Pacific Islands.—Mr. Alfred Newton communicated descriptions of two new species of birds from the Island of Rodriguez, which he proposed to call *Foudia flavicans* and *Drymœca rodericana*. These birds had been discovered by Mr. Edward Newton, during a recent visit to Rodriguez, and were stated to be the only two indigenous land birds existing in the island.—Dr. Baird communicated the description of a new species of Entozoon of the genus *Bothridium*, of De Blainville, from the intestines of the Diamond Snake of Australia.

January 24th, 1865.

The Secretary read some extracts from a letter addressed to him by Dr. G. Bennett, of Sydney, N.S.W., relating to a specimen of the Lyre-Bird (*Menura novæ hollandiæ*), now living in Sydney, in the aviaries of the Acclimatation Society of that city, and intended to be transmitted to this country for the Zoological Society by the first opportunity.—Mr. Sclater exhibited a specimen of the continental Water Pipit (*Anthus spinoletta*), from the collection of the Bishop of Oxford, stated to have been obtained near Brighton, in the winter of 1859-60.—Dr. J. Murie read a memoir on the anatomy of a species of Whale (*Physalus antiquorum*), captured at Gravesend, the skeleton of which was now exhibited in Rosherville Gardens.—A communication was read from Dr. G. Hartlaub, For. Memb., entitled "Descriptions of seven new species of Birds collected in Benguela by Mr. J. J. Monteiro." This was followed by a communication from Mr. J. J. Monteiro himself, containing notes on these and other specimens of birds which he had obtained in the littoral region of Benguela, in the years 1862-1863.—Mr. Sclater communicated a series of notes by the late Mr. W. Osburn on the *Chiroptera* of Jamaica, giving the observations made by that gentleman on twelve species of this order of Mammals met with during his residence in that island. Mr. Sclater also exhibited the original specimen of *Galago monteiri* described by Mr. Bartlett in 1862 from the living animal, and stated that he considered it to be scarcely more than a pale variety of *Galago crassicaudata*.—Mr. O. A. L. Mörch, of Copenhagen, communicated some supplementary notes to his review of the family *Vermetidæ* which had been published in the Society's Proceedings for 1861 and 1862.—The Secretary called attention to the specimen of the Pronghorned Antelope of America (*Antilocapra americana*) just added to the Society's collection, being the first instance of this animal having reached Europe alive.—Two papers were read by Mr. G. French Angas, Corr. Memb. The first of these was entitled "Descriptions of four new species of Marine Shells from South Australia." Mr. Angas' second paper was a general article on the Marine Molluscan Fauna of South Australia, in which a list of all the species at present known to inhabit the coast of that country was given, together with remarks on their localities and distribution.

February 14th, 1865.

A letter was read from Dr. H. Burmeister, of Buenos Ayres, For. Memb., describing a new species of Whale, proposed to be called *Balænoptera patachonica*, founded on a skeleton in the museum of Buenos Ayres, and giving particulars as to specimens of certain other Cetacea in the same museum. — Dr. A. Günther gave an account of the present state of his researches into the British species of Salmonoid fishes, which he had undertaken whilst engaged in preparing the catalogue of the specimens of this family in the collection of the British Museum. Dr. Günther stated that the genus *Salmo* was essentially an arctic group, inhabiting the northern portions of both hemispheres, and becoming more abundant in species upon receding from sub-tropical into temperate latitudes. Dr. Günther was disposed to believe that the species of this genus to be found within British waters would be ultimately found to be much more numerous than had been hitherto suspected. From the materials at present at his command, he had already been able to distinguish what he believed would turn out to be four new species of the non-migratory group of true *Salmo*, besides identifying several others heretofore imperfectly distinguished. Dr. Günther requested the assistance of the Fellows of the Society and their friends in furnishing him with series of specimens of our native salmons and trouts from every part of the British Islands, stating that in this difficult group of fishes no certain conclusions could be arrived at without a large number of specimens for comparison.—Mr. A. Newton exhibited a specimen of the Carolina Crake (*Porzana Carolina*), stated to have been recently obtained on the Kennett, near Newbury, being the first recorded instance of the occurrence of this bird in this country. Mr. Newton also exhibited and made some remarks upon three bones of a large species of Dodo (*Didus*), recently disinterred by his brother, Mr. E. Newton (Corr. Mem.), from a cave in the island of Rodriguez.—Dr. Gray gave a notice of the skull of a new species of Bush-Goat, proposed to be called *Cephalophus longiceps*, which had been sent to the British Museum by Mr. Du Chaillu.—Dr. P. P. Carpenter communicated the diagnoses of some new forms of mollusks from the Vancouver district of Western America.—A letter was read addressed to the Secretary by Professor J. J. Bianconi, of Bologna, relating to the systematic position of the extinct bird of Madagascar, *Æpyornis maxima*, which he was of opinion should be referred to the *Vulturidæ*.—Mr. Gould exhibited and pointed out the characters of two new species of Australian Birds (*Artamus melanops* and *Malurus leuconotus*), discovered during the recent expeditions into the interior of that country.—Mr. Fraser read a list of a collection of shells recently made by Mr. R. Swinhoe, F.Z.S., in Formosa, and forwarded by that gentleman to Mr. Cuming's collection.

February 28th, 1865.

Mr. F. Day read the second part of a Memoir on the Fishes of Cochin on the Malabar coast of India. In this and a former communication on the same subject Mr. Day had enumerated, as obtained by himself in this locality, 210 species of fishes, about one-tenth of which he considered to have been previously unknown to science.—A communication was read from Dr. H. Burmeister, For. Memb., describing a new species of Porpoise in the Museum of Buenos Ayres, proposed to be called *Phocæna spinipinnis*. The specimen upon which Dr. Burmeister established this species had been taken alive in the mouth of the Rio de la Plata some years ago.—A communication was read from Dr. J. Kirk, giving a list of the Land and Fresh Water Shells of the Zambezi and Lake Nyassa regions, which he had met with during his recent expedition into those countries in company with Dr. Livingstone.—A second communication from Dr. Kirk contained a reply to some remarks of Dr. Peters, published in a recent number of the Society's Proceedings, concerning the native name of an African Lizard (*Gerrhosaurus robustus*).—Mr. W. K. Parker read some observations on the osteology of the remarkable Parrot, *Microglossa alecto*, as observed in a specimen of this species that had recently died in the Society's Gardens.—Mr. St. George Mivart and Dr. Murie communicated a joint Paper on the Anatomy of *Nycticebus tardigradus*, in which various peculiarities presented chiefly by the muscles of this Lemur, unnoticed by former authors, were pointed out and described.—Mr. Fraser exhibited some eggs of the Rose Crested Cockatoo (*Cacatua rosacea*), laid in confinement.—Mr. Sclater exhibited and made some remarks upon a rare species of Ground Pigeon (*Phlogœnas bartletti*), which had recently died in the Society's Menagerie.

XXV.—Miscellanea.

1. Eozoon canadense in this country.

Professor Rupert Jones writes to us as follows:—

"You will like to know perhaps that the oldest animal yet known lately found in the lowest and oldest rocks of Canada is abundant in the British Isles also, namely *Eozoon canadense*. Mr. W. A. Sanford has hunted it up in the Green Connemara marble, and I find it there in masses indicated by him. The best way of getting a sight of the structure due to the presence of Foraminifera is to dissolve small flakes of the 'Irish Green' (as the stone-masons' men called the Galway and Connemara marble) in very weak dilute acid, and then the shelly part being removed the green silicates remain representing the sarcode that filled the chambers, pseudopodian tubules and stolon passages. Of course some parts of the marble retain the organic structure better than the rest."

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2. New Species of Felis.

Professor Cornalia of Milan has lately described before the Royal Lombardian Institute a new small species of *Felis*, discovered by Professor Mantegazza in the high-lands of Bolivia, at an elevation of 1500 metres above the sea-level, with the following characters:—

F. villosa, cinerea, subtus et intus allida: maculis brunneis pallidis plenis rotundatis aut ovato-elongatis, seriatim dispositis, per latera corporis descendentibus; maculis ventralibus rubiginosis aut læte fulvis; artubus externè nigro-fasciatis, internè nigro maculatis: cauda elongata, occiput attingente, annulis latis perfectis 9 brunneis: long. tota corp. o. 60, caudæ. 45 metr.

Hab. in Bolivia, circa Potosi et Huanahuaca.

For this species (which is allied to *Felis brasiliensis*, *F. maracapa*, *F. elegans*, *F. mitis*), Prof. Cornalia proposes the name *Felis* (*Leopardus*) *jacobita*. It enters the burrows of the Viscacha (*Lagostomus viscaccha*) and preys upon them.—Rend. R. Ist. Lomb. i. p. 241.

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3. The White Whale.

Professor Jeffries Wyman, the well-known anatomist of Harvard College, Cambridge, U.S.A., has contributed to the seventh volume of the "Boston Journal of Natural History," an accurate description of a male White Whale (*Beluga leucas*) which died in Mr. Barnum's Museum, after having been exhibited to the public alive in a water-tank for nearly two years. Prof. Wyman remarks:—

"The descriptions of this species by different naturalists are quite defective, and render the identification of it quite difficult. By Lacépède and Cuvier, and also by Hamilton, (Naturalist's Library," Vol. xxvi. Whales, p. 204), it is described as being without a dorsal fin, an error which doubtless grew out of the small size of this organ. The last-mentioned author states also that the "blow-hole" has its concavity backwards, instead of forwards, as in our specimen. According to Lacépède and Cuvier, the number of teeth is $\frac{9}{9}\,\frac{9}{9} = 36$; according to Dr. Neil, $\frac{9}{6}\,\frac{9}{6} = 30$; Crantz, $\frac{8}{6}\,\frac{9}{6} = 29$; Anderson, $\frac{0}{8}\,\frac{0}{8} = 16$; as our specimen has $\frac{10}{8}\,\frac{11}{8} = 37$, and as there are indications, as already stated, that two on each side have been dropped below, and one on the right side above, the full number is doubtless 42. These differences in the enumeration of the teeth depend, as has been stated by Cuvier, on the age of the animals,—the shedding of them beginning quite early, and eventually, as stated by Anderson, the upper ones are all lost; so that this last-mentioned observer is disposed to place the "white whale" among the cachalots or sperm-whales.

"I am informed by Mr. T. A. Cutting, the proprietor of the Aquarial Gardens, and who is a very careful and trustworthy observer, that this animal, during his confinement, showed some capacity for education. He was sufficiently well-trained to allow himself to be harnessed to a car, in which he drew a young lady round the tank; he learned to recognize his keeper, would allow himself to be handled by him, and at the proper time would come and put his head out of the water to receive the harness or take food."

"At times, he showed a playful disposition, and amused himself sometimes with splashing about in the water, and at others with tossing stones with his mouth. He often took in his mouth a sturgeon and a small shark which were confined in the same tank, and, after playing with them for a while, allowed them to go unharmed."

"Mr. Cutting states that the white whale was less docile than the *Delphinus tursio*, who was for a time a companion with him in the tank."

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4. Dr. W. Peters on Cholœpus Hoffmanni.

On the 8th Dec. last, Dr. W. Peters, of Berlin, made an interesting communication to the Royal Academy of Sciences of that city, respecting the osteology of the Costa-Rican Sloth, which he had described some time before as *Choloepus Hoffmanni.** Dr. Peters remarked that deviations from the normal number of seven

* See Monatsb. Berl. Akad. 1858. p. 128.

cervical vertebræ in Mammalia, were, as is well-known, very few in number. The only two exceptions known to Dr. Peters, were that of the genus *Bradypus*, amongst the species of which, the cervical vertebræ are either one or two more, and that of the Walrus (*Trichechus*), in which the cervical vertebræ are, usually, one less than the ordinary number.* To these according to Dr. Peters' investigations we must now add the Two-toed Sloth of Costa Rica, which has only six cervical vertebræ, and is thereby, as well as by other characters, well distinguished from its southern representative *Ch. didactylus*, of Northern Brazil and Guiana, in which the usual number of seven cervical vertebræ is found. Dr. Peters had received five skeletons of this Sloth, in all of which the number of cervical vertebræ was six. In four of the specimens these vertebræ were all separate; in the fifth specimen the second and third had become united as is sometimes the case in *Ch. didactylus*, and in this example, moreover, the sixth cervical had coalesced with the first dorsal vertebra.

We believe that the British Museum has lately acquired one of these skeletons by exchange from the Royal Zoological Museum of Berlin.

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5. Macrauchenia Patachonica.

Letters from Prof. Burmeister, Director of the Museum of Buenos Ayres, state that that distinguished Naturalist is now principally engaged in investigations into the fossil Fauna of the Argentine Republic. Prof. Burmeister states that he has already made a magnificent collection of specimens formed by different collectors in several localities, and will shortly publish the first number of a new Journal to be called the "Annals" of the Museum of Buenos Ayres, wherein the perfect skeleton of *Macrauchenia Patachonica* (established by Professor Owen on some vertebræ and other fragmentary portions of a skeleton discovered by Mr. Darwin during the voyage of the Beagle) will be described.

Dr. Burmeister's description of this skeleton will be looked forward to with greater interest, as it will, no doubt, settle the question as to the correct classification of *Macrauchenia*, which its first de-

* A third exception not noticed by Dr. Peters is that of the African Manatee (*Manatus senegalensis*), in which, as recorded in the last number of this Journal (N. H. R. 1865, p. 18), there are certainly only six cervical vertebræ.—Ed.

scriber considered to be allied to the Camelidæ, while M. Gervais (Zool. of Castelnau's Expedition, Anatomie, p. 36) makes it a distinct type of Perissodactyles, near *Rhinoceros* and *Tapirus*.

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6. Proceedings of Collectors in Foreign Countries.

Mr. Edward Bartlett, who accompanied Mr. Tristram's expedition into Palestine last winter, has recently left this country for Para, Brazil. From Para Mr. Bartlett will take the steamers up to the highest point to which steam-navigation is at present carried upon the Peruvian branches of the river, and will thus commence his work at a point beyond that where Mr. Bates' labours ceased. Judging from the amount of work executed during the Palestine expedition, there can be no doubt that Mr. Bartlett will turn out an enterprizing and successful collector. His agent in this country is Mr. Stevens, of 20, Bloomsbury Street, London, W.C.

Mr. F. Plant, as we learn by his latest dates, is still in Madagascar, and Mr. Gerrard, who is now in Natal, will proceed to the same country about April next. Mr. P. Bouchard is at present at Santa Martha, whence he will shortly proceed into the interior of New Grenada. Mr. E. C. Reed—another young and enterprizing Entomological collector—will shortly leave for South America. Mr. Reed's present plan is to proceed to Bahia, and to work along the line of the new railway lately opened into the interior. Mr. S. Stevens is also agent for all these gentlemen.

From Prof. Baird of the Smithsonian Institution, Washington, we hear that arrangements are in progress whereby Mr. Drexler, one of the best collectors attached to that Institution, will shortly be enabled to leave for Panama in order to devote three years to the exploration of the Pacific coasts between Panama and Guayaquil, proposing also to visit the Galapagoes.

Mr. F. Godman, F.Z.S., has just left this country to pass a few months in the Azores—with a view of increasing our at present small acquaintance with the Zoology and Botany of those islands. Mr. Godman will devote his own time mostly to the Birds, Diurnal Lepidoptera, and Plants—but is accompanied by a very experienced Entomological collector.

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7. List of Publications Received.

[*Continued from page* 152.]

(18.) New Entozoic Malady: Observations on the probable introduction of this formidable disease, and on the almost inevitable increase of parasitic diseases in general, as a consequence of the proposed extensive utilization of Sewage. By T. Spencer Cobbold, M.D, F.R.S. London, Groombridge and Sons. 1865.

(19.) Lectures on Man: His place in Creation, and in the History of the Earth. By Dr. Carl Vogt. Edited by James Hunt, Ph.D. London, Longman and Co.

(20.) Zeitschrift fur die Gesammten Naturwissenschaften. Herausgegeben von dem Naturw. Vereine fur Sachsen und Thuringen in Halle, redigirt von C. Giebel und M. Siewert. Jahrg. 1863-4. Berlin.

(21.) Annuario del Reale Instituto Lombardo di Scienze e Lettere. 1864. Milano.

(22.) Functional Diseases of the Stomach. Part I. Sea-sickness: its Nature and Treatment. By John Chapman, M.D. London, Trübner and Co. 1864.

(23.) Homes without Hands, &c. By the Rev. J. G. Wood, M.A., F.L.S. Parts XII., XIII., XIV. London, Longman, 1864.

(24.) Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Classe di Scienze Matematiche e Naturali. Vol. I. Fasc. IV.—VIII. Milano, 1864.

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(51.) Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution for the year 1862. Washington, 1863.

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THE
NATURAL HISTORY REVIEW:
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Reviews and Notices.

XXVI.—The Zoology of British India.

(1.) Catalogue of the Mammalia in the Museum of the Asiatic Society of Bengal. By Edward Blyth, Curator, Calcutta, 1863.

(2.) The Birds of India, being a Natural History of all Birds known to inhabit Continental India. By T. C. Jerdon, Surgeon-Major, Madras Army. 3 vols. 8vo. Calcutta, 1862-4.

(3.) The Reptiles of British India. By Dr. Albert Günther. London, 1864. Published for the Ray Society, by Robert Hardwicke.

Having already spoken of the Mammals and Birds of British India in two former articles upon this subject, we shall on the present occasion confine our remarks to the Reptiles of the same country, as treated of by Dr. Günther in the volume recently issued by the Ray Society. But before we commence to speak of Dr. Günther's valuable work, a few words may be devoted to the Society which has published it. A recent writer in the "Athenæum," which affects to consider itself a scientific journal, while acknowledging the merits of Dr. Günther's volume, takes the Council of the Ray Society soundly to task for having published it. It is alleged that Dr. Günther's work is of such a character that any ordinary London publisher would have undertaken it, and that it therefore falls within the operation of one of the rules of the Ray Society which enacts that works of this kind shall not be published by that Society. To those who have the slightest acquaintance with London publishers and the general style of their dealings with the authors of scientific works, it is unnecessary to say anything in reply to this. But the facts are, we believe, that the author of the "Reptiles of British India" never for a moment entertained the idea of offering the work to a London publisher—being well aware that it would not have been accepted, except upon the terms of his paying the expenses of its production. Even in the case of British Zoology it is hard enough to find a publisher who will undertake a strictly scientific work, and as regards the Zoology of Foreign countries we are not aware of the phenomenon of a "London publisher" willing to venture his capital on such an unsaleable article having ever occurred. Such works are invariably produced either at the cost of the authors themselves, usually at a considerable sacrifice, or by the assistance of a grant from some Government fund or other external means. So far, therefore, from the Council of the Ray Society meriting any censure for their publication of Dr. Günther's work, we consider that they deserve the greatest credit for having undertaken it. It has long been a national scandal that so little pains have been taken to make use of the great opportunities enjoyed by our countrymen in India for producing a complete scientific survey of that country. The Ray Society have already issued many very valuable works, but we believe that, as regards the progress of zoological science, they have never presented to their subscribers and to the public a more important volume than the "Reptiles of British India."

Although Dr. Günther has adopted the "Reptiles of British India" as a title for his work, as being based on collections "mainly brought together within British dominions or in countries under British protection," he has included in it notices of all the species of this group of animals found within the limits of the adjacent south-eastern corner of the Asiatic Continent. "The fauna of Burmah, Siam, Cochin-China, and Southern China" forms, he observes, "a natural unity with that of India proper." In order to point out where the Reptilian fauna of the Indian continent becomes intermingled with forms properly belonging to other regions, he has likewise included what is known of the Reptiles of Afghanistan, Tibet, and Southern China. In a few cases, such as the curious flying Lizards of the genus *Draco* and the Hydrophiidæ, or sea-serpents, he has gone still further, and introduced into his work complete monographic essays upon the whole of the known species of the group.

In the large alcoholic collection of the British Museum under his own charge, Dr. Günther found an invaluable series of types of species described by authors in this country since the time of Russell.

Amongst these may be noticed as of primary importance the types of the species described by Dr. Gray in his catalogues of the Reptiles in the National Collection, and in other publications—amounting to upwards of one hundred in number. There was likewise a large accumulation of unnamed specimens. In 1860, the entire collection of Reptiles belonging to the late East Indian Company was transferred to the National Collection, and its treasures were thereby greatly augmented. Dr. Günther has likewise enjoyed free access to the Museum of the Royal College of Surgeons, of the University of Oxford, and to other scientific institutions where typical specimens of Indian Ophiology are preserved, besides having received valuable assistance in the shape of notes and drawings from Mr. Walter Elliot, Mr. Hodgson, Capt. Beddome, and other well-known Indian Naturalists. Yet, with all these advantages, it must not be supposed that his task was an easy one. To arrange and describe some 500 species of animals of any order, cannot be in any case otherwise than a work of great labour. But this labour was greatly increased in the present case by the absolute novelty of the subject—no previous attempt having ever been made to give even a general sketch of the Herpetology of South-eastern Asia. Moreover, many of the actually named species of the Indian Reptilian Fauna have been so inaccurately and incompletely described, that they have been altogether omitted in general works on Herpetology, or included amongst the synonyms of other species. These it was necessary to re-discover and characterize anew, a task often presenting more difficulties than the description of absolutely new species.

With regard to the arrangement of the references to previous writers, introduced by Dr. Günther into the present work, we must also say a few words. While our author has carefully recorded all the different specific denominations under which each species has been described, he has omitted those in which the genus is simply altered. In reference to this point, we call particular attention to the following weighty observations, given by Dr. Günther, as embodying his reasons for adherence to this rule.

" Changes in the generic nomenclature are frequently ventured
" upon now-a-days in the most unscrupulous manner by persons who,
" having seen only a small proportion of the species, copy the
" delusive characters of their new genera from the original descrip-
" tions, and with these most slender materials attempt to break up

"well-characterized and natural genera. Whilst the genus is that "which, in the Zoological system, simplifies most, and at the same "time preserves the greatest variety of types—is therefore that "which is most frequently used in our philosophical intercourse and "operations, and ought to be as comprehensive as the natural "affinities of the species will allow—any trifling character is now "used to give a new generic name to every two or three species; "and I am afraid this is more frequently done for the purpose of "introducing the author to notice, than from a desire to advance "science. For it will be observed that, generally, the men who "thus endeavour to burden our memories, are not satisfied with "having their name recorded in connexion with their systematic "productions, but must have all the old, well-known species assigned "to their credit also. Under all circumstances, such a change of "the name of the authority for binominal designations is quite irra- "tional, nor does our method imply anything which is untrue."

To the systematic index which heads the work, Dr. Günther prefaces some remarks on the geographical distribution of the Reptilia over the Indian continent and adjoining lands which merit our attention. The Fauna of an area so large as that treated of in the present work is, as Dr. Günther observes, necessarily much diversified, and as a large portion of it is still unexplored, it is, of course, somewhat hazardous to draw general deductions from such a limited knowledge of particulars. But certain leading features in the Reptilian Fauna of this region may be pointed out without difficulty. The island of Ceylon is remarkable as being the head-quarters of the singular underground snakes of the family Uropeltidæ. These are peculiar to the island, and to the adjacent parts of the Indian Peninsula, and are found nowhere else. Contrary to what occurs in other orders of Vertebrata, the Reptilian Fauna of Ceylon seems to show very little affinity with Archipelagic types. Ceylon is therefore considered by Dr. Günther to form part of the same Herpetological Region, as Mysore, the Carnatic, and the other portions of the southern part of the Indian Peninsula. The Deccan, which borders this province to the north, as likewise the immense tract occupying the centre of India, between the Deccan and the great Gangetic plain is almost unexplored herpetologically. Little, therefore, can be said about it. In the north-west, the plain of the Indus presents us with many forms of reptiles, as of mammals, of an Indo-African character, which extend southwards for some distance along the western coast of the Peninsula. As types characteristic of this region, Dr. Günther notices the Saurian genus, *Uromastix*, and the Ophidian form, *Zamenis*. A little further west in Afghanistan, we find very few reptiles identical with those of India proper, but mostly referable either to purely African or to Central-Asiatic types. Much, however, remains to be done before our knowledge of this part of the Reptilian Fauna of Asia can be deemed complete.

On the other hand, the reptiles of the great Gangetic plain are well known, and form part of a distinct herpetological province, which also includes the upper part of the valley of the Indus, and extends northward to the Himalayas, where, at an elevation of about 4000 feet, it gradually loses its peculiar characters. Southwards, this Fauna is considered by Dr. Günther to extend along the western shores of the Bay of Bengal, to about 20° N. L. Although several forms are peculiar to this province, such as the well known Gavial of the Ganges, and certain species of *Emys*, its features are mostly of a plain and rather uniform character. The Reptiles found within its limits are principally common species, ranging over a greater or smaller part of other provinces. *Dipsas* may be noted as a characteristic genus of snakes, five species having been already recorded as found within the limits of this province.

The Reptilian Fauna of the Himalayas which begins to replace that of Bengal at an elevation of about 4000 feet, is well marked by many new species and genera peculiar to it. For what we know of its features we are mainly indebted to a previous publication by Dr. Günther in the Proceedings of the Zoological Society for 1860,* where he has taken advantage of a collection submitted to his examination by Messrs. von Schlagintweit to compile a complete account of all that has hitherto been done towards the working out of this peculiar Fauna. The reptiles of the Khasya hills, as has been shown by Dr. Günther in the same paper, must be referred to the same Fauna, and probably also those of Upper Assam, although we as yet know too little of the latter country to form any definite conclusion upon them.

The belt of land along the eastern coast of the Bay of Bengal and round the Malayan Peninsula to Siam has, on the other hand, been well explored, and shows a Fauna as well distinguished as

* Contributions to a Knowledge of the Reptiles of the Himalaya Mountains. By Dr. A. Günther. P.Z.S., 1860, p. 148.

regards its Reptilia, as it is in the other classes of vertebrata. Its most noticeable character is the presence of well-marked types belonging to the great islands of the Indian Archipelago. These increase in number as we descend the Malayan Peninsula until we arrive at Malacca, where more than one half the reptiles are, as Dr. Günther calls them, of "Archipelagic" species.

Proceeding farther eastwards Laos and Cochin China are almost unknown herpetologically. The late lamented naturalist, Mouhot, made several collections in these countries, of which special accounts have been given by Dr. Günther in the Zoological Society's Proceedings,* but little else has yet been done. Indeed our present knowledge of the whole Fauna of this region is exceedingly defective. But we may expect that the French, who are now firmly established in Saigon, will soon have leisure to devote themselves to the Natural History of these countries, which will doubtless produce many interesting novelties. From China, on the other hand, which as we have already said likewise comes within the scope of Dr. Günther's work, numerous collections have reached Europe, and what we have to look forward to for the future is rather an accurate identification of localities ("China" being the usual vague "habitat" attached to specimens from every part of that vast empire) than any great addition to the number of known species. China certainly embraces parts of two very distinct Faunas. In the Southern Provinces a thoroughly tropical character, allied to that of India, prevails. These tropical forms gradually diminish as we pass north, and are replaced by temperate forms, until in Northern China "every trace of the Indian Reptilian Fauna has disappeared," and the greater part of the forms are specifically identical with those of Central Asia and Europe.

After this preliminary sketch of the geographical limits of Dr. Günther's investigations we now proceed to notice the systematic portion of the work.

Dr. Günther's volume includes the Batrachians as well as the Reptiles of India, the former being ranked only as a Sub-class of the Reptilia. The Reptilia proper are divided into Chelonia, Sauria and Ophidia—the Crocodilia being ranged only as a separate family of Saurians. The second Sub-class of Batrachians is divided into three Orders: *B. salientia*, *B. gradientia*, and *B. apoda*. We shall

* See P. Z. S. 1860, p. 113, and 1861, p. 187.

devote a few paragraphs to the most important features of each of these groups as treated of in Dr. Günther's work.

The order of Tortoises, which stands at the head of the class of Reptiles, is well represented in India as in most other tropical countries; nearly fifty species being included in Dr. Günther's work. Of the true Land-tortoises, however, of the genus *Testudo*, only a single species, the *T. elegans*, is found in the peninsula of India. Of two others, mentioned in Dr. Günther's work, one is from Afghanistan, and the other from the Malayan provinces. The fresh-water Tortoises, forming the family Emydidæ, are on the other hand, very numerous in South-eastern Asia, and are referable to different well-characterized genera, through some of which a gradual transition is formed from the Land-tortoises proper, to those the habits of which are thoroughly aquatic. The typical genus *Emys*, so rich in species in all temperate and tropical regions except Australia, has eleven well-marked representatives within the area over which Dr. Günther's researches have extended. Dr. Günther states that the Indian species are in no case used as food by man, a somewhat curious fact when we recollect that several of the American terrapens belonging to the same genus are highly appreciated by Transatlantic gastronomes. Some species of the Trionychidæ or Fresh-water Turtles, as Dr. Günther calls them, on the other hand although purely carnivorous in their habits, appear to be better appreciated in India as articles of diet. The *Chitra Indica*, as we are informed, as well as the species of true *Trionyx* are often eaten by the natives, particularly the Chinese. Of the true marine Turtles, four species occur with more or less frequency on the coast of India. The herbivorous *Chelonia virgata*, the Indian representative of the well-known *Ch. midas* of the Atlantic, is very abundant in the Straits of Malacca, and equals the Atlantic species in size while it rivals it in flavour. The Hawksbill Turtle, *Caretta squamata*, was formerly also very abundant on the same coasts, but in consequence of the great demand for Tortoise-shell, has of late years become very scarce at places where it was once very common. This has been particularly the case on the coasts of Ceylon, so that the Ceylonese Government which is now going to some expense to re-establish the pearl-fisheries in these seas, would perhaps do well to extend their care over the Turtles as well.

Dr. Günther commences the second order of reptiles as we have already stated, with the Crocodiles, of which he enumerates five species as met with in South-eastern Asia. Four of these belong to the typical form *Crocodilus*, the fifth being the celebrated Gavial peculiar to the Ganges, where it is popularly supposed to feed principally on the bodies of the deceased Hindoos, who drown themselves in the sacred stream. Of the true Lizards, which form the bulk of the order, representatives of nine families occur in India, and in the surrounding countries. The Scincoids (Scincidæ), the Geckos (Geckotidæ), and the Agamoids (Agamidæ), are the most abundant of these, and are all very numerous in species. The Water-lizards (Varanidæ) are also a well-marked feature in Indian Herpetology—the species being in many cases large in size and numerous in individuals. The only well-ascertained species of Land-lizards (Lacertidæ) belong to the genera *Tachydromus* and *Acanthodactylus*—other forms referred to this family not having come under Dr. Günther's examination. The Zonuridæ are represented by a single very interesting species—the *Pseudopus gracilis*, or Glass-snake of the Khasya Hills, a close ally of the well-known *Pseudopus pallasi* of Eastern Europe, although differing in the total absence of the rudimentary hind-limbs. The three remaining families: the Acontiadidæ, Sepidæ, and Chamæleonidæ, are very feebly represented in Indian Herpetology, being essentially African groups. Of the first of these only two (Ceylonese) species have been properly described; of the last, but one Indian representative is known, the *Chamæleon vulgaris*—a very widely diffused species. The claims of the Sepidæ* to figure in the Herpetology of India rest solely on a single species of *Sphenocephalus*, described by Mr. Blyth from Afghanistan. But as there are numerous other instances of the extension of African forms along the Arabian coast, even unto the Western coast-region of the Indian peninsula, there is no *primâ facie* reason to doubt Mr. Blyth's correctness on this point. The total number of species of Saurians (including Crocodilians) given in Dr. Günther's work amounts to nearly 150. In several instances, however, he has included species not occurring even within the somewhat wide limits laid down by himself for the scope of his work, particularly in the case of the very singular and interesting form of Agamoid Lizards known as *Draco*, where a complete monograph of all the known species is given. The *Dracones* are peculiar in the whole Order of Reptiles for the additional apparatus for locomotion formed

* Sepidæ (from σήψ, σηπὸς)—not Sepsidæ, as written by Gray and Günther.

by the prolongation of the hinder ribs and their connection by a broad expansible fold of skin, the whole forming a sub-semicircular wing on each side of the body, and serving as an organ of flight. The species of *Draco* known to science are fourteen, entirely confined to the Indian region, that is, South-eastern Asia and the great islands adjoining. Only one of these—*Draco dussumieri*—is found in the peninsula of India; others, however, occur on the opposite side of the Bay of Bengal.

The Ophidians, which Dr. Günther next enters upon, are the most formidable part of the Indian Reptilian Fauna: we are not now alluding to those who encounter them in a state of nature, but to the Naturalist who has to arrange and determine their numerous and varying forms in his cabinet. Had our author not already previously devoted much time and toil to the working out of a large section of this group, as shown by his well-known catalogue of Colubrine Snakes,* he would hardly have succeeded so well in the present part of his book. Of the Innocuous Colubrine division of this extensive order 203 species, of the Venomous Colubrine 60 species, and of the Viperine section 19 species are contained in Dr. Günther's work, and with the exception of the Sea-snakes (Hydrophiidæ) where a complete monographic account of all the known species is introduced, nearly all these occur within the limits assigned by Dr. Günther to his labours. Space will not permit us, we fear, to discuss separately each of the twenty-one families, to which these 282 species are assigned by Dr. Günther, but we must say a few words on some of the more prominent forms. At the head of the order Dr. Günther stations the Typhlopidæ, Tortricidæ, Xenopeltidæ, and Uropeltidæ, four abnormal families, the members of which depart from the usual habit of the Ophidians by living entirely or almost always underground. The last-named group forms one of the most peculiar features of the Reptili-fauna of India proper, being known to occur only in Ceylon and the adjoining parts of the peninsula. Eighteen species of this curious type are recognized by Dr. Günther, and now that attention has been called to them there is little doubt that further discoveries will ere long be made in them. They are by no means scarce in their native country, but escape observation by their peculiar mode of life. "In order to collect

* Catalogue of Colubrine Snakes in the British Museum. By Dr. A. Günther, London, 1858.

them it is necessary to dig for them to a depth of four feet in the ground!"

The Calamariidæ or Dwarf Snakes, which next follow, are likewise a characteristic family of Indian Herpetology. They are all of small size, live on the ground, and feed principally on insects and worms. Moreover, they are very gentle and never attempt to bite! The Oligodontidæ are likewise peculiar to the Indian region—one of the two genera (*Simotes*) being very numerous in species. The Colubridae, which next follow, are on the other hand very widely diffused, being found all over the world, and being likewise very numerous in India. Sixty-nine species of this family are treated of by Dr. Günther, who divides them into five sub-families, each of which is well distinguished by peculiarities of mode of life, as well as of structure. The last of the four sections, the Natricina, in their water-loving propensities, form a transition to the next following family, the Homalopsidæ, which are thoroughly aquatic in their habits, and only occasionally found on shore. Several of them even enter the sea, and in some points show resemblance to the truly marine Hydrophiidæ. Perhaps the most singular of them, and indeed one of the most outré forms in the whole series of Ophidians is the *Herpeton tentaculatum*,* of Siam, which is remarkable for two flexible, cylindrical, scaly tentacles, which terminate its snout, and are supposed to serve as organs of touch in the water or mud, and to save the necessity of exserting the tongue. Dr. Günther was formerly inclined to remove this snake from its present position to the neighbourhood of *Acrochordus*. But he now acknowledges that it was rightly assigned by Prof. Schlegel to the Homalopsidæ.

The Psammophiidæ, or Sand-snakes, are an African group, of which two species occur in India. The Dendrophiidæ, or Tree-snakes, are generaliy distributed throughout the tropics, living on trees, as their name imports, and feeding principally on tree-lizards. Eight species of the group are contained in Dr. Günther's work, amongst which is *Chrysopelea ornata*—perhaps the most beautifully coloured species in the whole group of Ophidians. The slender-bodied Whip-snakes (Dryophiidæ) are likewise arboreal in their habits, and bright in their colours, and generally distributed in tropical countries. They are, however, nocturnal in their mode of life as are the next succeeding family, the Dipsadidæ, of which

* See P. Z. S. 1860, p. 113, pl. xxiii.

ten species, all referred by Dr. Günther to the typical genus *Dipsas*, occur in South-eastern Asia. The Lycodontidæ, which next succeed, are Ground-snakes, said to be nocturnal, and having the vertical pupil, which generally denotes such habits. Eleven species of this group are Indian; others occur in Africa. Allied to them are the Amblycephalidæ, or "Blunt-heads," a small group of nocturnal Snakes peculiar to the Indian region, two genera being found on the continent, and the third being peculiar to Sumatra. The Pythonidæ, which now follow, are well known as the old-world representatives of the American Boidæ. Exceeding in their dimensions as they do, their allies of the American tropics, the Pythons are among the largest of living reptiles. The two Indian species, *Python reticulatus* and *P. molurus*, are only rivalled in size by the African members of the same genus, and the American Anaconda (*Eunectes murinus*). "Their dimensions," however, as well as "their strength, "have been much exaggerated. Specimens of from 18 to 20 feet long, "are very rare, although isolated statements of individuals, measuring "30 feet long, are on record, and worthy of credit." The Pythons are likewise remarkable for the performance of the act of incubation, otherwise unknown in the class of Reptiles. Most of our readers will, no doubt, recollect the sensation caused in London, by a large African Python depositing her eggs in the reptile-house of the Zoological Society, and incubating them for some months, although in this instance not with successful results.* Next to the Pythonidæ, Dr. Günther places the Erycidæ or Sand-snakes, a group generally allied in structure to the Boas, but of burrowing habits, and frequenting dry, sandy, and stony plains, where the soil is suitable for such a mode of life. Two species of this family occur in the peninsula of India, and a third is said to be from Afghanistan. With the Acrochordidæ or Wart-snakes, a family composed of three abnormal and isolated types, forming so many genera, Dr. Günther terminates the series of innocuous Colubrine Snakes. *Acrochordus javanicus* is believed to feed on fruits; *Chersydrus granulatus* is a thoroughly aquatic species. Both of these occur within the limits of Dr. Günther's work. The third type, *Xenodermus*, if indeed it belongs at all to this family, is only found in Java.

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* See Proc. Zool. Soc. 1862, p. 365, "On the incubation of Python Sebæ." By P. L. Sclater.

We have now closed the long array of innocuous Colubriform Ophidians, and come to the Venomous division of the same order, which are furnished with an erect immoveable grooved or perforated poison-tooth, situated in front of the maxillary bone. Two families of this sub-order are represented in the Indian Fauna, the Elapidæ and the Hydrophiidæ. To the former group belongs the well-known Cobra, in reality one of the most deadly of known Ophidians, although not belonging to the sub-order structurally most adapted for inflicting poisonous wounds. Of the latter group, as we have already stated, Dr. Günther gives a complete monographic account. So little known is this peculiar family of Snakes, and so indifferent are the accounts given of it by former authors, that Dr. Günther was forced to adopt the plan of working out all the species anew, in order to determine the Indian forms with exactitude. The result has been that we have to thank him for a most valuable contribution to our knowledge of the Ophidians.

The Hydrophiidæ are "Sea-serpents," in the truest sense of the word, passing their whole lives in the salt water, and feeding on fishes. They inhabit the tropical parts of the Indian and Pacific Oceans, from the coast of Madagascar to the isthmus of Panama, but are unknown in the Atlantic. Dr. Günther recognises 44 species of this family belonging to 8 different genera.

The third and last sub-order of Ophidians, which Dr. Günther now enters upon, are the truly poisonous Snakes provided with a perforated fang on the maxillary bone and a special organism adapted for the delivery of deadly wounds. Of the two families of the Order, one, the Crotalidæ, is common to Asia and America, the finest and largest forms of it occurring only in the New World, but five genera (containing 17 species) being found within the Asiatic area treated of by Dr. Günther. The Viperidæ, which are confined to the Old World, are not nearly so numerous within the Indian region, only two species being recognized by our author, both of which however are common in the peninsula of India. One of these, *Daboia*, is a well-marked Indian type—the other, *Echis*, an African form—the Indian species being barely distinguishable from the *Echis arenicola* of the Sahara. With them Dr. Günther concludes his account of the true Reptilia of India, which number no less than 474 species.

The subclass of Batrachians, which our author now treats of, is not nearly so numerous in forms, little more than 50 being treated of in the present work. The subclass is divided into three orders, Batrachia salientia, or Tail-less Batrachians, B. caudata, or Tailed Batrachians—and B. apoda, or Burrowing Batrachians. Although the last section is here arranged at the foot of the subclass, some details are given concerning the structure of certain members of it (as we shall notice further on) which lead to the inference that it would be more naturally placed at the head of it. Of Batrachia salientia, Dr. Günther gives an account of 47 species, belonging to the continental portion of the Indian Fauna, which he is able to refer to their correct place in the Systema, either from personal examination, or from trustworthy accounts of other Naturalists. But as among the Reptilia proper, so among the Batrachia, many named species have been so imperfectly described by previous authors, that Dr. Günther has not been able to "make head or tail" of them, as the saying is. Dr. Jerdon, Mr. Blyth, and the late Mr. Hallowell of Philadelphia, are the writers that seem to have been the chief offenders in this way, according to Dr. Günther, who has occasionally bestowed some rather severe remarks upon them, and upon others who have done like them. Some of these strictures would have been certainly better omitted, as the bare fact that "it is impossible to recognize" a description, is quite sufficient condemnation of it. But we cannot think that Dr. Jerdon has acted wisely in printing the very angry letter on this subject, given to the world in the last number of the "Annals of Natural History."* Dr. Günther's reply has not yet appeared, but we anticipate one that will give very little satisfaction to the complaining party, although it is possible that Dr. Günther may have overstated his case in one passage.

The Batrachia caudata, or Batrachians in which the tail is persistent through life, are, as is well known, entirely confined to the northern parts of both hemispheres—the Palæarctic and Nearctic Regions. Two stragglers only can in any sense be said to belong to the Indian Region. One of them is a newt of the genus *Cynops*, from Ningpo† in China, which is after all not far from the boundaries

* Remarks on Observations contained in Dr. Günther's work on the Reptiles of British India. By T. C. Jerdon, Ann. Nat. Hist., 1865, p. 416.

† About 30° N.L.

of the Palæarctic Fauna. The other, and more striking exception, is a species of the North American genus *Plethodon*, stated to have been found in Siam by the late M. Mouhot.* In the latter case, we cannot help thinking that there may have been some error. Either the two specimens stated to have been found in Mr. Mouhot's collection, which are the sole authority for the Siamese locality, may have been accidentally introduced from elsewhere — we know that such accidents do occur even in the best-ordered establishments —or we think it *possible* that the animal may have been brought over to Siam in an American vessel. Certainly, further evidence as to the occurrence of Tailed Batrachians in Siam is very desirable. We are not yet quite convinced of the fact!

Of the worm-like Cæcilians or Burrowing Batrachians, as Dr. Günther terms them, three species occur in British India. It is not long ago that the late Johannes Müller's discovery of the metamorphosis of these singular creatures caused their degradation into the class of Batrachia. Dr. Günther's discoveries as to the structure of the uro-genital apparatus in *Epicrium glutinosum* (see p. 442), will probably cause their elevation to the head of the Batrachians, and certainly tends to diminish the ordinarily insisted on distinction between the Batrachia and the true Reptilia. If Dr. Günther's views are correct, the middle portion of the cloaca in this species is developed into a copulatory organ, provided with special muscles for its retraction, and imitates a similar structure known to exist in certain Saurians.

We now take our leave of Dr. Günther's work, which on several accounts we take to be one of the most important contributions to Zoological science that have lately appeared in this country. It is important, not only for its own sake, as a highly elaborate account of the present state of our knowledge of a part of the Fauna of a rich tropical region, of which we had previously no connected history, but also for the results which will slowly but surely follow it. It will certainly bring a number of new workers, who will now have something to start upon, into a very neglected branch of Natural History. It will also tend to wipe away the national reproach that might have been deservedly cast upon us, of not caring for the

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* Cf. Gray, P.Z.S. 1859, p. 230.

interests of science as regards Indian matters. If our Government is utterly indifferent to such undertakings—and we believe they refused even to subscribe for a single copy of the present work—we have Associations amongst ourselves who will supply its shortcomings, and provide means for bringing the labours of our Naturalists before the world. In the name of Science we thank Dr. Günther for his work, and the Ray Society for publishing it.

XXVII.—The Structure of Macrauchenia.

(1.) Descripcion de la Macrauchenia Patachonica. Anales de Museo Público de Buenos Ayres. Por German Burmeister, Med. Dr., Phil. Dr., Director del Museo Público de Buenos Aires. Entrega prim., Buenos Aires. 1864.

(2.) Beschreibung der Macrauchenia Patachonica, Owen. (Opisthorhinus Falconeri, Brav.) Nach A. Bravard's Zeichnungen und den im Museo zu Buenos Aires vorhandenen Resten entworfen von Dr. Hermann Burmeister. Abhand. d. naturf. Ges. zu Halle. Bd. IX., p. 75. Halle. 1864.

In our last number* we spoke of Dr. Burmeister's forthcoming account of the Osteology of *Macrauchenia*, from the fossil remains in the Museum of Buenos Ayres,† of which he is now Director. Dr. Burmeister's essay on this subject has since appeared in two publications, as will be seen by the title of them above given, and fully equals in interest the expectations we had formed of it.

The original discovery of the singular form of extinct Mammals known as *Macrauchenia* is due to Mr. Darwin, who, during the voyage of the Beagle, in 1842, found the first known specimens of the remains of this animal at Port St. Julian, on the coast of Patagonia. Upon these remains, which consisted mainly of vertebræ and bones of the anterior extremities, Professor Owen, in the

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* Antea, p. 300.

† It appears, however, that the *skull* of *Macrauchenia*, certainly the most valuable part of the skeleton, is not in the National Museum, but belongs to the late M. Bravard's private collection, and is now for sale. Surely this is worth the attention of the authorities of the British Museum.

Zoology of the Voyage of the Beagle,* established the species *Macrauchenia patachonica.* Professor Owen considered that this remarkable quadruped, though "referable to the Order Pachydermata," judging from the peculiar formation of the cervical vertebræ, must have had "affinities to the Ruminantia, and especially to the Camelidæ."

Further remains of the *Macrauchenia patachonica* were discovered by the Vicomte F. de Castelnau during his journey through South America, and described by Gervais, in the "Zoology" of that traveller's "Voyage." Professor Gervais does not recognize any affinity between *Macrauchenia* and the Camelidæ, but insists on its close alliance to *Rhinoceros* and *Tapirus*, the structure of its foot being nearly the same as in these two latter genera.

In 1859, Mr. D. Forbes, F.R.S., obtained portions of a skeleton from the copper mine of Santa Rosa, in Bolivia, upon which Professor Huxley has founded a second species of *Macrauchenia—M. boliviensis.*† Here again, only two very imperfect and mutilated portions of the skull were present, so that the great question as to the true position of the genus could not be definitely set at rest. It will be evident, therefore, that the discovery by Bravard of a perfect cranium of this animal, together with other portions of the skeleton, near Buenos Ayres, was an event of no slight interest, and well worthy of the attention which Professor Burmeister has devoted to it.

M. Bravard made his discovery as long ago as 1856, and, not recognizing that the cranium was that of *Macrauchenia,* commenced a description of it, in a new work intended to illustrate the fossil Fauna of La Plata, under the name *Opisthorhinus falconeri.* Bravard unhappily perished in the fatal earthquake of Mendoza, leaving only three plates of his proposed work completed, which have been used by Professor Burmeister for the Spanish edition of his paper in the "Anales."

We shall not follow Prof. Burmeister into his description of the cranium, the dentition, and other particulars of the structure of *Macrauchenia,* but shall content ourselves by giving a short analysis of the results arrived at at the close of his paper as to the systematic position of this remarkable Mammal.

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* Zool. Voy. Beagle, I., p. 35.

† Proc. Geol. Soc. Lond. XVII., p. 70.

"If," says Professor Burmeister, "we divide the Ungulate "animals according to the structure of their feet into Artiodactyles "and Perissodactyles, there can be no doubt that the Ruminants "must form one end of the series, and the Elephants (*Proboscidea*) "the other. In this way we get a natural series, beginning with "the Ruminants, and passing through *Anoplotherium* to the Swine "(*Suina*) and so to *Hippopotamus*, which concludes the series of "Artiodactyles. The transition to the Perissodactyles is, perhaps, "effected by *Toxodon*, of which the structure of the feet is not yet "accurately known, but which seems to unite certain characters of "*Rhinoceros* with those of *Hippopotamus*. To *Toxodon* succeed "*Rhinoceros*, *Hyrax* and *Palæotherium*—genera, of which the dentition "is reducible to one common plan. Next, however unnatural it "may at first appear, we must place the Solidungula—the fossil "genus *Hipparion*, forming the transition between *Equus* and "*Palæotherium*, and, on the other side, comes in *Macrauchenia*, "perhaps along with *Nesodon*. To *Macrauchenia* succeeds *Tapirus*; "and the series is closed by *Elephas*."

It will be observed, therefore, that Prof. Burmeister considers that the true position of *Macrauchenia* is now definitely settled to be between *Equus* and *Tapirus*, and that the resemblance to the Camelidæ, indicated by its cervical vertebræ, is entirely analogical, and unsupported by any other characters. He defines the genus as follows:—

Macrauchenia, genus Ungulatorum imparidigitorum, inter genera *Equus* et *Tapirus* ponendum—Dentes 46, serie continua*—Primores utrinque sex — Laniarii parvi, conici, inferiores majores. Molares supra utrinque octo; anteriores compressi, posteriores quadrati: infra septem bilunati—Nasus elongatus, proboscideus. Cranium figura cranio Caballi proximum—Palmæ et plantæ tridactylæ, digitis æqualibus; astragalus superficie unica articulatoria suborbiculari cum osse scaphoideo conjunctus; digitis externis et internis accessoriis obsoletis, sed conspicuis."

* The dentition is formularized as follows (Abh. N. G. z. Halle, p. 85)—

$$\text{I.}\ \frac{6}{6},\ \text{C.}\ \frac{1-1}{1-1}\quad \text{M.}\ \frac{8-8}{7-7}$$

The great peculiarity, besides the large number of the teeth and the *eight* superior molars, consists in the series being almost continuous, only one small diastema occurring, between the canines and incisors in the upper jaw. In this respect *Macrauchenia* approaches *Anoplotherium*.

We conclude this notice with the very significant moral, which Prof. Huxley has attached to his account of the second smaller species of *Macrauchenia*, and which acquires additional strength now that the true position of the genus is definitely ascertained. "The "genus *Macrauchenia*," Prof. Huxley remarks, "alone affords a "sufficient refutation of the doctrine, that an extinct animal can be "safely and certainly restored if we know a single important bone "or tooth. If up to this time the cervical vertebræ of *Macrauchenia* "only had been known, palæontologists would have been justified "by all the canons of comparative anatomy, in concluding that the "rest of its organization was Camelidan. With our present knowledge "(leaving *Macrauchenia* aside), a cervical vertebræ with elongated "centrum, flattened articular ends, an internal vertebral canal, and "imperforate transverse processes, as definitely characterizes one of "the Camel tribe as the marsupial bones do a Marsupial,—and indeed "better; for we know of recent non-marsupial animals with marsu-"pial bones. Had, therefore, a block containing an entire skeleton "of *Macrauchenia*, but showing only those portions of one of the "cervical vertebræ, been placed before an anatomist, he would have "been as fully justified in predicting cannon-bones, bi-trochanterian "femora, and astragali with two, subequal, scaphocuboidal facets, "as Cuvier was in reasoning from the inflected angle of the jaw to the "marsupial bones of his famous Opossum. But, for all that, our "hypothetical anatomist would have been wrong; and, instead of "finding what he sought, he would have learned a lesson of caution, "of great service to his future progress."

XXVIII.—Recent Works on the Entozoa.

(1.) Entozoa: an Introduction to the Study of Helminthology, with reference, more particularly, to the Internal Parasites of Man. By T. Spencer Cobbold, M.D., F.R.S. (Roy. 8vo. pp. 480.) London: Groombridge and Sons, 1864.

(2.) Die Menschlichen Parasiten und die von ihnen herrührenden Krankheiten. Ein Hand-und Lehrbuch für Naturforscher und Aerzte. Von Rudolf Leuckart. Vol. I. (8vo. pp. 768.) Leipzig and Heidelberg, 1863.

(3.) On Parasites, and the Diseases which they Produce. By G. Busk, F.R.S. (Article in Vol. IV. of "A System of Surgery, edited by T. Holmes, M.A." 8vo. pp. 902-21.) London, 1864.

When we consider, on the one hand, their characteristic mode of life, and, on the other, those curious problems which all questions touching their genesis and development tend to suggest, we might naturally be led to expect that the study of internal parasites should have occupied the attention of investigators from a very remote period. Accordingly, we find that such has, indeed, been the case; and that no special department of our science, Entomology always excepted, can vie, in the copiousness of its literature, with Helminthology.*

To unfold the relations between organised beings and the external conditions of existence; to determine, in short, those phenomena in the orderly correlation of which life may be said to consist, must ever be regarded as one of the most interesting, as it is, undoubtedly, one of the most important aims of the philosophic biologist. When these conditions are of such a nature as to escape our immediate ken,

* The words Helminthology and Entomology are often wrongly employed, nor can they be rightly understood without implied reference to the history of systematic zoölogy. Of invertebrate zoölogy there are plainly four departments, namely, (1) Malacology (including Conchology); (2) Entomology (the study of the *Insecta* of Linneus, or *Articulata* of Cuvier); (3) Helminthology; and (4) Zoöphytology. The two latter were at first nearly synonymous terms, both meaning the study of the *Vermes* of Linneus. We find O. F. Müller (Vermium terrestrium et fluviatilium, 1774), placing *Hydra* and *Tubularia* among his *Helminthica*, although with a note of caution. Even Cuvier arranged all the Helminths under his extensive 'embranchement des Zoophytes.' Afterwards, Helminthology meant the study of Worms, properly so called; and, finally, of parasitic worms only. We may add that, of vertebrate zoölogy, there are also four departments; Masticology, Ornithology, Herpetology, and Ichthyology.

so that they can be apprehended only in imagination, or by recourse to unaccustomed methods of research, the interest of the inquiry becomes doubled. Thus it is that some feeling, stronger than a "cold, wondering," intellectual spirit, urges us to investigate, alike the extinct forms of past times, and the unseen fauna and flora of the microscopic world. From this point of view, if from none other, does Helminthology display attractions equal to those of Paleontology, or of the science of minute organisms.

It is true that, with many persons, these creatures only excite disgust; partly by reason of the outward aspect of some, but chiefly because of associations derived from their peculiar habit, and the diseased conditions which, in certain cases, they produce. Hence the ignorant and prejudiced, who care little for natural history in general, care still less about the study of parasites. Professor Owen, combatting such prejudices, has termed the Helminths "outcasts" of the animal kingdom.* But the external appearance of several parasites, especially of the more minute forms, is, assuredly, not repulsive; while the internal organisation of all, as revealed by dissection, presents an arrangement of parts which it would be no misuse of language to term beautiful. Nay, some are so transparent that, without any dissection whatever, their structures, under the microscope, show themselves with such exquisite distinctness as to banish at once all feelings save those of delight and curiosity. Even among the more obviously disgusting species, as the tape-worm or common *Ascaris*, the vulgar sensations at first aroused by their apparent loathsomeness are quickly effaced whenever we commence the study of their morphology and development. We deprecate, therefore, as weak, and unworthy of so accomplished a zoölogist, the sentiment which makes M. De Quatrefages† declare that he will spare his readers "the technical details in endeavouring to convey some portions of a history, which touches on the most important questions in general and philosophic physiology."

Of internal parasites, some are vegetable, some animal; and, of the latter, most would find a place in the sub-kingdom *Annulosa*. Again, of annulose parasites, a few are Arthropods, as the 'bot' larvæ among Insects. But the great majority belong to that vast assemblage of lower annulose forms, generally denominated *Worms*.

* Lectures on the Invertebrate Animals, 2nd ed. p. 58.

† English translation of "Les Métamorphoses," p. 202.

The class *Vermes* of Linneus contained, as our readers know, all those invertebrate* animals which he excluded from his Insects, that is, from the *Arthropoda*. The 'Worms' of modern systematists constitute a less extensive, though still far from inconsiderable, series, including:—

a.—The typical Annelids,† or *Polychæta* of Grube.

b.—The Earthworms, Naids, and their allies; *Oligochæta* of Grube.

c.—The Leeches.

d.—The *Gephyrea*, or Sipunculoid worms.

e.—The *Rotifera*, or Wheel-animalcules.

f.—The *Turbellaria*, or Ciliated worms.

g.—The Helminths proper, or parasitic worms.

h.—The genus *Sagitta*, and other genera of doubtful affinity; especially *Peripatus, Tomopteris*, and *Phoronis*.‡

From the *Rotifera* we here exclude the *Ichthydina* of Ehrenberg, and from the Helminths, the *Pentastomata* of Rudolphi (= *Acanthotheca*, Diesing), which appear to be indubitable Arthropod animals of degraded structure.

Burmeister, Van Beneden, and Agassiz would associate all, or nearly all, the above forms under a single 'class,' in the technical sense of that term. This, however, is but a return to the antiquated views of Bruguières and Oken, which Cuvier long since condemned.

We believe, with the great majority of modern helminthologists, that several distinct 'classes' of Worms exist. But it is by no means an easy task to determine the limits of these, and the various forms comprehended under each. Our knowledge of the structure of Worms is still very far from perfect. Nor do naturalists in general possess an accurate acquaintance with the facts already known. We find that scarcely any two of them agree as to what are the primary sub-divisions which this department of the animal kingdom includes.

In the preceding list we have endeavoured to enumerate the

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* Besides *Limax lanceolatus* of Pallas (=*Amphioxus*) and *Myxine*.

† That is, the marine, unisexual *Setigera branchiata*, or "Annélides proprement dites" of M. Milne Edwards (1846).

‡ *Tomopteris* would seem to be a Rapacious Annelid (see Grube) of free-swimming habit, reduced to the utmost simplicity of organisation, just as that curious polyzoöid form *Phoronis* is, perhaps, but an humble ally of the *Tubicolæ*. Grube places *Tomopteris* in a special order (*Gymnocopa*).

various groups of Worms, with a view, as far as possible, to avoid the difficulties which arise from the differences of opinion to which reference has just been made. These groups are far from being equivalent to one another. Each has, however, a well-defined existence in the literature of zoölogy. For the present we shall not discuss their mutual relations further than may be necessary to indicate the position occupied by the parasitic worms in the animal kingdom.

By Rudolphi,* these worms were brought together into a class, to which he gave the name of *Entozoa.*

Cuvier† associated with the *Entozoa* certain worms of free habit, including the genera *Planaria, Nemertes,* and their allies, which Ehrenberg ‡ and others have separated to constitute the group *Turbellaria.* Cuvier also placed in the same division a few arthropod parasites, now transferred to the *Crustacea* and *Arachnida.* The whole were united into one class, 'Les Intestinaux,' of his sub-kingdom, 'Les Zoophytes ou Animaux Rayonnés.' Another class, 'Les Annélides,' together with the Insects of Linnæus (sub-divided into three classes), formed the sub-kingdom of 'Les Animaux Articulés.'

True to the principles of a morphological classification, Cuvier was amply justified in not regarding the *Entozoa,* because of their peculiar habit alone, as worthy to take the rank of a separate class. And he was also right in perceiving the essential similarity of structure between this group and the *Turbellaria.* Did he err in his estimate of the anatomical differences between the '*Intestina*' and the Annelids, classes which are now seldom placed in distinct sub-kingdoms? And yet, as we shall see, they agree with one another less closely than many modern zoölogists are wont to suppose.

De Blainville, with his usual sagacity, was one of the first to point out the errors (?) into which both Rudolphi and Cuvier had fallen. He it was who, in 1816,§ removed the *Entozoa* to the Articulate sub-kingdom, and thus wrote of their mutual affinities:

"Sous le nom *d'Entozoaires,* qui est évidemment mauvais puisqu'il "est tiré d'une circonstance non inhérente à l'objet, et qu'en outre

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* Entozoorum Historia Naturalis, vol. i. 1808.

† Le Règne Animal, tome iv. 1817. See also tome iii. of his second edition, 1830.

‡ Symbolæ Physicæ, series prima, 1831. The *Turbellaria,* as first constituted, did not include the *Nemertina,* which De Quatrefages, Siebold, and Schultze afterwards grouped with them.

§ Prodrome d'une nouvelle distribution systématique du règne animal.

"on doit y placer des espèces externes, on confond très-probablement "des animaux dont les structure est fort différente: comparez en "effet un Ascaride lombricoïde avec une Ligule."*

The conception expressed in the concluding lines of this quotation was at length, in 1851, systematically embodied by Vogt,† who divided the *Intestina* of Cuvier into two classes, *Platyelmia* and *Nematelmia.* The former were, in general, hermaphrodite, with a more or less flattened body. The *Nematelmia* included the uni-sexual, round-bodied, parasitic worms.

These divisions were in some degree indicated by Cuvier himself, when he arranged his *Intestina* under the two groups of 'Cavitary' and 'Parenchymatous' worms; groups which nearly correspond with the *Cœlelmintha* and *Sterelmintha* of Owen.‡ But these anticipations of Vogt's arrangement failed to gain a fixed position in scientific nomenclature, because resting on insufficient, or even positively erroneous data.

In our opinion the *Platyelmia* and *Nematelmia* of Vogt constitute sub-classes rather than classes, anatomical facts justifying this estimate of the structural differences existing between them. So, likewise, the *Turbellaria,* albeit more nearly related to the *Platyelmia* (with which Vogt arranged them) than to the round worms, perhaps form a third sub-class in the same natural assemblage. For, within the limits of the Turbellarian group, distinguishing morphological characters exist, which are almost equivalent to those employed to subdivide the *Nematelmia* and *Platyelmia.* Thus we take up an intermediate position between those naturalists, such as Ehrenberg, Schultze, and Siebold, who would make the *Turbellaria* a 'class,' and those who, on the contrary, would consider them but a single order of *Platyelmia.*

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* De Blainville divides the animals now called worms into two classes, *Setipoda* and *Apoda;* the Leeches being regarded as a sub-class of the latter, and, in some degree, intermediate between the *Entozoa* and *Annelida.* To show how little this view differs from that current on the same subject among modern zoölogists, we refer the reader to Professor Huxley's Lectures on General Natural History, No. VII. (Med. Times and Gazette, Aug. 9, 1856), where it is expressly stated that the affinities of the leech tribe are closer with the *Trematoda* than with the *Annelida.* Agassiz, Diesing, and R. Leuckart, not to mention others, maintain very similar opinions.

† Zoologische Briefe, Erster Band, p. 174.

‡ Lectures on the Invertebrate Animals. Professor Owen has, however, formed a distinct class, *Epizoa,* for those parasitic Crustaceans (Les Lernées) which have been separated from the *Intestina* of Cuvier.

R. Leuckart* has still further modified the groups of Vogt, which he extends so as to embrace the whole department of Worms, thus:—

VERMES.

Class I.	Class II.
Platodes.	Nematodes.
(4 orders.)	(4 orders.)
Turbellaria.	*Acanthocephala.*
Cestodes.	*Nematoidea.*
Trematodes.	*Chætognatha.*
Hirudinei.	*Chætopoda.*

So far back as 1838, M. Milne Edwards† established the division of 'Worms,' in its modern or restricted sense, as a province‡ of the Annulose sub-kingdom. He thus expressed himself:—

"In a word, I think M. de Blainville right in referring the "Helminths to the series of articulate animals, and I am of opinion "that this department should be divided into two principal groups, "the one comprising the *Articulata*, with jointed appendages, and "the other the Annelids, Helminths, Rotifers, etc., for which series "the common name of *worms* may be retained."

M. Milne Edwards has himself subsequently introduced a number of minor changes, affecting the sub-divisions of the group in question.

Many of the German naturalists, following the example of Siebold, have elevated '*Vermes*' to the rank of a complete sub-kingdom.

At a later period, M. Milne Edwards§ proposed a binary classification of the Worms in accordance with the modifications of their nervous system. It has long been known that among the higher worms the principal ganglia, with their commissures, form a double

* Op. cit. supr., from which we quote. See, however, his 'Bericht,' in Wiegmann's Archiv. wherein the above arrangement was first announced.

† Ann. d. Sci. Nat. Zool. Ser. 2. Tome X. p. 194.

‡ "Sous-embranchement"—"Grande division." He uses both these words on various occasions, evidently meaning thereby a group less than a sub-kingdom (embranchement), and greater than a class.

§ In his lectures at the Jardin des Plantes (probably for 1846) as we learn from De Quatrefages, who seems to have been the first to promulgate this arrangement (Voyage en Sicile, p. 206). See also Blanchard, 'Sur L'Organisation des Vers,' (Ibid., Part III).

chain, or median series of centres, comparable to the ventral chain so conspicuous in the type *Arthropoda*. In the other worms (*Pleuroneura*) the nervous centres never present this aspect, but vary much in their arrangement. Often they are reduced, and sometimes altogether wanting.

On very similar grounds, Mr. Busk, in his Lectures at the Royal College of Surgeons, suggested the propriety of placing the higher worms in a province by themselves, intermediate between the *Arthropoda* and *Annuloida*. For the *Intestina* of Cuvier, as modified by recent researches, he proposed the better name of *Scolecida*.

Both the *Gephyrea* and *Rotifera* are by some arranged with the *Scolecida*, by others placed in specially constituted classes. We think Vogt rightly estimated their systematic value when he regarded the former as an order of Annelids, and the *Rotifera* as a separate class. The *Rotifera* have undoubted affinities with the *Turbellaria* and *Platyelmia*, whether we consider their nervous or water-vascular systems. But their similarity to the larval conditions of various *Polychæta* and *Gephyrea* is equally striking. On the supposed resemblances of the *Rotifera* to such widely different groups as the *Polyzoa* and *Crustacea* we say nothing.* Nevertheless these resemblances, taken in conjunction with the deeper ones already indicated, do, so far as they go, justify the opinion that the *Rotifera* constitute a distinct class of animals. This class clearly belongs to the *Annuloida*.

Lastly, the *Scolecida* are related, it may be distantly, to the *Echinodermata*. First, the nervous system of the Echinoderms is more like that of the *Pleuroneura* than of the *Annelida*. Secondly, the water-vascular system of the one class reminds us strongly of the ambulacral vascular system of the other. Again, certain members of both classes present, in the course of their development, a curious combination of metamorphosis with internal gemmation, not witnessed elsewhere in the animal kingdom.

The near affinity of the Echinoderms and *Scolecida*, and the desirability of uniting both classes into one group, *Annuloida*, has been urged, for years past, by Mr. Huxley. A more usual view, however, for those who separate them from the *Radiata*, is to look upon the Echinoderms as equivalent to a primary division, or subkingdom. One or other of these two conflicting opinions must be

* Leydig and R. Leuckart are the two well-known advocates of these extremes of opinion.

adopted. We find modern German naturalists ignoring the old sub-kingdom *Annulosa*, and substituting in its stead three sub-kingdoms—*Arthropoda*, *Vermes*, and *Echinodermata*, while Professor Huxley* brings us back to the Articulate sub-kingdom of Cuvier, by associating once more, in a group apart, the *Arthropoda* and *Annelida*. The *Annuloida* he would also regard "as a distinct primary division of the Animal kingdom."

Proposed Sub-kingdoms. (*Germans.*)	Sub-kingdom ANNULOSA. Classes.	Proposed Sub-kingdoms. (*Huxley.*)
ECHINODERMATA.	1. *Echinodermata.*	ANNULOIDA.
VERMES.	2. *Scolecida.*	
	3. *Annelida.*	ARTICULATA. (Cuvier.)
ARTHROPODA.	4. *Crustacea.*	
	5. *Arachnida.*	
	6. *Myriapoda.*	
	7. *Insecta.*†	

In their nervous system and segmented body furnished with lateral appendages, the higher Annelids come so near the *Arthropoda* that morphology imperatively requires us to place both groups in the same sub-kingdom. On this point we at once adopt the views of Cuvier, as re-advocated by Professor Huxley. To raise the province of '*Vermes*' to the rank of a primary division seems, therefore, a mistake.

Nor are we indisposed to follow Professor Huxley when he would associate the Echinoderms in one primary division with the *Scolecida*. This appears to us a good provisional arrangement, in support of which we could say at least as much as can be urged in favour of any other view of their affinities.

On the other hand, so many diverse forms of Worms connect the true Annelids with the typical *Scolecida*, that we might hesitate

* Elements of Comparative Anatomy, 1864, (pp. 74-9). It is interesting to note this conservative tendency in a naturalist who cannot be accused either of want of originality or of undue proneness to venerate authority.

† We have purposely excluded the *Rotifera* from the above list of classes; first, because these animals are by Mr. Huxley placed under the *Scolecida*; and secondly, because the German naturalists (J. V. Carus, R. Leuckart, Gegenbaur, and others), to whom we refer, express very divergent views concerning their affinities.

to go so far as our esteemed colleague, when he objects to the retention of these classes within the limits of the same sub-kingdom. The existence of such forms as *Sagitta*, the Rotifers, and the Leeches, militates, in some degree, against this opinion. The Leeches, for example, so obviously resemble the *Trematoda*, that Diesing* has placed both groups in one order, *Myzhelmintha*. And yet the Leeches present a nervous system agreeing in its plan of structure with that of the higher *Annelida*. If, in this portion of their organisation, the latter approximate to the *Arthropoda*, not the less, in their pseudo-vascular system, do they find their nearest allies among the *Annuloida*. The affinities of the *Scolecida* and *Echinodermata* are not to be ignored. Neither must we lose sight of the relationship between the *Scolecida*, *Rotifera* and *Annelida*.

"Our classifications," writes Mr. Darwin,† "are often plainly influenced by chains of affinities." Such chains of affinities connect, it may be said, the *Arthropoda* with the higher *Annelida*, the higher *Annelida* with the lower, the lower *Annelida* with the *Scolecida*, the *Scolecida* with the *Echinodermata*, and all these forms with the *Rotifera*. The series, though a broken one, is never completely sundered, and each class has its own characteristic type of structure.

If, however, the argument from "chains of affinities" be rejected, then no choice is left us but to accept, for the time being, the classification suggested by Mr. Huxley. For though, as Linnæus long ago observed, a group is not constituted because we are able to define it; still, in systematic zoölogy, all groups of which we cannot offer exact definitions must be suspected. We fear the *Anarthropoda* are somew. at in this predicament.

Retaining, for the present, the sub-kingdom *Annulosa*, we may arrange its anarthropod forms under three distinct provinces, the *Annulata*, *Annuloida*, and *Echinodermata*. This we have done in the accompanying table, wherein the classes and orders of '*Vermes*' are enumerated. The arrangement therein submitted is thoroughly eclectic, however much it may seem to agree, in several of its aspects, with the views advocated by certain helminthologists. In its preparation we have been careful to consult all the classic memoirs on the structure and affinities of Worms, and to avoid, as far as possible,

* See his 'Revision der Myzhelminthen,' Wien Sitz., 1858. Also Note *, p. 26.
† Origin of Species, 1859, (p. 419).

prejudices arising from an attachment to particular systems, on the one hand, and a desire for innovation, on the other.

In the foregoing summary of our opinions touching the mutual relations of Worms, we regret that, for want of space, we have been unable to take up the detailed consideration of the several organic systems of this most interesting and extensive group, more especially of that complex series of parts which may collectively be denominated their 'pseudo-vascular'* system. Such a résumé ought rightly to precede any exact discussion of the affinities, limits, and sub-divisions of the group in question. We regret, consequently, that we have thus been compelled to present the general results to which our reflections have led us, apart from a full statement of our views of the facts on which these results have been based. But we are not the less confident of the proofs to which we refer, or the less ready to bring them forward, whenever a fitting opportunity offers: always, nevertheless, with this restriction, that we profess not to go beyond the present state of science, though ever ready to alter our views as soon as confirmation succeeds discovery.

(*See table, next page.*)

We thus see that all the annuloid parasites belong to one class, —*Scolecida*. This class includes the *Turbellaria*, beside the *Entozoa* of Rudolphi.

The *Turbellaria* need not now detain us. This order includes two sections; the *Proctucha*, which are unisexual, and have an alimentary canal furnished with both oral and anal orifices, and the *Aprocta*, which, in their general hermaphroditism, and the structure of their digestive apparatus, clearly approach the *Trematoda*.

The *Entozoa*, or Helminths† proper, were divided by Rudolphi into five orders:—*Nematoidea*, *Acanthocephala*, *Trematoda*, *Cestoidea*, and *Cystica*.‡ These groups have been universally admitted. Siebold

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* Including the ciliated and non-ciliated 'water vesssels,' the pseudo-hœmal system, the ambulacral system of the Echinoderms, and the 'secretory' tubules of various *Annelida*.

† The name Helminths, or rather its Greek equivalent, (ἔλμινς) may be traced as far back as the writings of Hippocrates. Aristotle, in the fifth book of his History of Animals, (Ed. Bekker, vol. i. p. 551,) refers to worms which live in the viscera, as those which are called ἕλμινθες (pl. of ἕλμις). Of these he distinguishes three kinds,—πλατεῖαι, στρογγύλαι, and ἀσκαρίδες. The word Helminth afterwards came to signify worms in general; but it was restored to its older signification before the close of the last century. Hermann (Helminthologische Bemerkungen, 1782-4) is usually cited as the founder of the group *Helminthes* of modern zoologists.

‡ 'Entozoorum Hist. Nat.' and 'Synopsis Entozoorum.'

ANNULOSA ANARTHROPODA.

PROVINCE—ANNULATA.

		Orders.
CLASS I. ANNELIDA. (Cuvier.)	**Monæcia.**	1. *Oestelmintha*, Gegenbaur.‡ 2. *Hirudinea*, Savigny, Vogt. 3. *Malacopoda*, De Blainville.† 4. *Oligochæta*, Grube.
	Diæcia.*	5. *Gephyrea*, De Quatrefages. 6. *Polychæta*, Grube.

PROVINCE—ANNULOIDA.

		Orders.
CLASS II. ROTIFERA. (Cuvier.)		1. *Natantia*, Vogt. 2. *Sessilia*, Vogt.

		Orders.
CLASS III. SCOLECIDA. (Busk.)	**Platyelmia.** (Vogt.)	1. *Turbellaria*, Ehrenberg. 2. *Trematoda*, Rudolphi. 3. *Cestoidea*, Rudolphi.
	Nematelmia. (Vogt.)	4. *Acanthocephala*, Rudolphi. 5. *Gordiacea*, Siebold. 6. *Nematoidea*, Rudolphi.§

PROVINCE—ECHINODERMATA.

	Orders.
CLASS IV. ECHINODERMATA. (Klein, *ext.*)	(*not given.*)

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* The diæcious Annelids have ciliated larvæ, which undergo a metamorphosis. The embryo of the monæcious forms is never ciliated, and, on leaving the egg, more or less closely resembles the parent.

‡ Suggested by Gegenbaur as the name of a 'class' for the genus *Sagitta*, which he considers should be placed between the *Nematoidea* and *Annelida*. We follow Krohn in regarding this perplexing form as an aberrant *Annelid.*

† Containing only the genus *Peripatus*, which Guilding, its discoverer, regarded as a Mollusk; Gervais, as a Myriapod; Audouin and Milne Edwards, as representing a family among the *Annelida Errantia*. Grube established for its reception a separate order (*Onychophora*) but afterwards thought it more nearly allied to the Leeches. A like view is held by Van Beneden. De Blainville, followed by Blanchard, raised *Peripatus* to the rank of a class. The first opinion of Grube seems to us that nearest the truth, but De Blainville's name has the priority. Milne Edwards, in his Lectures, has arranged *Peripatus* among the *Pleuroneura.*

§ It will be seen that the above arrangement returns into itself in so far as the has added a sixth order, *Gordiacea*, which some unite to the *Nematoidea*. The order *Cystica* has recently been suppressed, since it has been proved that an intimate genetic relationship subsists between these forms and the *Cestoidea*.

There exists, indeed, a greater amount of morphological resemblance among the Helminths than might, *a priori*, have been predicted. We must not, however, forget the existence of internal parasites belonging to other classes, as the *Infusoria* and *Insecta*. We find, on the contrary, some non-parasitic forms among the *Scolecida*, namely, all the *Turbellaria*, and several genera of *Nematoidea*.*

The astomatous Helminths (*Cestoidea* and *Acanthocephala*) are parasitic during the entire period of their existence. The parasitic Nematoids, which form the majority of that order, spend a portion of their life free. So do, likewise, the *Gordiacea*, and, to a still greater degree, the *Trematoda*.

The *Nematoidea* are directly developed from fertilized ova, and, so far as is known, do not exhibit the phenomena of agamogenesis, or asexual generation. The same is true of the *Gordiacea*, some of which, however, undergo a slight metamorphosis. Some, also, of the *Trematoda* develop themselves, in the usual manner, from ova of relatively large size, containing a copious supply of formative material.†

But many *Trematoda*, and all *Cestoidea* and *Acanthocephala*‡ present in their developmental cycle singular changes, in which metamorphosis is strangely blended with the phenomena of 'alternate generation.' The primitive zoöid resulting from the immediate development of the embryo is, in all cases, sexless, and gives rise by gemmation to the organism in which true generative elements make their appearance. Moreover, in order that development may take place, it is absolutely necessary that the ova or zoöids of each parasite

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highest *Scolecida* (*Nematoidea*) are those which approach nearest the *Annulata*. The *Rotifera*, a diœcious group, resemble the larval forms of the diœcious *Annelida*. In like manner the *Turbellaria aprocta* come next the *Trematoda*; and the *Cestoidea* immediately precede the *Acanthocephala*, although placed in distinct subclasses. The Nematoids and *Turbellaria proctucha* complete the circle of *Scolecida*, both groups touching upon the *Annelida*.

* For the most recent information on these, see Eberth, 'Untersuchungen über Nematoden,' 1863, and Mr. Bastian's forthcoming memoir in Linn. Trans.

† See Leuckart, op. cit. sup., p. 489.

‡ Presuming the facts observed by Leuckart in the case of *Echinorhynchus proteus* to be true of the whole group.

should find their way to the body of a second (perhaps a third or fourth) 'bearer.' In some instances this second animal-host is nearly allied to the first, differing from it, however, in habit; but often it belongs to a separate class, or even sub-kingdom.

Bearing in mind that these changes are by no means of the same simple character as those of ordinary metamorphosis, we may adopt the very convenient terminology of Van Beneden, and arrange the life cycle of the agamogenetic *Scolecida* under four periods, viz.:—

(*a.*) The 'proscolex,' or embryo.
(*b.*) The 'scolex,' or sexless zoöid developed therefrom.
(*c.*) The 'strobila,' or mature organism, with
(*d.*) The 'proglottis,' or generative zoöid.

Rarely is the second of these stages apparently wanting. Much more frequently do these organisms persist in the sexless condition for an indefinite period of time, continuing to grow, and multiplying by internal gemmation. In this manner many successions of 'nursing-forms,' as they have been termed, may arise from the development of a single embryo.

The structure of the *Scolecida* is scarcely less interesting than their development. It would be impossible, within our present limits, fully to discuss the problems which the study of their numerous anatomical relations suggests. In the body of most Scolecids we may, however, easily recognise the existence of the following principal systems of parts:—

(*a.*) A digestive system,
(*b.*) A tegumentary and connective,*
(*c.*) A reproductive,
(*d.*) A nervous, and
(*e.*) A pseudo-vascular system.

In two orders, *Cestoidea* and *Acanthocephala*, a digestive system is wholly wanting. Among the *Trematoda* the alimentary canal takes the form of a straight or branching tube, having but one aperture, the oral. The *Gordiacea*, quoad their digestive system, come between the *Trematoda* and anenterous *Entozoa;* that singular genus, *Sphærularia*, having an alimentary apparatus almost as simple as that of the *Infusoria*. The *Nematoidea*, in spite of their parasitic mode of life, have a digestive system not very different from that of the *Annelida*.

* Under this head, the 'muscular system' might also be described.

The *Scolecida*, wherein the digestive organs are thus reduced, present, on the other hand, a remarkably advanced development in their reproductive system. And though it is scarcely correct to speak of any of these creatures as sterelminthous or parenchymatous worms, still, what may be termed their general body-substance, or connective system, often occupies much of the interior of the organism, encroaching largely upon the perivisceral cavity. In both these points, relating, it is true, rather to grade of complexity than to type of organisation do the lower Helminths recall to mind the *Infusoria.*

Two leading modifications of the reproductive system may be indicated. In the *Cestoidea* and *Trematoda*, which are hermaphrodite, the spermatozoa become developed into active filiform bodies. The uterine and ovarian portions of the female genitalia always remain anatomically distinct from each other, and there is added a highly specialised yolk-forming apparatus, or 'vitellarium.'

The *Nematoidea* and *Gordiacea* are, in most instances, unisexual, and have their spermatic particles motionless, often rounded, but never filiform. The ovary and uterus are merely different regions of the same continuous tube.

The female apparatus of the *Acanthocephala* may be considered intermediate between that of the two types cited. Their sexes are distinct, as in the *Nematoidea* and *Gordiacea*, but the spermatozoa resemble those of the *Cestoidea* and *Trematoda.*

In some *Scolecida* no nervous system has yet been discovered. When present, its centres, like those of the lower neurosomatous animals generally (*Ctenophora*, *Rotifera*, *Polyzoa*, and *Tunicata*),* consist of a single ganglion, or of two more or less approximated. Much uncertaiuty still exists as to the true nature of the parts called nervous among the *Nematoidea* and *Gordiacea*, some authorities doubting if these animals possess any nervous system whatever.†

As to the various parts to which we have given the name of 'pseudo-vascular' system (the true vascular system of other animals being here, we need scarcely state, the general cavity of the body),

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* We here omit the *Echinodermata*, where the nervous apparatus presents features altogether peculiar to this remarkable class.

† It is, however, probable that future and more exact researches will detect among the round worms a nervous apparatus varying much throughout the different genera, but presenting among their higher forms a degree of complication greater than that of the simpler type to which we have above referred. In short, the nervous system of the *Nematoidea* will be found to differ from that of other Annuloid animals, much in the same manner as the *Brachiopoda*, in this respect, are distinguished from the lower Molluscoids.

their full description demands a separate article. Anatomists differ much in their interpretation of these "vessels," and in their attempts to correlate the diverse arrangements which they present among the leading genera and orders of Helminths. The same, unhappily, may still be said of the structures of these animals in general.

Three periods may be traced in the history of Helminthology, corresponding in some degree, to similar periods which have marked the progress of zoölogy in general.

The first, or tentative period, during which observations of all kinds were being accumulated, without due regard to completeness, accuracy, or orderly arrangement, may be said to have closed with the commencement of the present century.

The two next periods are nearly conterminous, and the commencement of both was foreshadowed in the writings of Goeze,* who may, however, arbitrarily be referred to the first period.

The second, or systematic period, is easily dated from the publication (1808-10) of the 'Entozoorum Historia Naturalis' of Rudolphi, a naturalist strongly imbued with the opinions of his great master, Linnæus. In 1819 appeared a condensed revision of this work under the title 'Synopsis Entozoorum.' Many minor essays on systematic Helminthology soon followed, among which those of Nitzsch, Creplin, and F. S. Leuckart especially claim attention. All these, however, had to give way to the 'Histoire Naturelle des Helminthes, ou Vers Intestinaux,' of Dujardin, published in 1845, as one of the volumes of the Nouvelles Suites a Buffon. A third great general work was the 'Systema Helminthum' of Diesing (1850), who has, in addition, written a series of most valuable memoirs on the several tribes of these animals, of the systematic characters of which he may justly be deemed the prime living expositor.

The third, or anatomical and embryological period, commenced later than the second, and, in spite of all it has accomplished, is yet in comparative infancy. Von Baer,† the father of modern embryology, was also the first to promote the deeper study of the

* Versuch einer Naturgeschichtes Eingeweidewürmer der thierischer Korper, 1787.

† In his 'Beiträge zur Kenntniss der Niederen Thiere' (1827), containing many curious observations on the *Trematoda*.

parasitic worms. But a great light was thrown on this department of zoölogy in 1835 by Von Siebold, when he gave to the world his account of the formation of the embryo in *Monostomum mutabile*, an apparently insignificant parasite of water-fowl. The full importance of Von Siebold's researches was not perceived till 1842, in which year Steenstrup produced his renowned essay 'On the Alternation of Generations.' The most interesting chapter in this essay was devoted to the Trematode animals; a chapter containing many original observations by Steenstrup himself, and unfolding, with rare ingenuity and boldness, the existence of a relation between various forms previously supposed distinct, but now shown to be metagenetic conditions of the same individual organism. Other investigators soon entered the field. It would be vain here to attempt even the most scanty survey of the discoveries effected in scientific Helminthology during the past thirty years. But amid the many illustrious names which reference to such discoveries must recall, that of Siebold still holds the foremost rank. As was said in 1854,* so may we say in 1865, that this great anatomist and embryologist is "truly at the head of Helminthology."

Dr. Cobbold's work, to which we would now direct the attention of our readers, is the first general treatise on the *Scolecida* ever published in Britain, and, for this reason alone, claims notice.

It is also gratifying to find a British publisher undertaking the issue of a work so purely scientific. The 'style' in which the book has been produced is excellent. Its size (royal octavo), its toned paper, its typography, and its illustrations all deserve admiration.

Dr. Cobbold's treatise contains a large amount of collateral information which will be useful to medical men, more especially as it discusses the pathology of verminous diseases and their treatment. Still, this is not its primary object. Nor does it enter copiously into anatomical and embryological details; so that, although convenient for reference, and by no means destitute of original matter, it will not, in any marked degree, advance the science of Helminthology. But it fills up, nevertheless, an important gap in our literature. It offers to educated persons ignorant of zoölogy, and to those naturalists who do not interest themselves deeply in

* By Dr. Waldo Burnett, in his translation of Siebold's Anatomy of the Invertebrata (p. 103).

helminthological studies, the best connected account which the English language affords of the general history of the *Entozoa*, their classification, external aspect, structure, habits, and development, with special reference to those forms which occur in man.

Very different in its nature is the work on Human Parasites by Rudolf Leuckart, who is well known as one of the most learned zoölogists in Germany, and who, apart from his many other original investigations, has taken a position in Helminthology scarcely inferior to that of Siebold. We need only refer to his treatise on the Cystic Worms* in proof of this assertion. Leuckart has, in truth, given the best account of the formation of the tœnioid scolex from its embryo. And he has also usefully extended the experiments of Küchenmeister and others on the strange wanderings of the *Cestoidea* in general. He is the only naturalist who has hitherto investigated with success the life-history of the *Acanthocephala*. Furthermore, he has thrown light upon the structure of certain parasitic forms not included among the Helminths, alike in his admirable memoir on *Pentastoma*,† and in his short account of the *Paramecium coli* of Malmsten.

The first volume of Leuckart's work is now before us. It contains an introduction, of nearly 130 pages, on the general natural history of parasites. A few pages follow on the parasitic *Protozoa* of man. But the greater portion of the volume is devoted to the human *Cestoidea*, *Trematoda*, and Leeches. These last, it may be said, occupy a curiously intermediate position between parasitic and non-parasitic animals. A second volume will be devoted to the *Nematoidea*, and to the parasitic Arachnids and Insects.

Although Leuckart's treatise is not 'got up' in the same luxurious style as Dr. Cobbold's, it is, nevertheless, well printed and copiously supplied with woodcuts. Most of these are original. The book, moreover, derives a classical character from the circumstance that the author has prefixed to the first volume a portrait of the illustrious Rudolphi,—pupil of Linnæus, and teacher of the scarcely less celebrated Johannes Müller, who wrote an able and affecting éloge in praise of his deceased master. Creplin, in 1829, dedicating to Rudolphi his 'Novæ Observationes de Entozois,' justly styled him "Princeps Helminthologorum."

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* Die Blasenbandwürmer und ihre Entwicklung, 1856.

† Bau und Entwicklungsgeschichte der Pentastomen, 1860.

The article 'Parasites,' by Mr. Busk, written for Holmes' System of Surgery, contains a general account of the human Helminths, with special reference to those forms, happily few in number, which give rise to morbid changes requiring the aid of the surgeon. We may add that Dr. Cobbold has dedicated his book to Mr. Busk, who has, indeed, contributed several of its illustrations.

Dr. Cobbold's book is divided into two Parts, the first treating of *Scolecida* in general, the second of human Helminths in particular.

The first Part (142 pages) contains a general survey of the families of *Turbellaria* and *Entozoa*, arranged under their several orders in one class, *Helmintha*. All the genera are mentioned by name, and a few of the more important forms belonging to each order of *Entozoa* have been selected for illustration.

The following is the arrangement of Helminths submitted by Dr. Cobbold:—

HELMINTHA. (Class.)	STERELMINTHA. (Sub-class I.)	*Turbellaria.* (Ord. I.)	ENTOZOA.
		Trematoda. (Ord. 2.)	
	CŒLELMINTHA. (Sub-class II.)	*Nematoda.* (Ord. 3.)	
	ANENTERELMINTHA. (Sub-class III.)	*Acanthocephala.* (Ord. 4.)	
		Cestoda. (Ord. 5.)	

Here the *Cestoidea* are separated far from the *Trematoda*, to which in structure they are allied, and placed in a sub-class with the *Acanthocephala*, distinguished by the negative character of wanting a digestive system. To the use of the word *Sterelmintha* we object, as it is not truly applicable to most of the forms so designated. Nor do we see any reason for altering the spelling of two of Rudolphi's names. The association of the *Turbellaria* and *Trematoda* in one group, not including the *Cestoidea*, was suggested long since by Milne Edwards and Blanchard. The last mentioned naturalist gave the title of 'Anévormes' to such an assemblage.

The first chapter, after some introductory remarks, closes with a brief survey of the *Turbellaria*. Then follow two chapters on the

Trematoda, three on the *Nematoidea*, one on the *Acanthocephala*, and two on the *Cestoidea*. Thus Part I. is completed.

Part II., entitled 'Special Helminthology,' is devoted to "an outline of the anatomical peculiarities, origin, mode of development and propagation of the *Entozoa* infesting Man; with a particular account of the injurious effects they produce, including a brief notice of the remedies employed in medical practice." This Part occupies the greater moiety of the volume.

The internal parasites of man were estimated by Professor Owen,* in 1855, as "not fewer than eighteen" in number, fourteen of these being "good and well-established species of Entozoa."

Three years later, Dr. Weinland, in his "Systematic Catalogue of all *Helminthes* found in Man,"† enumerated so many as thirty-two species of human *Entozoa*. Six, however, of these were characterised as "doubtful," and twelve others, as "imperfectly known," so that there remained, as in Professor Owen's estimate, but fourteen admissible specific forms.

The following is Professor Owen's list,‡ in a slightly revised form:—

1. *Echinococcus hominis.*
2. *Tænia solium,*
   (including *Cysticercus cellulosæ.*)
3. *Bothriocephalus latus.*
4. *Distoma hepaticum.*
5. *Distoma lanceolatum.*
6. *Trichina spiralis.*
7. *Filaria medinensis.*
8. *Filaria oculi humani.*
9. *Filaria bronchialis.*
10. *Trichocephalus dispar.*
11. *Spiroptera hominis.*
12. *Strongylus gigas.*
13. *Ascaris lumbricoides.*
14. *Oxyuris vermicularis.*

With the exception of *Spiroptera hominis*, which the recent re-

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* Second Edition of his Lectures on the Invertebrate Animals.

† Forming the "Appendix" to his "Human Cestoides—An Essay on the Tapeworms of Man," 1858.

‡ We have compiled this list from his 'Lectures.' An earlier catalogue will be found in the article 'Entozoa,'—Todd's Cyclopædia (Vol. II.)

searches of Schneider* have effectually banished from Helminthology, all the above species are still admitted, though, in some cases, under different names. *Echinococcus hominis* is the "hydatid" of a distinct form of *Tænia* (*T. echinococcus*, Siebold). R. Leuckart's investigations have conclusively shown that *Trichina spiralis* is not, as Küchenmeister, Weinland, and others supposed, a stage in the development of *Trichocephalus dispar*. Not only are all the above "good" species, but they are also undoubted human Helminths, save only *Strongylus gigas*.

Weinland's catalogue of human *Entozoa* has been very carefully revised by Dr. Cobbold, who has, in so doing, availed himself of the results of his own observations, as well as those of other helminthologists. Dr. Cobbold admits the following thirty-one species:—

1. *Fasciola hepatica*, Linn.
2. *Distoma lanceolatum*, Mehlis.
3. *Distoma ophthalmobium*, Diesing.
4. *Distoma crassum*, Busk.
5. *Distoma heterophyes*, Siebold.
6. *Bilharzia hæmatobia*, Cobbold.
7. *Tetrastoma renale*, Della Chiaje.
8. *Hexathyridium pinguicola*, Treutler.
9. *Hexathyridium venarum*, Treutler.
10. *Tænia solium*, Linn.
11. *Tænia mediocanellata*, Küchenmeister.
12. *Tænia acanthotrias*, Weinland.
13. *Tænia flavopuncta*, Weinland.
14. *Tænia nana*, Von Siebold.
15. *Tænia elliptica*, Batsch.
16. *Tænia marginata*, Batsch.
17. *Tænia echinococcus*, Von Siebold.
18. *Bothriocephalus latus*. Bremser.
19. *Bothriocephalus cordatus*, Leuckart.
20. *Ascaris lumbricoides*, Linn.
21. *Ascaris mystax*, Rudolphi.
22. *Tricocephalus dispar*, Rudolphi.
23. *Filaria lentis*, Diesing.

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* Müller's Archiv, 1862. p. 275. Mr. Busk has translated Schneider's paper in the Quarterly Journal of Microscopical Science for the same year, and gives a short abstract of its contents in his article above cited, p. 918.

24. *Filaria trachealis*, Cobbold.
25. *Trichina spiralis*, Owen.
26. *Strongylus bronchialis*, Cobbold.
27. *Eustrongylus gigas*, Diesing.
28. *Sclerostoma duodenale*, Cobbold.
29. *Oxyuris vermicularis*, Bremser.
30. *Dracunculus medinensis*, Cobbold.
31. *Dracunculus Loa*, Cobbold.

We have here nine Trematode, ten Cestoid, and twelve Nematode species. There are no human *Acanthocephala* or *Gordiacea*.

The round worms, as we have said, are not enumerated in the first volume of Leuckart's work. His list of Cestoids and Trematodes has priority of publication over that of Dr. Cobbold, and there are differences between the nomenclature of the two writers. Three of the human Trematodes admitted by Dr. Cobbold, Leuckart excludes on the ground of having been as yet inadequately observed; namely, *Hexathyridium pinguicola, H. venarum* and *Tetrastoma renale*. The *Monostoma lentis* of Nordman, considered by Leuckart a doubtful species, is associated by Dr. Cobbold with *Distoma ophthalmobium*. Both, it has been conjectured, are immature forms of the same species, probably *D. lanceolatum*. With these exceptions, the two lists essentially agree. Almost the only positive additions made to Weinland's enumeration are *Dracunculus loa*, and the second species of *Bothriocephalus*.

The above certainly appears a formidable catalogue, especially if we bear in mind that some human Helminths present themselves to the naturalist under a variety of conditions, distinguished so from one another, whether in form, structure, or by affecting different organs of the body, that, previous to a knowledge of their life-history, they were looked upon as constituting distinct species. Nay, the dissimilar zoöids of the same individual have been placed in separate genera and even orders. Here, at least, is a department of zoölogy with which all of us are intimately concerned. The paragon of animals may without exaggeration boast, how copious and diversified is the fauna which finds scope and verge enough to gratify the fullest parasitic propensities within the widely extended domain of his body politic. Not the number of species only, that of individuals, also, merits his attention. Küchenmeister assures us, on the authority of Dr. Kleefield of Görlitz, that forty tapeworms were harboured by one of his patients. We read, in an authentic record, of more than five hundred Ascarids inhabiting the alimentary canal of a child. But what are these to the thousands of *Trichinæ* which have been known in several cases to infest the muscles of a single "host"?

It is true that some of the above may be looked upon as bad or immature species, especially in such genera as *Filaria*. But human Helminthology is yet young, and, doubtless, further researches will soon bring to light new forms, to replace those which are lost by being merged into others.

With regard to comparative abundance, the species may be thus arranged. Ten* have hitherto been observed in man's body once only, and seven† others on but two or three occasions respectively. Four species—*Fasciola hepatica*, *Tænia elliptica*, *Sclerostoma duodenale* and *Dracunculas loa* appear to be of more frequent occurrence than is usually supposed. The remaining ten species may fairly be regarded as common human parasites.

Some of the human Helminths are less frequent in man than in other animals. *Fasciola hepatica* is the well-known liver 'fluke' of the sheep; *Distoma lanceolatum*,‡ of the ox, and both Trematodes occur in many herbivorous quadrupeds. *Bothriocephalus cordatus* is common in dogs, within which also *B. latus* has been found. The same may be said of *Tænia cucumerina*, with which *T. elliptica* of the cat appears identical; Leuckart, however, is opposed to this opinion. The strobiloid stages of the rare *T. marginata*, and, unhappily, the too common *T. echinococcus*, alike infest the dog and wolf, while the sexless condition of the former is parasitic not only within man but likewise within monkeys, squirrels, and various herbivora. *Ascaris mystax*, which Dr. Cobbold has shown to include the *A. alata* of Bellingham, is the round worm of the cat, and, like the *Cucullanus*

* *Distoma crassum*, *Tetrastoma renale*, *Hexathyridium pinguicola*, *Tænia acanthotrias*, *T. flavo-punctata*, *T. nana*, *T. marginata*, *Bothriocephalus cordatus*, *Filaria trachealis*, and *Eustrongylus gigas*. It is very uncertain whether the last-mentioned species be truly a human Helminth. Mr. Busk justly characterises the accounts of its occurrence as "either of such remote date, or so imperfect, that it is impossible from them to conclude whether the worm in question is really identical with that of the animals above mentioned [dog, polecat, etc.], or another species of the same genus, or whether, as is not improbable, in all the human cases some confusion has not arisen with the common round worm, *Ascaris lumbricoides*." (p. 918.)

† *Distoma lanceolatum*, *D. ophthalmobium*, *D. heterophyes*, *Hexathyridium venarum*, *Ascaris mystax*, *Filaria lentis*, and *Strongylus bronchialis*.

‡ This species is said to occur also in the Cat, but the fact needs confirmation.

and other Nematoids so well studied by Kölliker, has, thanks to the researches of Nelson, become famous in the history of embryology. *Trichina spiralis*, equally with the cysticercoid state of *Tænia solium*, is a common parasite of the pig. Lastly, it is interesting to note that the blood-worm of man has been detected by Dr. Cobbold within the portal vein of *Cercopithecus fuliginosus*. Most of the remaining Helminths in the above list would seem, so far as at present known, peculiar to the human species.

And now as to the parts of the body which the human *Entozoa* infest, a few words may be said. The *Trematoda* affect various viscera, both solid and hollow, and two species (*Bilharzia hæmatobia* and *Hexathyridium venarum*) have even been found in the blood. The *Cestoidea*, in their strobiloid stage, occur only within the alimentary canal, to which some of the ancients supposed all human parasites restricted. This opinion is clearly stated in a rather obscure passage in the works of the now little read poet *Apophantiacus*, which may be thus rendered:—

> Tell me, where is Tænia bred;
> In the guts, or in the head?
> In the former, truly.
> Kindly Providence confines
> To the human intestines
> Parasites unruly.

But the scolices of the same worms, especially of *Tænia echinococcus*, "may be found in any part and in any of the tissues, including the bones themselves." Among Nematoids, the guinea-worm takes up its abode within the cellular tissue, coming closer to the surface when mature. Another species of *Dracunculus* (*D. loa*) occurs commonly beneath the conjunctiva of negroes. To the same category, of eye-parasites, belong also *Filaria lentis* and one or two forms of *Trematoda*, besides the *Cysticercus cellulosæ*. *Trichina spiralis*, in its most familiar phase, is essentially a parasite of the muscular system. *Strongylus bronchialis* and *Filaria trachealis* select the respiratory organs. Most of the other human Nematoids inhabit the digestive canal.

With regard to his Cestoid parasites, the position man occupies is altogether peculiar. He is the only animal species in which the scolex and strobiloid condition of the same tape-worm have both been observed. This is true of two species, at least, *Tænia solium*, and *T. medio-canellata*. The strobiloid stages of these tape-worms are unquestionably derived from without. But how have their scolices been obtained? Leuckart would attribute their presence, when occurring in large numbers, to a process of 'self-infection.' *T. acanthotrias*, *T. marginata* and *T. echinococcus* have as yet been detected in man in the scolex state alone. His other Cestoids are only known in their strobiloid form.

The relative frequency of human Helminths varies much in different regions. According to Davaine, at least half the population of Paris are infested by *Trichocephalus dispar*. Kaschin writes that "In Irkutsk, the Burätes stationed there as Cossacks, and who, in part, have been away from their homes for many years, are, almost all of them, infested by tape-worms; some individuals harbouring as many as fifteen specimens at a time. In one hundred and thirty *post-mortem* examinations only two bodies were found entirely free from these parasites, and among five hundred other persons, treated in hospital, the existence of these entozoa was demonstrated in all." And in Iceland the common hydatid is so numerous, that Schleisner out of 327 patients, encountered 57 who were suffering from it. In all such instances, where a notable superabundance of *Entozoa* occurs, the explanation is not far to seek. We find, when we examine the habits of those infested, a neglect of the ordinary means of prevention. Thus, the Cossacks above referred to, "are herdsmen, and "feed almost exclusively upon flesh, especially that of calves, sheep, "camels, and horses; they neither clean the meat of these animals "properly, nor cook it completely, and, moreover, they eat from "tables which immediately before have served for the purpose of "cutting up the flesh. The tables are just as little familiarized with "the application of water, as are the dishes and the people them-"selves; in other words, they are never cleaned. Fat, liver, and "kidneys are eaten quite raw, and diseased animals are as much "relished as half-rotten carcases. Moreover, these Burätes are so "voracious that any two of them can demolish a one-year old lamb "at a single meal."

Human Helminths, like other animals, obey the laws of geographical distribution. The two species of *Dracunculus* are found only in some tropical regions, while the broad tape-worm restricts its range to certain parts of the continent of Europe. *Bilharzia** is confined to Africa. Some might choose to state that these para-

* This parasite is also remarkable as affording, in common with one or two species of *Distoma* proper, the rare example of a unisexual Trematode.

sites are thus distributed because they affect peculiar races of mankind. But the guinea-worm has been met with "in individuals of every race; the only condition apparently necessary being that they should have visited some of the parts comprised in its endemic range within a certain period." So, in like manner, English and American visitors to the continent occasionally return thence the involuntary hosts of *Bothriocephalus latus*, which they have brought with them as a pleasing memento of their stay in countries beyond the sea.

The backward state of Helminthology in former times affords no data for solving the interesting problem, whether during the progress of years an increase has taken place in the catalogue of human *Entozoa*. Again, are these parasites capable of being rendered endemic in animal species to which they were before strangers? This is preeminently a question of fact, which it is yet possible experiment may enable us to answer in the affirmative.

These enquiries necessarily lead on to others, touching the precise character of the relations between Helminths and their host, and the diverse conditions under which each form is capable of existing. The limits of range in structure or habit which the species of Helminths present, and their apparent modificability by external influences demand henceforth a diligent investigation. For here the adjustment between the organism and its environment is of so peculiar a kind, as to suggest the consideration of a most curious series of cases to all entering upon the study of the boundless subject of variation.

The great majority of human Helminths appear to be introduced from without, and, when found in considerable numbers, their presence is usually traceable to obvious neglect of cleanliness, the drinking of impure water, or the eating of imperfectly cooked flesh, particularly beef and pork. The guinea-worm is, in all probability, transferred to our bodies by bathing the feet in the waters which this parasite frequents, while in an early phase of its existence. The neighbourhood of dogs, also, unless proper precautions be taken, is favourable to the development of *Tænia echinococcus*. But, of all animals, feral or domestic, the common pig is, beyond doubt, the most fertile nurse of human *Entozoa*. At least, two important parasites, *Trichina spiralis*, and *the* tape-worm, would, there is good reason to suppose, cease to infest us did not this favourite quadruped act the part of a communicating medium. Considering the important aids to helminthogenesis thus afforded, we may be excused for assigning a new meaning to Hamlet's supposed reference to the earth-worm: "Your worm (*Tænia*) is your only emperor for diet; we fat all creatures else to fat us, and we fat ourselves for maggots (*Trichinæ*)." *T. medio-canellata* comes to us from calves and oxen. Most *Entozoa*, in the first instance, enter by the alimentary canal. There some remain, and acquire their complete development; others, including the embryos of these last, pierce the digestive wall, and obtain access to their appropriate dwelling-place, either by direct penetration, or the more ready transporting influence of the blood-current.

Of Helminthology, in its relation to pathology and therapeutics, we shall not here treat. It has been shown that some *Entozoa* give rise to various symptoms of a general or special character, indicating either slight affections or diseases sufficiently serious to end in death. These diseases require medical or surgical assistance, though cases may arise in which, from the situation of the parasites, no remedy can be obtained. Moreover, the diagnosis of the presence of Helminths is often very difficult, and sometimes quite impossible.

And yet it may be urged that scarcely six species of human *Entozoa* produce morbid phenomena sufficiently pronounced or alarming in their nature to merit (in the aggregate) distinct names. *Trichina*, *Bilharzia*, *Dracunculus*, the two last extra-European forms, and the various kinds of hydatids are, in this respect, particularly worthy of notice. Even hydatids cannot, in strictness, be said to cause special symptoms; but rather, as foreign bodies occupying important organs, induce, to a greater or less degree, local mischief. Other worms, occurring in the hollow viscera, may, in like manner, excite irritation. But such irritation is seldom pathognomic. Many Helminths produce no positive symptoms whatever, and the evils ascribed to their presence ought fairly to be attributed to other causes. Thus, to take *Tænia* as an instance. When this animal, in its strobiloid state, occurs as a parasite of the alimentary canal, good authorities inform us that no indication of its existence there can be relied on, save the expulsion of proglottids from the body. "Man may enjoy perfect health through a number of "years, with a tapeworm in the intestines. We have ourselves "[continues Weinland] known one case of this kind, in our neigh-"bourhood, the person being a butcher. The Abyssinians even "consider it as a sure sign of health to be the bearer of a tape-"worm, and a negro slave among them is valued higher for it."

And if this freedom from unpleasant consequences be true of that "monstrum horrendum et ingens," as Doeveren* styles the *Tænia*, how much more does it not apply to most of the smaller parasites?

In truth, it is a monstrous assumption to regard the occurrence of *Entozoa* within the human body as constituting, *per se*, an abnormal state of things. Let us not forget the case of other animals, with reference to the same category. Is the existence of the whole helminthoid group, with its manifold types, displaying such wonderful structures, such wonderful relations to other groups, and to the general conditions of life, to be regarded as an anomaly? *Entozoa*, in excessive numbers, or in unusual situations, have indeed proved dangerous, but such dangers are either rare or, if not so, may be met by proper prophylactic measures. No doubt a single *Dracunculus*, or a large hydatid, or even a small scolex-cyst in some situations (*e.g.*, *Cysticercus cellulosæ* in the eye, as described by Von Gräfe) offer exceptions to what has just been said. And the multilocular or colloid form of hydatid disease which Virchow and Leuckart have so well explained, demands a special place in the 'genera morborum.' Still, even in these instances, modifying circumstances may occur. Spontaneous disappearance of hydatids is not infrequent. *Dracunculus loa*, though more than an inch in length, quits, after a residence of years, the eye which it infests, "and thus the disease becomes naturally cured."† Even its larger congener is not always dangerous. "In one case," writes Mr. Busk, "in which a guinea-worm fully six feet long was accidentally discovered lodged in the deep cellular tissure of the leg around the tendo Achillis, and which occurred under our own observation, no morbid symptom whatever was exhibited during life, nor after death was there the slightest appearance of irritation in the surrounding tissue."

We might recollect, also, how man is liable to suffer, though in a different way, from his enemies among the non-parasitic members of the animal kingdom.

It would appear, further, that certain morbid states of the body, due to various causes, render man particularly obnoxious to the attacks of parasites. This seems proved by the fact that numerous *Entozoa* of several kinds, having obviously no genetic connection

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* Dissertatio de Vermibus Intestinalibus Hominum, 1753, p. 15.

† Cobbold, p. 389, on authority of Guyot.

with one another, and differing much in habit, have revealed themselves at times in an unexpected manner, together with other evidences of disease, in the same subject.

Of *Entozoa* indirectly injurious to man, because of their affecting, in extraordinary abundance, valuable domestic animals whose death or deteriorated condition they seem to cause, by far the most noteworthy are the 'fluke-worm' of the sheep, the scolex which induces the disease called 'staggers' in the same animal, and the scolex which gives rise to the 'measled' condition of pork. The first of these scolices is derived from one of the six species of tape-worm which infest the dog; the other is identical with the *cysticercus*-stage of *Tænia solium*. Here also we may mention the nematode worm, *Sclerostoma syngamus*, which causes the 'gape-disease' in our domestic fowls. An interesting description of this species is given in the first Part of Dr. Cobbold's work.

Dr. Cobbold has added a third, or supplemental Part, on "Spurious Helminthology." The first chapter of this Part contains detailed descriptions of the two species of *Pentastomata* found occasionally in the body of man. One of these (*P. constrictum*) is only known, as a human parasite, in its larval condition, which is, however, sufficiently distinct from the corresponding stage in the development of *P. tænioides*.

The second, and concluding chapter, is devoted to an enumeration of the principal 'Pseudo-entozoa,' which have, from time to time, perplexed medical practitioners. Some of these are genuine Helminths, not belonging to man, which, through accident or design, have been placed in conditions of such a nature as to cause their being mistaken for human parasites. Others belong to different classes of the Annulose sub-kingdom, as the *Annelida* or *Insecta*. The *Dactylius aculeatus* of Curling, for example, is, doubtless, a true Annelid. Dr. Cobbold has given a long excerpt from the Rev. J. F. Hope's list of Insects or their larvæ, cases of the occasional parasitism of which within our bodies have been recorded. Rejecting many of these as truly spurious, some still remain, the authenticity of which it is not easy to disbelieve.

A word should be said in praise of the beautiful series of figures which serve to illustrate Dr. Cobbold's volume. Besides several woodcuts, no fewer than twenty-one tinted plates, each containing a number of separate drawings, are given. Altogether there is total of two hundred and thirty-eight illustrations, of which one hundred and five are by Dr. Cobbold himself. Mr. Busk is the contributor next in importance. The remaining figures are taken from a large selection of authors.

The volume is brought to a conclusion by a long bibliographical catalogue, extending to sixty pages. This is entirely devoted to English works and papers, or to translations in the English language of foreign memoirs on the *Entozoa*. It has been Dr. Cobbold's object "to do for British and American authors what Davaine has done for foreign writers." These two lists, together with that of J. V. Carus and Engelmann in the Bibliotheca Zoologica, and the Reports furnished by Leuckart to Wiegmann's Archives, afford the fullest and most copious reference to the extant literature of Helminthology. Let not the magnitude of the subject deter students from entering so rich a field. Here, as in other departments of zoölogy, the capital works are not too numerous, or too often read. For human Helminthology alone, the treatises of Davaine and Küchenmeister, together with the little tractate of Weinland, will be found a sufficient addition to those which we have named at the head of the present article. If restricted to a single book, the student cannot do better than choose that of Leuckart, but, if ignorant of German, let him by all means purchase the useful monograph of Dr. Cobbold.

XXIX.—Bronn's Animal Kingdom.

Die Klassen und Ordnungen des Thier-reichs, wissenschaftlich dargestellt in Wort und Bild. Von Dr. H. G. Bronn: fortgesetzt von Dr. W. Keferstein. Leipzig und Heidelberg: 1860—1865, 8vo. vols. i.—iii.

It is perhaps hardly fair to institute a comparison between the great work on the Classes and Orders of the Animal Kingdom, designed and partially executed by the distinguished Palæontologist of Heidelberg, Professor Bronn, and the Handbook of Zoology, of which we noticed the appearance in a recent number. The latter is intended only as a Manual of Zoology—a work for students, to contain as much information as possible in a small space,—the former, destined apparently to an almost unlimited extension, may be regarded as a nearly exhaustive Textbook of Zoological Science. Nevertheless, the two books illustrate the two different modes of treatment of the subject to which we adverted in the notice of the "Handbuch der Zoologie;" and perhaps the extent to which Professor Bronn's work threatens to attain, may serve to indicate the fact that the accumulation of observations on the structure, habits and general classification of animals, is now so great as to require a book of no small compass for their satisfactory exposition.

Some notion of Professor Bronn's idea of the nature of a treatise on Zoology, may be gathered from his definition of the science and of its various branches. "The task of Zoology," he says, "is to observe, describe and arrange all animals in accordance with all their parts, peculiar activities and external relations, and to arrange them in such a manner that not only are the species brought together in proportion to their mutual agreements in genera, families, orders, classes, &c., but that these also are placed one above the other in accordance with their degree of perfection. It consequently divides itself into many separate branches, amongst which we may indicate as the most important, Zootomy, or the dissection of all the formative parts of the body; Zoochemistry, or their chemical investigation; Zoophysiology, or the science of the functions of the organs; the tracing of the changes of form, and of the course both of corporeal and intellectual life from the first germ of the *individual* through all its ages to its death,—and lastly, with regard to species and groups of species, (*a*) their complete description or Zoography; (*b*) their systematic arrangement or Taxonomy; (*c*) their geographico-topographical distribution; (*d*) their geological evolution; and lastly, (*e*) their position in the œconomy of nature."

This being, as it were, the outline which Professor Bronn set before him at starting, and which he conscientiously endeavoured to fill up, it will be readily understood that his work takes far higher ground than any other treatise on Zoology,—aiming indeed at bringing together the whole body of scientific Zoology, with the exception of specific descriptions, which from the nature of the case could not be included in his design. But besides all this he gives a prominent place to the history of the science, indicating in his general introduction the chief observers by whose labours Zoology has been brought to its present position, and detailing under each class, the different views which have been entertained by naturalists as to the nature and relationships of the animals composing it. The importance of a knowledge of the history of a science to those engaged in its cultivation can hardly be overrated; it is to this, more than anything, that the philosophical naturalist owes his preeminence over the mere observer and collector; and by it and the knowledge which it gives of the phases through which opinion has passed, the student of science, as of some other subjects, may be preserved from a bigotry and prejudice to which his not more earnest but less instructed brethren are but too liable. Professor Bronn's historical notices are necessarily very brief, but they suffice to indicate the general direction in which the student must push his investigations; and the excellent lists that he has given of the principal works and memoirs extant in each class, will furnish great assistance in carrying out this object.

In his treatment of each class the author adopts the following course. Commencing with a dissertation on the names given to the class and its zoological history, followed by an admirably arranged bibliography, in which the general nature of the contents of each work is indicated by a word or two, which takes the place of the title in the case of Memoirs published in Journals and the Transactions of Societies, he proceeds to describe in detail the anatomical structure of the members of the class, including under this head the anatomy of the external form, the histology of the animals as far as it is known, and the nature of the organs of which the body is composed. These particulars are followed by indications of the chemical constituents found in the animals and in their different parts, and these again by general considerations on the functions of the organs, and the means by which they are employed for the purposes of the individual. In a special section devoted to the life-history of the animals forming each class, we find a full account of the various phases of development through which they pass, a department of the subject which, especially as regards the lower animals, presents the most attractive field for the observations of the Zoologist. Throughout the foregoing sections the author has necessarily derived the greater part of his materials from the labours of other observers, but the facts thus presented have been elaborated by him in so perfect a manner, that the student will find in his pages an almost perfect digest of the present condition of these branches of Zoology, so arranged as to be peculiarly easy of reference.

In his sections on Classification, Professor Bronn has not been contented with describing the characters of the orders into which he divides each class, but has furnished his readers with a tabular analysis of the genera, which, with the help of the tables of geographical and geological distribution appended to the sections on the relations of the classes to space and time, produces a remarkably clear and comprehensive view of the highest results of systematic Zoology.

In the section treating of the part played by the different classes, or rather by their members in the general œconomy of nature, we find briefly indicated the principal modes in which each animal type reacts upon its fellows, whether by preying upon them or by being preyed upon, and also the effects produced in the grander operations of nature, connected with the formation of new geological beds. After this brief and imperfect account of the general treatment of the subject adopted by Professor Bronn, we may now proceed to indicate the general classification which has been followed by him in the present work.

Professor Bronn distinguishes five sub-kingdoms of Animals, which he calls *Amorphozoa*, (=*Protozoa*), *Actinozoa* (=*Radiata*), *Malacozoa*, *Entomozoa and Spondylozoa.* The characters of these five primary groups are brought together at the end of his general introduction, (Vol I. p. 9), in a table which will well repay a close examination, as it displays the agreements and discrepancies presented by all those portions of the organism to which naturalists have referred for the characters of their primary classification, and at the same time shows the difficulty of adopting any one system of organs, or set of characters for the discrimination of the leading types of animal structure. Of all single characters, the nature of the nervous system corresponds most closely, as is well known, with the general results of systematic investigations, but even this is liable to exceptions; and Professor Bronn's table shows clearly that embryological characters cannot be applied to this purpose on the scale in which they have been employed by some writers.

The sequence of the sub-kingdoms in the ascending or descending scale, which we are forced to adopt in treating of the animal kingdom as a whole, is perhaps in the present day, a matter of little consequence. Professor Bronn places the Entomozoa, (or Annulosa) above the Malacozoa, evidently guided by the fact that in them as a rule the organic systems of animal life predominate, whilst in the three lower groups, as indicated by him, we find a predominance of the vegetative functions. It may, however, be questioned whether, although the great majority of the Entomozoa may present more highly animal characters than the majority of the Mollusca, the highest forms of the latter do not really occupy a more elevated position in the scale of organization than any Annulose animals, whilst the lowest members of both groups appear to stand in this respect pretty much on a level.

The great defect in the system adopted in this work is, however, the non-adoption of the sub-kingdom Cœlenterata, which may certainly be regarded as well established. The retention of the Radiated animals (Actinozoa) as a primary group, including both the Cœlenterata and Echinodermata is manifestly a mistake, and it is clear from Professor Bronn's table that it has given him some trouble to arrange his characters, so that one is surprised that he was not led to separate elements so incongruous.

After what we have said of the nearly exhaustive mode of treatment adopted by Professor Bronn, it will be unnecessary for us to do more than furnish our readers with a brief exposition of the general classification followed by him. His sub-kingdom *Amorphozoa* is divided into four classes, of which the Sponges occupy the lowest place. These are followed by the *Polycystina*, including besides the organisms ordinarily known under that name, the *Acanthometrina* and *Thalassicollæ*, the whole of which appear to have been regarded by the author as constituting a group intermediate in many of its characters between the true Rhizopoda and the Sponges. The remaining two classes of Amorphozoa admitted by Professor Bronn are the *Rhizopoda* and *Infusoria;* the *Gregarinæ* and *Noctiluca* being provisionally, but we believe erroneously, referred to the former group. In his description of the structure of the Foraminifera, the author has availed himself freely of the admirable papers published by Dr. Carpenter in our Philosophical Transactions, but the portion of his work relating to them appeared at too early a date, to allow his views to be influenced by the magnificent volume on those interesting animals issued by the Ray Society.

With regard to his *Actinozoa,* the author admits the great difference existing between the *Cœlenterata* of Leuckart and the *Echinodermata,* regarding them as forming two distinct groups (*Unterkreise*) subordinate to the great primary subdivision of Actinozoa. He indicates moreover that "the Echinodermata form on the whole a group placed by important characters far above the Cœlenterata," but adds, "that a parallel serial arrangement makes its appearance in the classes on each side, inasmuch as their progress to a higher state of organisation is effected, at least partially, by analogous changes," a parallelism which he illustrates in a tabular form on p. 423 (Vol. II.) It must be confessed that this view of the matter is not a very satisfactory one. Professor Bronn's parallel series are exceedingly fanciful, and they certainly furnish no evidence in favour of the retention of the Echinodermata in the same primary group with the Cœlenterata. In the classification of the latter, moreover, there is much that seems to us unsatisfactory, there is no recognition of the division of the group into the two sections of Hydrozoa and Actinozoa, which appears to be fully warranted by the well marked differences of organisation presented by these animals, and the four classes into which the Cœlenterata are divided are of very unequal value. On the lowest step of the classificational ladder we find the *Polypi* (=Anthozoa) which we should have thought better placed at the highest point; these are followed by a class of *Hydræ,* including only the fresh-water Polyps of the genus *Hydra;* whilst the third class, under the name of *Medusæ,* embraces within its wide boundaries, the whole of the Hydroid Polypes, *Medusæ* and *Siphonophoræ.* The fourth class again includes only the Ctenophora.

Of the classification of the Echinodermata we need say but little. Professor Bronn has simply elevated the five orders of these animals usually recognized by naturalists to the rank of classes, under the names of *Blastoidea, Crinoidea, Asterioid, Echinoidea* and *Scytodermata(=Holothurioidea.)* In taking this course, Professor Bronn has realised a notion which, we think, must have frequently occurred to Naturalists, namely that the differences between the various groups of Echinodermata, are of more than ordinal value; in fact the characters on which these groups are founded are fully equal in importance to those by which the classes of Arthropoda are distinguished. Our only surprise is, that having gone so far he did not advance a step further by forming the Echinodermata into a sixth primary group, a proceeding which, notwithstanding the annuloid relationships of these animals, would certainly have been preferable to leaving them in the same sub-kingdom with the Cœlenterata.

The third volume on the Malacozoa, which is still incomplete, although it already extends to nearly 1300 pages, is only partly the work of Professor Bronn, who had advanced in his ascending classification as far as the Nudibranchs at the time of his lamented decease. This portion of the book has been continued, as already stated, by Dr. Keferstein of Göttingen.

The classification of the Mollusca has been so fully elaborated by so many eminent Zoologists, that the greater groups of the Malacological system may now be regarded as generally agreed upon, and we scarcely look for any alterations in them except from writers who are urged by a restless spirit of innovation. That Professor Bronn was rather conservative, perhaps almost too conservative, in his mode of treating some zoological questions, is evident from what we have already stated, and he shows a similar spirit in his primary classification of the Mollusca. Instead of adopting Milne-Edwards' division of this great sub-kingdom into Molluscoida and Mollusca proper, a course which has received the approbation of most modern Zoologists, he reverts to the old Cuvierian arrangement, and divides the group into two sub-groups; the *Malacozoa acephala* and the *M. cephalota* or *Cephalo-malacia*. Among the former, however, he again recognises two groups to which he gives the names of *Saccacephala* and *Conchacephala;* the former including the Bryozoa and Tunicata (*Molluscoida*), the latter the ordinary Bivalves and Brachiopods. In the classification of the Bryozoa (for which he retains Ehrenberg's name) the author follows Professors Allman and Busk; in that of the Tunicata he has adopted a new system, or rather a remodelling of an old one, which does not seem to us to be particularly happy. Neglecting the results of Professor Huxley's investigations upon the affinities of these animals, he divides the class Tunicata into two orders, *Nectascidia* and *Chthonascida*, distinguished solely by the presence or absence of the power of natation, by which means *Pyrosoma* and *Doliolum* are united with the *Salpæ*, although curiously enough, the former is parenthetically stated to be "most nearly allied to the *Botryllina.*"

In the Brachiopoda (*Brachionacephala*, Bronn), the *Lingulidæ*, *Discinidæ* and *Craniadæ* are separated from the rest of the class to form an order called *Pleuropygia*, in allusion to their possession of an anus, and in opposition to the term *Apygia* applied to the other forms in which no anus is present. These groups are further characterised by the existence of a toothed hinge in the latter and its absence in the former. The Lamellibranchia are likewise divided into two orders, the *Hippuritidæ* being separated, under the name of *Endocardines*, from the rest of the class; to which the name of *Exocardines* is given.

In the arrangement of the Cephalophorous Mollusca here adopted the *Dentalia* figure as a distinct class, for which the name of *Prosopocephala* or *Scaphopoda* is proposed. The *Pteropoda*, on the contrary, are referred to the Gasteropoda, among which they apparently take an ordinal rank. The other orders of Gasteropoda adopted are the

Opisthobranchia, with the completion of which Professor Bronn's work ceases; *Heteropoda; Prosobranchia,* and *Pulmonata.* We may note here that Dr. Keferstein has abandoned the arrangement of the Synopsis of genera in a tabular form, a plan which was adopted by Professor Bronn throughout his portion of the work; and also that he devotes a great deal of space to the geographical distribution, which is discussed in great detail.

It will be seen that, with the exception of the classification of some parts of the Actinozoa, the chief objections that we have to urge against this valuable work relate only to minor points, and that they are such as very slightly detract from its usefulness to those advanced zoological students for whose behalf it has evidently been prepared. When we set against these defects the evidences of care in the compilation of the accounts of the different classes, and the copiousness of the details given upon all points of the structure and life-history of the animals composing them, the faults retire still further into the background, and we are impressed solely with the great excellence of the work, and with a sense of the gigantic labour which must have been required to bring together such a mass of material, and to arrange it in so convenient a form. As a Textbook of recent and fossil Zoology it is, and will probably long remain, without a rival.

We have hitherto spoken only of the literary portion of this work, but its illustrations require some notice, as indeed might be expected from the statement on the title page. The pictorial department of these volumes seems to us to be deserving of all praise; the figures, although perhaps sometimes not quite so delicate as those with which the special works of naturalists are illustrated, are nevertheless admirably executed, and constitute unquestionably the grandest body of illustrations with which any scientific Textbook was ever adorned. The plates, which are lithographed, are exceedingly numerous, and furnish illustrations, generally copied from those of the best authorities, of all the points in the structure and developmental history of the animals which are most characteristic of the different classes and subordinate groups, and also representations of the external form and appearance of the most typical genera. The figures of generic types are referred to in the tables of genera, and thus the student will be enabled by the aid of this book alone, to determine a vast number of the animals which are most likely to occur to him in his investigations.

XXX.—Lacaze-Duthiers on Coral.

Histoire Naturelle du Corail. Par H. Lacaze-Duthiers. Paris, J. B. Baillière et Fils, 1864.

There is perhaps no invertebrate animal which has excited so much interest in the commercial or scientific world as that whose mortal remains are familiarly known to us as "Coral"—the red coral of our infant days, and the pink coral of our more mature and fashionable life. For many years its position in the organic world was a subject of fierce dispute among continental naturalists, and it was only by very slow degrees that the idea of its vegetable nature was dispelled and its place in the animal kingdom formally acknowledged.

Long, however, before this took place coral was an object of commercial pursuit, and its value for ornamental purposes contributed largely to direct attention to its nature and the best means of increasing its production. After the occupation of Algeria by the French the Colonial Government early gave its attention to the subject, and successive Governors of that province did their utmost to develope the fishery for coral as a source of revenue to the colony. Their efforts, however, were without effect, and it was not until 1855 that, at the instigation of Marshal Vaillant, steps were taken in a right direction, and the *Société d'Acclimatation* was consulted as to the proper means of dealing with the subject. It then became evident that nothing less than a thorough scientific study of the living coral would provide the necessary information for properly managing the fishery, and after many difficulties and delays M. Lacaze-Duthiers was appointed to carry out the investigation—an agreeable task, the results of which are embodied in the volume before us, and which adds one more to the list of elaborate and exhaustive monographs that the industry of French naturalists has contributed to the literature of science.

M. Lacaze-Duthiers was already favourably known by his published researches among the invertebrate animals of the Mediterranean, when he was called upon to investigate the natural history of the coral, and in the introduction to his volume he publishes, perhaps somewhat unnecessarily, the complimentary letter of M. Quatrefages offering him the appointment.

The work is divided into seven chapters, of which the first five are devoted to the scientific portion of the subject; the remaining divisions treating of the manner in which the fishery is carried on, the manufacture of the coral into ornaments, and the markets to which they are principally sent. The author commences with a general survey of what has been written on the subject of coral, and refers to the many wild opinions that in olden times were held about its nature, and to the manner in which, when the first glimmerings of truth were discovered, the facts became distorted into new forms of fiction. When, in 1706, Marsigli announced his discovery of the "flowers" of the coral the attention of naturalists was again directed to the question of its nature, for it had also been observed that these flowers had a considerable power of motion and were even capable of being altogether withdrawn in a manner totally inconsistent with anything that was known in the economy of the vegetable kingdom. The inquiry was pursued with various results by Boccone, Réaumur, and Peyssonnel, a pupil of Marsigli. Being appointed by the Government to examine into the natural history of the coasts of Barbary, Peyssonnel had then a valuable opportunity of working out the history of the coral, and to him undoubtedly belongs the credit of first comprehending and making known the relations of the various hard and soft parts which are together found in the living coral. Peyssonnel, however, had to share the fate of many of those whose researches lead to the overthrow of popular ideas. Although his writings had raised him to such a position among scientific men that he was admitted to the Academy when he was only twenty-six years of age, that learned body refused to believe in these discoveries, and it was not until many years afterwards that their truth was generally admitted. In the meantime, Peyssonnel, disgusted at the treatment he had received, left his country, never to return; and various memoirs written by him were translated into English, and appeared in the *Philosophical Transactions*, but were never published in French.

The animal nature of the coral was thus firmly established, but its organization and reproduction were not systematically worked out until M. Lacaze-Duthiers was specially appointed to the task.

Before commencing an account of his examination of the coral the author very properly gives an explanation of the several new terms he found it desirable to introduce into his descriptions, and defends himself against the expected charge of unnecessarily adding to or changing expressions already in general use. It is satisfactory to meet with a naturalist who is so conscious of the evil of multiplying technical terms—a necessary evil, undoubtedly, in many cases, especially when describing the varied organization of invertebrate animals, but one that has also a strong tendency to become fashionable. His substitution of *sarcosome* for *polypiëroide*, as used by Milne-Edwards to designate the fleshy part of the coral, has certainly the great merit of significance, and, moreover, gets rid of one of the many derivatives of the radical word *polype*.

The Mediterranean is the special stronghold of *Corallium rubrum*. A considerable quantity is procured from the coasts of Spain, France, and Italy, but the finest and best-grown specimens appear to be obtained from the immediate neighbourhood of Algeria. M. Lacaze-Duthiers accordingly posted himself at La Calle, one of the principal fishing stations on that coast, and there he remained for several months before he succeeded in obtaining suitable specimens for examination. He speaks in detail of the various difficulties he met with from the ignorance and suspicion of the fishermen, of their broken promises and worthless specimens, and finally of the objection he himself felt to going out in the fishing boats, when the period of their return depended mainly on their success in the fishery. No doubt many in this country will sympathize with the author, and can also explain to him that most of the difficulties he encountered were those usually attending the demand for deep-sea animals when ordinary fishermen are the only channel for procuring them. At last, however, his official position carried him through—a position that, it might have been expected, would have smoothed his path from the first, and prevented his losing so much time in waiting on the caprices and prejudices of the fishermen. The aquarium now did him good service, and his situation in a latitude where the temperature makes some approach to that of the tropics furnished him with some hitherto rare experience of the difficulties attending the proper regulation of light and heat in the management of marine animals in captivity. The author, however, appears to have ignored the great principle of the aquarium, and we find no indication of his acquaintance with the magic influence of vegetation in decomposing the fatal carbonic acid gas and restoring the oxygen so essential to animal life. He speaks of "regularly emptying the glasses for the purpose of cleaning them and changing the water," a practice alike undesirable and unnecessary. The disadvantage of thus periodically exposing the coral to the atmosphere ultimately induced him to arrange a system of pipes by which the new water was gradually circulated through the aquarium, and the waste carried off from below. This habit of changing the water led accidentally to an observation of some interest. A branch of coral which had for some time flourished in captivity at other places on the coast remained in a contracted state for a fortnight after being brought to Algiers. The water, renewed with the greatest care, was obtained at the pier on the *outside* of the harbour, but without producing any change. It was then suggested by the sailor in attendance on the author that this water had been too much aerated by continued breaking on the rocks, and a supply from *within* the harbour would be more suitable. The experiment was tried, and the polyps immediately expanded. This explanation, adopted by M. Lacaze-Duthiers, may possibly be the correct one, although opposed to general experience, and if we cannot at once accept it as satisfactory it is because so many delicate conditions besides that of aeration may be involved in such an experiment. We have called attention to this observation of the author's because if confirmed, it may be of importance in the management of deep-water animals, the study of which can be so materially assisted, as in the present case, by the employment of a more or less well-regulated aquarium.

The structure of the polyps does not call for any lengthened notice, agreeing as it does with that which has often come under observation in *Alcyonium digitatum*—an easily accessible representative of the group characterized by the presence of eight pinnate tentacula. We must not, however, omit to mention that the author points out an important distinction between the structure of the thread-cells or nematocysts of the actinoid polyps, and of those of *Corallium*. In the actinoid polyps the cell is simple and the thread occupies the whole of the cavity; but in *Corallium*, as well as in the group generally to which it belongs, the thread is coiled up in a small elongated cell placed in the middle of a larger one. We could have wished that the author had pursued his inquiries further into this subject, and thrown some light on the obscurity surrounding the means by which the thread is extruded, and the origin of the urticating properties that are so painfully evident on its insertion. The subject, no doubt, is a difficult one, and requires the most careful attention with high magnifying powers, and materials fresh from the sea. With regard to the digestive organs of the coral polyp, we are glad to observe that the author does not insist on the œsophageal tube being considered the true stomach, as it is generally supposed to be; but, without giving any positive opinion respecting the function of this particular part of the organization, he acknowledges that the food is often found below it, in the general cavity of the body.

The sarcosoma or bark of the coral is next described, and the form, development, and distribution of the spicula minutely explained. This is followed by a detailed and interesting account of the system of vessels by which the so-called "milk" of the coral is circulated through the entire polyp-mass, or *zoanthodème*, as the author designates it. This milk escapes in some quantity when the extremity of a living branch is broken or scratched. It is described as consisting of a transparent fluid containing epithelial cells and slightly-developed spicula with, at certain times, imperfect ova, and spermatozoa. No mention is made of the numerous corpuscles usually found in the circulating fluid of similar zoophytes, and especially abundant after digestion has taken place, giving to it the incipient character of blood; but it is subsequently spoken of as containing "the constituent elements of the polyp and the bark," so that the nature of the fluid is obviously the same as in kindred species. No independent aquiferous system was found to exist in *Corallium;* and the superficial pores formerly believed to be for the passage of water are here shown to mark only the site of newly-budding polyps. There is, in fact, nothing to show that the water obtains access to the interior of the sarcosoma except through the mouths of the polyps. In the chapter on the mode of increase by budding (*blastogénèse*) some interesting particulars are given of the production of the polyps, and the manner in which injuries are repaired by a temporary diversion of the blastogenetic energy. It was also observed that the accidental contact of living branches soon resulted in a complete connection between the two parts. This, we believe, has not been before described as taking place in *Corallium* or its allies, although Dana has shown that such a union is of frequent occurrence in *Madrepora* and in other forms among the true stony corals.

In order to obtain a definite knowledge of the structure of the veritable coral (*polypier*) thin longitudinal and transverse sections of it, carefully polished, were found by the author to be essential; and these sections, when examined under the microscope, made everything clear and intelligible. The coral is described as being made up of successive layers of calcareous matter, and presenting, under transverse section, a series of concentric circles, surrounding an irregularly shaped spot, which is bounded by a narrow ribbon of colour. This peculiar character of the axis, is explained when the first development of the coral has been properly studied. It is then seen, that the calcareous matter is at first deposited in the form of a single lamella, or sometimes of three or four of them united, around which the successive layers are placed, and these lamellæ, in a cross section, present the appearance above described. Other points in the structure are commented on, and some reference is made to the probable cause of the variety in the tint of the coral, but the author can only assume that, as in the case of shells, there are periods when increase in size, and rapid secretion of colouring matter are evidences of renewed vital activity, so in the coral, times of exhaustion and vigour may be indicated by the different degrees of colour found in the calcareous layers.

The chapters on the Reproduction and Development of the Coral are the most important in this work, not only from a physiological point of view, but from their containing valuable information bearing on the special object of M. Lucaze-Duthiers' inquiries. Nearly eighty pages are devoted to those parts of the natural history of the coral.

Beginning with the distribution of the sexes, the author points out the great diversity of arrangement he found to exist. Each polyp-mass was usually found to be either unisexual, or with both sexes present, but confined to separate branches; occasionally males and females were found intermixed, and in a few cases, hermaphrodites were discovered, but these were very rare. No external distinction was observed, and an examination of every polyp was necessary in order to establish the character of the whole group. This variety in the distribution of the sexes, appears to be common among polyps in general, but hermaphroditism is undoubtedly more frequent in the simpler forms. With reference to the reproductive organs, which are described at some length, and their various histological characters pointed out, we need only remark that the number of these organs in the coral, appears to be considerably less than among the Actinoid polyps, but they have a more marked and definite character, and, when mature, occupy a larger portion of the general cavity of the body. The spermatozoa were not found to possess any special or exceptional form, and every grade in their development was to be met with in the contents of a single testis, although the testes themselves are successively matured. On the question of impregnation, the author confesses he can say little more than that it takes place not only within the body of the polyp but also within the ovary, and that this is always the case in both the Alcyonaria and Zooantharia. In stating that unimpregnated ova are never discharged from the Zooantharia, we think the author goes too far. It is perfectly true that the Actiniæ, to which reference is made on more than one occasion, commonly give birth to their young in a more or less developed condition, but we have reason to know that certain species also discharge ova which show no trace of segmentation having taken place, and which have no power of independent motion. This locomotive power is one of the earliest characters displayed by the embryo polyp, and the one mentioned by the author as being specially indicative of larval condition. In the case of *Caryophyllia* among the true coralligenous polypes, we can also speak to the fact of the occasional discharge of ova, in which the germinal versicle may be distinctly visible, and with none of the ordinary signs of impregnation having taken place. Such instances have occurred in small salt-water tanks, in which the water had been unchanged for several years, and we see no reason to differ from the author when he states his grounds for believing that the habits and behaviour of marine animals in the aquarium do not present any variation from what might be observed in them if they could be studied at the bottom of the sea. In the same tank that contained the oviparous *Caryophyllia,* we have also seen a specimen of *Balanophyllia* produce young in the earliest larval condition, their shape being slightly oval, and not undergoing any material change before they became attached to the stones.

We may pass over the author's account of the gradual development of the coral polyp, and turn to his interesting description of the production of the coral (*polypier*) itself. After acknowledging how much naturalists of the present day are indebted for many of their discoveries to the perfection of modern microscopes, he points out that no trace of spicules can be found until the first polyp—the direct produce of the ovum (*oozoite*), has been fully matured, and that Donati was certainly mistaken in believing he saw them in the larvæ. The spicules of the sarcosoma have from the first a constant and characteristic arrangement, as had been previously observed by Valenciennes, and this special character was of great use in tracing the growth of the actual coral. The long standing dispute as to whether the origin of the coral was in the epidermis or the deeper tissues of the body is examined into, and it is shown that the union of several of the spicules takes place internally to form the nucleus of the coral, and its growth is effected by a continued accretion of other spicules which are united around it by a cement having precisely the same chemical composition. The formation of the coral can be well studied at the extremity of any of the growing branches as the ragged end seen on the removal of the fleshy portion of the twig presents the same appearance as is found in the primitive nucleus. The whole process of formation is described with great minuteness, and is well worth a careful study. The chemical composition of the coral requires further investigation, and that with the nature of the colouring matter the author thinks should be made the subject of careful analysis.

Having concluded his examination of the entire coral, the author makes some remarks on its zoological position, and then proceeds to give an account of the manner in which the fishery is carried on, and the existing and proposed regulations for working it to the greatest advantage. We can here only glance at this part of the subject. The fishery is worked with decked boats, having a crew of from ten to twelve men each, and smaller half-decked craft with half that complement. The apparatus in use is called the machine (*engin*), and consists of a large wooden cross weighted at the centre, and having, in the larger boats, about forty-eight nets constructed of very stout twine attached to various parts of the frame. The nets are made with a large mesh, loosely netted, and are, each of them, fixed in such a manner as to form a kind of rosette or mop, the several folds of which spread out when in the water and cover a considerable space on the rocks, over which they are dragged. The process of working the nets is a delicate one, and requires a constant attention to the inequalities of the ground, which are easily observed by the "feel" of the rope. The practised hand of the master of the vessel is as useful in this case as in the somewhat kindred occupation of trawling among our own fishermen, where the hand placed on the trawl-rope shows distinctly whether or not the trawl is working properly. The labour of coral-fishing appears to be very great, and to this the author attributes the unwillingness of the French to be employed in it, and the consequent gradual loss to France of the profits to be derived from a steady attention to this fishery. Divers and diving apparatus of various kinds have been proposed as a substitute for the mechanical means now employed, but there is much to be said against the propositions when the depth of water in which the coral lives is considered. This part of the subject is fully discussed, and sufficient is said to prove, if not the impracticability, at all events the inexpediency of altering the present mode of working.

With special reference to his mission, the author then considers the relations of the coral fishery to colonization, and points out how many things must be considered if it be desired by the French (as is stated to be the case) to monopolise the coral fishery. Under the present system almost all the fishing is done by Italians, who return at the close of the season to their own country, taking with them a goodly sum of money as the produce of their labour. The coral itself also finds its way to Italy, which from time immemorial has been the home of its manufacture into ornaments. We are told, however, that Parisian taste is necessary for the production of the most elegant pieces of workmanship. The author concludes with a sketch of the different qualities of coral, their commercial value, and the widely distributed markets to which they are sent.

We must not close our notice without some mention of the illustrations to this work. They consist of twenty plates, engraved on metal and printed in colours. The drawings by the author himself show a complete acquaintance with his subject, and great command of pencil in rendering all the necessary details, while the colouring has been managed so as to give in many instances a delicacy of effect, such as is rarely produced by mechanical means. The book taken altogether is a very valuable one, not only from its containing a complete history of a single species, but from its being in a great measure a handbook to the structure of a large group of closely allied genera of polyps.

XXXI.—The Reproduction of Annelids.

On Alternate Generation in Annelids and on the Embryology of Autolytus Cornutus. By A. Agassiz. Reprinted from the Boston Journal of Natural History, Vol. vii. (No. iii. 1862.) With three plates.

So little is known about the reproduction of the Annelids, that we think it may not be amiss in noticing this interesting work of A. Agassiz to give somewhat in detail the facts mentioned in it that appear to us most worthy of narration. O. F. Müller, in his Zoologia Danica (1788) figured a small Annelid (*Nereis prolifera*) in the act of reproducing itself by division. This mode of reproduction among the higher Annelids remained for a long time unconfirmed, and many authors, especially Ehrenberg, began to throw doubts upon the observation of Müller. Ehrenberg even went so far as to establish a division among the worms, founded on their mode of reproduction, and placed *N. prolifera* in that section in which reproduction by division did *not* occur. Shortly after this, however, the researches of Quatrefages and Milne Edwards placed Müller's observations beyond the shadow of a doubt. They observed prolification in *Syllis* and *Myrianida*. Next Sars observed it in *Filograna*, and at last it became evident that this mode of reproduction was not confined to the Naidina, and that it might be expected to occur in all the other families of Annelids. The peculiar phenomena preceding the separation of the sexual individuals, the fact that the eggs and spermatozoa, seemed to be developed only in that portion which was to form a new individual, at once suggested the idea that there was an alternation of generation in this group.

O. F. Müller had observed that the individuals about to separate were alone filled with ova, and that these ova were less advanced in those sexual individuals which were farther from the posterior extremity. Quatrefages found in a species of *Syllis*, reproducing itself by division, that the reproduced form was either a male or a female, and that the anterior part never showed the slightest trace of sexual organs. Milne Edwards found in *Myrianida*, five or six zooids already well developed, those nearer the tail being the most advanced and he observed that the proliferous individuals were alone provided with sexual organs. Sars observed the same phenomena in *Filograna implexa*, one of the Serpulea; and Schmidt in a second species of the same genus, *F. Schleideni*. The observations of the latter plainly showed that a part of the parent stock passes into the sexual individuals when division takes place. Frey and Leuckart repeated the observations of Müller to a certain extent; but they endeavoured to show that the development of *N. prolifera* was a case of budding and not of division, and that there was nothing in its development to justify the assertion of an alternate generation. Krohn, however, (1852) was fortunate enough to observe the whole development of the same species, and it became evident that the remarkable phenomena which he observed could only be explained on the supposition of an alternate generation, he dwells particularly on the striking differences between the males and females, and says, the only link now wanting is to trace the development of an embryo coming from the ovum of one of the female individuals into a parent stock, similar to that from which the sexual individual was produced, which should in its turn, produce males or females only by division and not by sexual reproduction. It was this link which Mr. A. Agassiz has been fortunate enough to discover. Before proceeding to notice this portion of the subject, we wish to call attention to the fact that an important paper* by Professor Huxley on a fissiparous species of tubicolar annelid is forgotten in the otherwise admirable resumè of this part of the subject. In this annelid, which has been provisionally assigned to the genus *Protula*, the prolification appears to take place so as to separate all the segments of the parent behind the sixteenth, as a new zooid; but it is not a mere process of fission, for the seventeenth segment, *i.e.* the first of the new zooid, undergoes a very considerable enlargement, and eventually becomes divided into the nine segments of the head and thorax of the bud. These segments do not appear all at once, but gradually, one behind the other. The intestinal canal of the stock and of the bud are at first perfectly continuous, but the peri-intestinal cavity of the bud is completely filled with a mass of red granules. These would seem in some way to subserve the nutrition of the young animal, for in some free zooids, apparently fully formed, but wanting the sexual organs, the caudal segments were full of them, while no trace of them was to be found in the anterior segments. From a consideration of the various modes of prolification described by O. F. Müller, Milne Edwards, Schulze, and others, Professor Huxley enumerates the following different forms.

1. All the segments of the zooid form mere segments of the 'parent stock,' the new products being merely cephalic organs.

2. None of the segments of the produced zooid belonged to the 'parent stock,' but the former is a metamorphosis of a whole segment of the latter.

3. None of the segments of the produced zooid belonged to the 'parent stock,' and the former contains hardly any of the primitive substance of the latter, being developed by germination from its last segment.

The prolification of the *Protula* described by Professor Huxley,

* Edinburgh New Philosophical Journal, Vol. I. n. s. 1855. p. 113.

is a combination of the first and second of these methods, the prolification of *Autolytus cornutus,* the development of which we proceed to consider, belongs partly to the first group, and partly to the third. The female *Autolytus cornutus* is about half an inch in length, of a flesh colour. The alimentary canal appears as a green tube extending from one end of the body to the other; the posterior and the anterior rings are of a greenish hue. The cephalic segment has three long tentacles, one, the longest, in the centre, the other two on either side. The ova in their earliest stages of development are found thickly packed between the walls of the alimentary canal and the outer body wall—along the whole length of the annelid. As they increase in size, filling more and more of the perivisceral space, there is developed on the lower side of the body a large receptaculum into which they pass; when fully swollen with ova, this pouch extends from the 12th to the 25th or 26th ring. In it the ova are hatched and soon afterwards the young embryos—the envelope of the pouch bursting—escape, and swim freely about. It is probable that the females are killed by this bursting of the uterine pouch, as A. Agassiz never succeeded in finding a single female after it had discharged its embryos. The young *Autolytus* is triangular in shape, and is provided with two large eyes: the alimentary canal follows the outline of the young embryo, and there is no appearance of a mouth. In its next stage, there is an indentation behind the eyes, thus separating the head slightly from the body, the alimentary canal as well as the young embryo assumes a more elongated shape, and the former is divided by two constrictions into three regions. In the next stage, the embryo is divided still more plainly by the constrictions—the three regions of the alimentary canal are better marked, the head with the eyes is more distinct, the triangular shape has completely disappeared, and the mouth can be seen as a small slit on the lower surface, then the middle tentacle is seen; next the lateral tentacles appear in advance of the eyes, these soon outstrip in growth the middle tentacle, the anterior rings are provided with bunches of stiff bristles, and the anal ring has on each side one small anal cirrus. The tentacles of the head go on increasing in length—some additional rings are formed, and bristles are found on each ring except the first and last; when it has reached this stage the embryo does not increase in length until the appendages of the different rings are so well developed that it can be unmistakeably recognized as a parent stock of *Autolytus* with a small number of rings. The anal cirri increase in length, slight swellings make their appearance on the sides of the first two or three rings, and then on the others, and become frequently changed into dorsal cirri, and by the time the last dorsal cirrus is developed, the middle tentacle has again outgrown the lateral tentacles, the tentacular cirrus has been developed, and the annelid has all the appearance of a parent stock with short cirri. From this stage the development goes on very rapidly, the number of rings increases very fast, and in a few weeks the embryo has passed through all its stages—has reached its full size, and is ready to begin the reproduction by division; it is now called the parent stock. This 'parent stock' has the same colour as the males and females: the tentacles of the head are like those of the female, the middle one being longer; in place of the large well developed eyes of the males or females, we find but two large and two small accumulations of pigment cells: the rings are provided with but one kind of bristle. There is also a great difference in the alimentary canal, the anterior portion of which is specialized to a degree which does not exist in the sexual individuals, in which the alimentary canal is simply the cutting off of a portion of the tube forming the common digestive cavity of the parent stock and the sexual zooid while this is still attached to the parent stock. There is a narrow œsophagus winding from the mouth to a true stomach. Thence the alimentary canal passes as a wide, almost straight tube through the whole length of the body. When fully developed the parent stock has from 40 to 45 rings. On the upper side of the 13th or 14th ring, most generally the former, a swelling is found, which eventually becomes the head of the sexual zooid. As the central swelling increases, there will be found two additional ones on the sides, these three swellings are the tentacles of the head. The large eye next makes its appearance, and then the dorsal cirrus. After this has reached a certain length, the second eye can be seen. Tracing the development further we find there is a marked difference in the growth of the tentacles in parent stocks which are otherwise identical. This is on account of the difference in sex of the zooids, the male and female tentacles being developed in a totally different manner. The rings following the head (five in males and six in females) undergo scarcely any change, but in the succeeding rings, the dorsal cirri increase still more in length, a slight protuberance is formed immediately below the dorsal cirrus, from which a bundle of fine needle-like bristles are developed; thus the anterior rings have *two* bunches of bristles, as in the adult males and females, and the upper bunch attains its full size before the young separates from the parent stock. The ova and spermatozoa are likewise then developed, and we find females with their bodies entirely filled with ova while they are still attached to the parent stock, while in this latter in its 12 anterior rings not the least traces of ova or spermatozoa are to be found; in the males it is only the anterior rings that are filled with spermatozoa. The parent stock secretes a case for itself on the stems of some *Campanularia* and with the sexual zooid still attached, moves freely about, leaving its case and returning to it. The male and female after they have separated from the parent stock do not build cases, but creep along the stems of Campanularias and are often to be found swimming about.

The general appearance of the male is entirely different from that of the female. The body, instead of tapering gradually from the middle towards both extremities, attains its greater width much nearer the head, the number of rings provided with long setæ, and having short dorsal cirri are five instead of six. The spermatozoa are found on the sides of these five rings only, but they never, as in the case of the ova in the female, extend throughout the whole cavity. The two large tentacles, instead of being simple, of the same breadth, and rounded at their extremities, are very broad at their base, where they are united by a prolongation of the anterior part of the head. At a short distance from their base they bulge out, but without actually meeting, and they then divide into two branches at their extremity. The median tentacle is much larger than that of the female, and directly behind the eyes there is an additional small cirrus.

We thus see that from a fertilized ovum a form is produced which having passed through a certain number of stages, at last reaches what we may call an adult existence, that this form is asexual, but that by means of a process of prolification it gives origin to one or several sexual zooids, which are either male or female, and which in their turn produce what A. Agassiz calls 'parent stocks.' If we compare the embryonic development of the parent stock from the ovum with that of the male and female zooids from the parent stock, we cannot fail being struck with the perfect coincidence that exists between the development of the parts of the head and of the dorsal cirri in both. In the parent stock the alimentary system is more highly differentiated. The generative system is thrown off as it were, in the form of male and female zooids, destined to live but for a brief period, and more locomotive than the parent stock— which on the separation of a zooid, forms by means of budding, new rings; and the same process apparently begins again. There is thus an important difference between the primary formed and the secondary zooids, which Agassiz does not refer to, viz., that the former are more particularly the result of fission, while the latter are the result of both gemmation and fission. The former would come under Professor Huxley's first category, the latter under his third. We suspect in the proliferous development of the higher Annelids such will always be the case, and that there will always be a combination of two of these categories in their development.

It is interesting to observe that the earlier stages of this *Autolytus* closely resemble those of a Planarian worm. So remarkably is this the case, that this stage might well be called the Planarian stage. Then in their onward development they resemble some of the genera of Annelids that we have long been in the habit of considering adult forms, such as *Leucodore* and others—this state reminds A. Agassiz of the Nematoid worms, but this resemblance is not sufficiently evident to us—in their last stage they have become genuine Annelids. Hence it follows that for the future one must be very cautious in defining new species and genera of Annelids, unless their life history is known; otherwise the parent stocks and the sexes of the one species might be referred to three very different species not to say genera.

This paper of Mr. A. Agassiz is illustrated with three excellent plates, which give full details of the development and appearance of the parent stock in *Autolytus cornutus* and of its male and female zooids. It proves that the son is following well and worthily in his father's footsteps, and we trust we may yet have to notice many papers on this confessedly difficult group of animals from his pen, even though we cannot expect them all to be as startling in their details as this present one.

XXXII.—Herbert Spencer's Biology.

The Principles of Biology. Part IV. Morphological Development. Caps. ii. et iii. The Morphological Composition of Plants. By Herbert Spencer. London: 1865.

Mr. Herbert Spencer, as is known to most of our readers, is engaged in the publication of a system of Philosophy. Several sections of this great undertaking have already been issued, but our present task concerns the most recent of his publications, the title of which is prefixed to the present article.

Some objections may, doubtless, be raised to this mode of treating a subject in separate parts; but it is one imposed upon us by the necessities of the case, no less than by Mr. Spencer's method of publication. Naturalists in general are so accustomed to think and work inductively that it will be, if not absolutely novel, at least very interesting, to see their subject handled deductively. Not that Mr. Spencer proceeds wholly on the deductive plan, such a course would be plainly impracticable; the method he prefers as likely to conduce to both brevity and clearness is "to establish each general truth empirically, and then proceed to the rationale of it."

The reader, indeed, in perusing this brochure will often be forcibly reminded of the famous "camel" story, and will regret that the author did not make more use of his observant faculties, and trust less to his inner consciousness. Albeit everything that owes its origin to Mr. Spencer's thought is well worthy perusal and reflection. We shall, therefore, now attempt to lay before our readers an analysis of the views held by this eminent thinker on Vegetable Morphology, and shall add such comments as, in our judgment, we may think desirable. Our task is not an easy one, for the style of writing no less than the mode of thought manifested in this work, is different from those in use among Naturalists generally.

The plant is its own architect, and not only its own architect, but it forms the materials for the edifice to be raised; that edifice is raised according to a certain plan, handed down from generation to generation, and never entirely departed from, though continually modified to meet varied, often conflicting, requirements. A living plant, then, it will be conceded, is made up of a number of units. By the mere increase in number and aggregation of such units the plant grows and increases in bulk, and not only in bulk but in shape, so that its form is changed. The plant, in fact, grows and it is developed.

The Morphologist has thus to study the various ways in which mere increase of bulk takes place, and must also inquire into the shape of the organism as a whole; he must ascertain how, and why, it assumes that shape, how and why its shape differs from that of allied organisms. Thus, at the very outset, is necessitated an inquiry into the nature of the component units, and an investigation of the influences which cause those units to increase in one way rather than another, and to assume certain forms in some instances, certain other forms in other cases. On the latter points Mr. Spencer does not dilate; he merely states that the factors bringing about the changes of form in plants are external, incident forces, or internal, hereditary proclivities, so that "every organism is the result of a compromise between internal forces tending to reproduce ancestral forms, which were in harmony with incident forces at the time of their evolution, and external incident forces tending to cause deviations from that form."

The two processes of growth and development, and the agencies influencing them, being thus alluded to, our author then proceeds to seek for the physiological units out of which the organisms are to be built. These are specks of protoplasm manifesting life, and yet showing no sign of organization. Organic evolution begins by the formation of a minute aggregate of them into a cell. We may expect "that as structureless portions of protoplasm must have preceded cells in the process of general evolution, so, in the special evolution of each higher organism, there will be an habitual production of cells out of structureless blastema;" and moreover, "that tissue may occasionally be formed by the direct transformation of the blastema." We regret that Mr. Spencer has not pursued this portion of his subject further, and shown us what tissue he expects to be so formed, where to look for it, how to recognize it. Is it the structureless cuticular layer overlying the epidermis of flowering plants, or the gelatinous envelope of such plants as *Palmella*, or the membrane lining the air-canals of *Victoria?* But on this point we are left in the dark. The void is in part supplied by the writings of Drs. Lionel Beale and Hughes Bennett on organic molecules, and on the structure and growth of cells.

A cell, then, is an aggregate of the first order, formed of physiological units united into a group, that is structurally single, and cannot be divided without destruction of its individuality. Of such cells we have numerous examples in the lower Algæ, Fungi, &c., the cells being sometimes of considerable size and much branched. Aggregates of the second order are plants composed of more than one cell, the cells being sometimes held together by a matrix of mucus, and aggregated in one plane, either in linear series, or radiating from a centre. In other cases they may be grouped on all sides of a central point, aud so form a spherical mass. It is not necessary to follow Mr. Spencer in his review of the filamentous, tubular, pseudo-foliar, and pseudo-axial Thallogens, as the general features of their composition are well known.

Caulerpa might have found a place in Mr. Spencer's digest as having, though strictly a unicellular plant, a creeping stem, so to speak, growing indefinitely and giving origin to two kinds of branches of limited growth, viz.: roots on one side, leaf-like branches on the other.*

Lessonia, though merely an aggregate of the second order, has a pseudo-foliar and pseudo-axial appearance. In *Rhodymenia*, *Phyllophora*, and *Delesseria*, there are successive stages in gradually increasing complexity. In the last-named beautiful sea-weed there are small fronds springing from the mid-rib of the parent frond, and completely resembling it, except in size. This tertiary degree of composition is yet more fully shown in *Sargassum*.

In passing from Algæ to *Jungermanniæ*, Mr. Spencer calls attention to the widely different circumstances under which terrestrial plants are placed, as compared with aquatic ones, and the consequent modifications in their mode of growth. The *Jungermanniæ* exhibit transitional forms from aggregates of the second order to those of the third order, till at length the more perfect of them have an erect stem with separate leaves, and a single root or group of roots; so that the leaves are now not able of themselves to carry on their functions, but depend one on another, and on the other organs, and in this way make up a compound individual.

Having thus dealt with flowerless plants, Mr. Spencer proceeds to the consideration of the morphological constitution of flowering plants, in which there is always aggregation of the third order, and very frequently aggregations of the fourth, fifth, or sixth orders, Mr. Spencer here using the word aggregations in the same sense as Alexander Braun does, when speaking of the "generations" of shoots, &c.

In speaking of the promulgation of the doctrine of metamorphosis, the principal merit is assigned justly to Wolff, for although Goethe arrived at his conclusions independently, and by a partially different road, "he is only entitled to a secondary place among those who have established this important generalization." The consideration of this subject leads Mr. Spencer to ask the important questions, "What is a foliar organ, and what is an axial organ?"

* Decaisne Plantes de l'Arabie heureuse. Arch. du Mus. ii. 1839. t. vi. B.

and, in replying to the question he expresses his conviction that the distinction between the two organs is not absolute. In this we heartily concur; but we regret that the arguments here brought forward in support of this opinion are based upon false premises. For instance, Mr. Spencer speaks of a sepal being transformed into a flower-bud, forgetting the morphological axiom that an organ once formed, never becomes transformed into anything else.

The greatest stress is laid upon the appearances presented by certain monstrous umbellifers. The descriptions of these given by our author are so much at variance with the teaching and dicta of Botanists generally, that it is to be regretted that they are not accompanied by larger and clearer illustrations, in the absence of which no morphologist, we are confident, will accept Mr. Spencer's interpretations. So far as we can judge, we should suppose the malformations in question to have been cases of prolification, either of the inflorescence or of the flower. That is, either the peduncles or rays of the umbel have been subdivided, so as to increase the compound nature of the umbel, or there has been an adventitious formation of flower buds in the axils of the sepals, or of the petals, &c.—axillary prolification in short. These changes have been accompanied by others of more or less importance. Finding an umbellule where, under ordinary circumstances, a single flower is produced, our author's inference is that the flower is transformed into an umbellule. Now, if this were so, then the simple umbel itself would be the result of a transformed flower, and not due to the formation of a second generation of flower-stalks. If Mr. Spencer's views be correct, in what light would he view the bracts of the involucre, or of the involucel? Would they be portions of the flower that is transformed into an umbellule? If so, they should at times, at least, show transitional stages between their ordinary condition and that of floral organs. Proceeding with his descriptions, Mr. Spencer mentions "a peripheral flower, of which one member (apparently a petal, is transformed into a flower bud)." How this could happen we are at a loss to know. Leaf-buds are formed upon leaves under certain circumstances, but there is no instance, that we know of, of a flower-bud actually arising from a leaf—though sometimes, as in *Erythrochiton*, the adhesion of the flower stalk to the leaf gives rise to such an appearance, but in neither of the cases just cited would any one say that the leaf or flower-bud had arisen from a transformation of the leaf. Other flowers are described as half-flower, half-umbellule; these, then, are the very flowers that should have been more fully described and more carefully drawn. As it is, we can only suppose them to have been similar to many seen by ourselves in *Umbelliferæ*, and noticed in the text books of Teratology. For instance, it is not uncommon to see stalked flower-buds proceeding from the rim of the calyx tube, with the petals and stamens, or even projecting between and beyond the two styles. So also we have often seen the calyx tube slit down on one side, the carpels partially disjoined, and from the very base of the open calyx proceeded stalked flower-buds, which originated clearly from the axils of the sepals. Suppose the calyx in such a case not slit down, but united as usual, then these adventitious buds would appear projecting above the calyx-rim, with the stamens as above mentioned. Any of these kinds of malformations would have, at first sight, the appearance of being part flower, part umbel; but none of them would justify the statement that the supernumerary buds were transformations of flowers, or of parts of flowers. Mr. Spencer seems to have anticipated the objections that would be raised to his explanation of these monstrosities, for he writes, "Where a cluster of flowers replaces a single flower, it is because the axillary buds, which hypothetically belong to the several foliar organs of the flower, become developed into axes; and assuming this, is basing an hypothesis on another hypothesis that is directly at variance with facts." At variance with facts because these axillary buds are almost universally absent from the cotyledons, from the sepals, petals, stamens, &c. Thus "out of eight leading forms which folia assume, one has the axillary bud, and seven are without it." Now, the absence of the buds is not so general as is here said to be the case; it is perfectly true that the buds in many cases cease to grow, so that in the fully developed plant they are hardly visible, but let the conditions be altered, cut off, or injure the terminal bud, and the result will be, if the plant live, the production of numerous lateral buds from the axils of the leaves. In the case of the upper leaves of the stem, those near the flower, or those constituting the flower itself, it is quite true that, under ordinary circumstances, the buds are not developed; but what is this but the result of that antagonism to which Mr. Spencer himself elsewhere alludes, between the vegetative and the reproductive parts of the plant? If the energies of the plant are exerted in one direction, the growth in the opposite direction is limited in proportion. But then, as if to prove the rule, these buds are, under exceptional circumstances, developed from the axils of the bracts, as in cases of prolification of the inflorescence, *(prolificatio a latere,)* or from the axils of the sepals or petals—axillary prolification.

Mr. Spencer proceeds with his argument thus:—"If, when an umbellule is developed in place of a flower, the explanation is, that its component rays are axillary to the foliar organs of the flower superseded; we may fairly require that these foliar organs to which they are axillary shall be shown." Certainly, if the case were as Mr. Spencer states it; and in cases of axillary prolification these foliar organs can be shown, or if not actually present, the cicatrices can be demonstrated to prove their former existence. Moreover, the position of the adventitious buds in relation to the parts of the flower is, in general, amply sufficient to enable the observer to ascertain to what organ the new bud is, or was, axillary. But this has little to do with the present question; the secondary umbellules are no more derived from the axillary buds of a transformed flower, than are the primary umbels. These secondary pedicels may, indeed, arise from the sides of an extremely contracted axis, and from the axil of one of the bracts of the involucre, when present; but that is a very different thing from saying that they arise either from a transformation of any of the foliar parts of the flower, or from the development of an axillary bud belonging to either of the foliar organs.

Mr. Spencer cavils at Botanists for speaking of a node as imperfect, if not provided with a leaf and a bud, for, says he, "there are plenty of nodes without buds, and therefore Goethe's notion of the non-existence of a node without a bud is incorrect." In so saying, the writer loses sight of the aim and object of an hypothesis—a singular thing in one who professes to work on the deductive plan. We must not, however, follow out this topic, or it would lead us too far; let us return to our proper subject. "Flower-bearing rays," continues Mr. Spencer, "that are homologous in position, with petals and stamens, we may conclude have arisen by development of foliar into axial buds." Apart from the ambiguity here between foliar and axial buds, we find it difficult to consider one petal or one stamen as the representative of a bud, or capable, under certain conditions, of being transformed into a bud. The nearest approach to anything of the kind that we can call to mind at the moment, is that of the leaves of the Tomatoe, mentioned by M. Duchartre, as bearing a tuft of branches.* Of a similar nature were the leaves of *Drosera*, mentioned by M. Naudin.†

Leaving this portion of the subject, we turn with much greater satisfaction to other facts and reasonings brought forward by our author to show that there is not so great a distinction between foliar and axial organs as is usually supposed. Incidentally, it is pointed out that the structure of the leaf-stalk is sometimes identical with that of the stem, *e.g.* as in *Richardia æthiopica*. So in the case of peltate leaves, it will be found that the structure of the leaf-stalk is precisely similar to that of the young shoot, the ordinary leaf-stalk, with its crescent-like arrangement of woody bundles, and the groove upon its upper surface, seems to be so formed to allow of room for the leaf-bud which lies in the furrow of the leaf-stalk, and is thus protected from undue pressure; but in the cylindrical leaf-stalks, the leaf-bud is secured from pressure by the divergence of the leaf-stalk, or of the stem itself, or by other special arrangements to which we need not now refer more at length.‡ And as, in the above instances, the leaf-stalk has more or less of the aspect of the stem, so may it also assume the aspect, and carry on the functions of the leaves themselves, as in the so-called Phyllodes in Acacias, Oxalids, etc.

Other illustrations of a similar nature are offered by the Nepaul Barley, the glumes of which bear florets on their midribs, and by the stems of *Cactaceæ*, and of many *Euphorbiaceæ*, which are pseudo-foliar. But it must be remembered that in the two families just mentioned, the resemblance to the leaf-type is more apparent than real, the woody bundles retaining their cylindrical disposition even in the most leaf-like portions of the stem, whereas in those cases where genuine leaves are formed, as in *Pereskia*, the fruit of some species of *Cereus*, etc., the vascular bundles lose their cylindrical disposition, are flattened out, and spread laterally, as in ordinary leaves.

Other cases, such as *Ruscus*, where the branch simulates a leaf, are mentioned, and reference is made to the similarity in structure between the midrib of a compound leaf and a branch. Indeed, in some deeply divided leaves, *e.g.* *Acanthus*, a similar resemblance is

* Ann. Sc. Nat. 3me Ser. xix. p. 241.

† Ann. Sc. Nat. 2me. Ser. xiv. p. 14. pl. i. f. 6.

‡ On this point see also Darwin on Climbing Plants. Journ. Linn. Soc. vol. ix. p. 113.

to be found. When leaf structure comes to be more fully worked out, we doubt not that other cases will come to light, showing the close resemblance between leaf and branch. The *Coniferæ* promise good results in this way, *e.g.* the leaves of *Phyllocladus*, and those of Araucaria, which latter are said to produce a layer of woody bundles for two or three years in succession. At present, acting under the supposition of the distinctness of axis and appendage, we have to assume two different ways in which the fruit may be formed; from carpellary leaves alone, or from a dilatation or hollowing out of the upper part of the flower-stalk. So, too, in the case of the placenta, we are compelled to consider the placentation as sometimes axial, at other times foliar.

Again, there is the nucleus of the ovule and its coats, the exact morphological nature of which is far from being understood. Take, for instance, the ovule of *Welwitschia*, and its outer covering. Is the latter of foliar or of axial origin? At present, the balance of evidence is in favour of the latter view, as also in the case of *Taxaceæ*.* The ovuliferous scales of *Pinus*, etc., lie under the same uncertainty. The *Podostemaceæ* too, or many of them, are all but destitute of roots, and their stems fulfil the functions and have the appearance of leaves. The difficulties that exist in the deciphering of the morphological nature of these and many similar cases that might be cited, would, we feel sure, be considerably lessened if it were at once acknowledged that no absolute distinction between stem and leaf existed. In the present state of our knowledge, the most important distinction that can be pointed out, or rather the one least liable to exception is this, that buds may be formed on the surfaces, or edges, or in the axils of leaves, while none are ever produced from its apex. On the other hand, it is the rule, not the exception, for the stem to terminate in a bud. The extremity of the axis is formed by a cone of growing cellular tissue, from which leaves may originate, while at the extremity of the leaf is a layer of dead, functionless cells.† But to revert to our author, Mr. Spencer, as we think very judiciously, looks for the beginning of the perfect exogenous or endogenous stems among acrogenous plants. It has,

* N.H.R. April, 1863.

† For an account of the structure and composition of the stem, the reader is referred to papers of M. Germain de St. Pierre, Bull. Soc. Bot. France, 1855, p. 159, et 1860, p. 5; to those of Hanstein, Ann. Sc. Nat. 4th Ser. Vol. viii. p. 5, and Linnæa, xxxi. p. 65, and to that of E. Meyer, Linnæa, xvi. p. 402.

we know, been said, even by so competent an observer as Mr. Berkeley, that there is only a relation of analogy, and not one of homology between the two classes of plants.* Mr. Spencer evidently is of a different opinion, for he traces the constitution of the stem up from those plants which present the earliest traces of such an organ, to those in which it exists in greatest perfection. He shows that in many Mosses, Hepaticæ, etc., there is no real differentiation between leaf and stem; the thallus is the representative of both. He further shows that in many of them, there is a separation of new plants or buds, while in other cases these buds remain attached to the parent, and become shoots, the lower part of the original frond becoming thickened, and its rootlets increased in number, so as to afford a sufficient supply of nourishment to the young shoot. If this means of deriving more nourishment be not possible, then the new bud will be thrown off as a distinct plant to gain its own livelihood independently of the parent. The influence of Mr. Darwin's theory on the mind of our author now shows itself, for says he with much reason, "there will be extra growth of those rootlets which are most serviceably placed," and "such a variation implying as it does circumstances especially favourable to the growth of the plant, will give to the plant extra chances of leaving descendants; since the area of frond supported by a given area of the soil, being greater than in other individuals, there may be a greater production of spores, and then, among the more numerous descendants thus secured by it, the variation will give advantages to those in which it recurs." If it become the habit of the primary frond to bear a secondary frond from its midrib, this secondary frond, composed of physiological units of the same kind, will inherit the habit; and so a tertiary frond will probably be followed by a quaternary one, and so on; each new frond necessitating, or being accompanied by an increased thickening of the midrib of the lower fronds, and an increased development of roots. And so ultimately we shall get a series of fronds placed alternately on opposite sides of a continuous axis, which increases in length, but very little transversely, unless, indeed, the stem is to rise perpendicularly, and bear large foliage, when the stem is proportionately thickened as well as lengthened. As plants thrive best when most fully exposed to light and air, so, argues Mr. Spencer, *more Darwinii*, natural selection will favour the

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* Berkeley, Introd to Cryptog. Botany, p. 32.

upright growing ones, and this upright direction is brought about in one of two different ways, the explanation of which, as given by Mr. Spencer, is very ingenious. The one way is simply by the rolling up of the frond into a cylinder or imperfect tube, which of course gives an increased stiffness and power of resistance to the growing fronds. This involution is shown to exist in many *Algæ*, in *Riella helicophylla*, in *Jungermanniæ*, etc. The successive fronds thus rolled round, will very often cohere by their edges, so as to form sheaths.* If during the successive formation of these sheaths one above another, the united midribs continue to grow, and serve as the channels of circulation between the uppermost fronds and the roots, they will increase in diameter, and ultimately form a solid axis wrapped round by the sheaths, as in *Dendrobium*, but if, on the other hand, the woody bundles of each succeeding midrib, instead of remaining concentrated, are distributed all round the sheath, then the structure will eventually be that of a hollow cylinder, as in grasses or sedges. The other way in which a mutually dependent series of fronds may acquire sufficient rigidity to maintain an erect position without involution, is by the thickening and hardening of the fused midribs, these latter, moreover, elongate, so as to allow of the separation of one leaf to a sufficient distance from its fellows. In this way such stems are produced, as those of *Jungermannia decipiens* and *J. Hookeri.* If the separation of the leaves in this way be incomplete, then we get "decurrent leaves," in which the continuity of the axis with the midrib of the leaf is manifest. If the internodes grow more rapidly, then the leaf will become amplexicaul simply, or if the midrib develop rapidly, an ordinary stalked leaf is the result. Such result being the consequence of the survival of the fittest, inasmuch as the formation of a leaf-stalk will throw the leaves further away from the axis, and so diminish the shading of leaves one by another. Here may be mentioned other arrangements that possibly have reference to the non-interference of one leaf with another, *e.g.* the spiral arrangement of leaves, one leaf being in course of formation, the one next to it is in process of growth also, but the axis is at the same time lengthening, therefore the second leaf is placed above the first; but a third leaf has also to be provided for, and another after this.

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* It is more consistent with truth to say that the sheaths are developed as such; the so-called cohesion of the edges being congenital.

By no means can mutual interference be better provided against, and a fairer chance given to all, than by the spiral arrangement. If the number of leaves be very great, the spiral cycles will be very numerous, and the leaves will be smaller, often mere scales, *e.g.* in the involucre of composites. Other arrangements with the same object are mentioned by Mr. Ruskin,* and these have been curiously overlooked by morphologists, though very worthy of their attention.

To account for the formation of axillary buds, Mr. Spencer refers to the compound proliferous fronds of *Delesseria hypoglossum* or *Jungermannia furcata*, where, if nutrition be abundant, a number of secondary fronds are produced on the primary ones; tertiary ones spring from the secondary ones, and so on. Now, by abbreviating the spaces between these new growths, we shall ultimately arrive at a form like that of a bud. This bud, if nutrition be abundant, will develop itself into a shoot, or if on the other hand the supply of nutriment fall short, a flower is produced, or if it be altogether insufficient, no bud is formed, as in the cases of flowers. But if, from whatever cause, the component parts of the flower receive an abundant supply of nourishment, then those parts become green and leaf-like, and then axillary prolification may arise.

Mr. Spencer even goes so far as to say that axillary prolification only occurs under such circumstances, a statement which is certainly not correct, in all cases, as the records of Teratology amply show. Mr. Spencer then proceeds to show how the monocotyledonous and dicotyledonous embryos are to be accounted for by his hypothesis. As to the monocotyledons, his explanation is simple. Starting from a proliferous frond, which is rolled up to insure the erect position, it is obvious that the first frond will conceal the second frond, and this in consequence will be dependent for a time on the first frond for its support, and must always lag behind the first in its development. This coincides with M. Germain de St. Pierre's account of the germination of *Tulipa*, wherein the embryo is at first a mere leaf, the plumule being developed subsequently in a spur-like cavity at the base of the first leaf.

But in an exogenous plant, where the erect attitude of the stem is produced by the gradual increase of thickness of the continuous midrib, the second frond will be quite as well, or better placed, as far as regards exposure to light and air, than the first, and so it will

* Modern Painters, Vol. V. p. 28.

rapidly gain an equality with the first; and thus in the course of time, structures originally, or in their primæval forms, produced in succession, will come to be produced simultaneously.

The general conclusions at which Mr. Spencer arrives, are in brief as follows. The unit of composition of a Phænogam is such a portion of a shoot as answers to one of the primordial fronds. This is neither a leaf nor an internode, but it consists of a foliar appendage together with the preceding internode, including the axillary bud, when this is developed; thus Mr. Spencer's "unit" precisely corresponds with Gaudichaud's "phyton."* Such an unit being allowed, its metamorphoses are inferable from known laws of development. Arrest of development attacks first those parts which arise last in the order of evolution. On this principle, therefore, the foliar organ is the most constant, the internode less so, the axillary bud still less so, and this gradual degradation we find in a flower; the bracts are lessened leaves, the internodes are less and less developed, the axillary buds are not formed, and in the flower itself we have only a foliar surface, without chlorophyll, and that foliar surface, in the case of the stamen, is reduced to a minimum.

In conclusion, we beg to express our hope that Mr. Spencer will find time to pursue this interesting subject, and by a more searching investigation of the literature of the subject than he appears at present to have made, and by more abundant personal observations, will add to the obligations under which he has placed botanists by the publication of the present essay.

XXXIII.—The Natural History of Cyprus.

Die Insel Cypern ihrer physischen und organischen Natur nach, mit Rücksicht auf ihre frühere Geschichte geschildert. Von Dr. F. Unger and Dr. W. Kotschy. Wien, 1865. 1 vol. 8vo.

The work before us may be regarded as an excellent physico-geographical monograph of the island of Cyprus, full of valuable details on all branches of natural science. The history and anti-

* Recherches sur l'organographie des végétaux. Paris, 1841. See also Hochstetter, Jahreshefte des Vereins fur Vaterlandische Naturkunde in Würtemburg, 1847, p. 1, 1848, p. 144.

quities of the islands are rather touched upon than treated fully, not from any want of information on the part of the authors, as they show their familiarity with these subjects whenever they find it needful to refer to them; but, because their object was mainly to give a faithful picture of the physical aspect and productions of the island. In this they have been very successful, for though the style of the work is rather desultory, leading to a good deal of repetition, nothing of importance has been omitted.

The object which our travellers had in visiting the East was to enrich the domain of natural science with observations and collections in some of the less known regions, and their choice fell on Cyprus, which had already yielded a rich harvest to the historian and archæologist, but the natural history of which was, comparatively speaking, unknown. Both of our travellers had already visited the East, and one of them, already a veteran in Eastern travel, had been twice before in Cyprus, no doubt taking away with him the conviction that it was deserving of much further investigation. Another reason which influenced their selection, was, that the limited area of the island enabled them to hope that they could explore it to their satisfaction within the time which they were able to devote to the purpose.

The island of Cyprus had indeed been previously visited on several occasions by naturalists, chiefly botanists. First of all by Labillardière in February 1787, who, however, only explored the Monte Croce, near Larnaka, and in the same year, a little later, by Sibthorp and his fellow-travellers, Hawkins and Ferdinand Bauer. The pencil of Bauer has in that magnificent work, the Flora Graeca given most admirable illustrations of the plants of the East in a style which, as our authors well observe, leaves nothing to be wished for. These travellers remained in Cyprus from the 8th April to the 13th May, exploring the southern coast and mountains. Of the figures in the Flora Graeca 374 represent Cyprian plants. In 1801, Clark visited Cyprus and described a few plants. In August, 1831, the well-known botanist Aucher-Eloy explored the neighbourhood of Paphos and the mountain Troodos. Kotschy on his return from Sennaar and Cordofan visited Cyprus in October and November, 1840, but at that unfavourable season though he travelled over a considerable portion of the island and collected assiduously, he only got sixty species. In 1853, Gaudry travelled in the island, devoting his attention chiefly to geology, but giving at the same time careful attention to agriculture. He collected a number of plants which were described in Paris by Spach. Kotschy again paid a hurried visit to the island in the early spring of 1859, and spent some time on Troodos, its highest mountain; making considerable collections.

Our travellers starting from Vienna reached Trieste on the 10th March, 1862. Embarking at that port on the 15th, they anchored on the 25th March at Larnaka on the south-east coast of Cyprus. On their arrival they found that spring had already made some progress. The work before us does not give us a continued diary of their journey, though a few of the more important details are briefly noticed. It is rather a copious statement of results than a personal narrative. We cannot, therefore, by extracts give anything like an accurate idea of it, but it is possible and may be interesting to our readers to select from it a few of the principal facts, and thus get some idea of the physical conformation, climate, and vegetation of the island.

The plan of our travellers led them to travel together, instead of each taking a separate district. They divided the field of work between them, each taking his own favourite branches of natural science. To Kotschy's share fell the flowering plants, it being his task not only to collect but to make copious notes of their range and distribution. Unger undertook Cryptogamic Botany, Geology and Meteorology. The animal kingdom was also divided, the land and fresh-water mollusks being allotted to Dr. Unger, while all the other branches were given to Dr. Kotschy. The travellers made Larnaka their head-quarters or depôt, as it were, making repeated short excursions varying from a few days to a fortnight or more, at the end of which they returned with their booty, which they deposited there, to start afresh unencumbered by collections. Dr. Kotschy spoke Turkish perfectly, and modern Greek sufficiently well to enable them to dispense with an interpreter. They travelled always on horseback, not only because travelling on foot is unusual, and would therefore have been remarked upon, but because it is often impracticable from the wretched state of the roads. In Cyprus, we may note for the benefit of future travellers, that it is rarely necessary, as is so often the case in Greece, to carry provisions for weeks together. Here each town affords biscuits or bread, rice, pulse, butter, &c., and there are few villages or monasteries in which eggs, fowls, mutton, and pork cannot be obtained. An occasional hare and francolin served to vary the diet of the travellers, and wine of fair quality was readily procurable. For themselves and baggage, a train of seven animals (horses, mules, and asses,) was required. Their attendants were a cook and two muleteers, and for collecting they trusted to themselves alone.

The different portions of the work are divided between the two authors pretty much as they divided their duties as observers, but the introduction and most of the general narrative and observations are from the pen of Dr. Unger, who further gives a general outline of the principal features of the vegetation. The more detailed observations on the Flora and the excellent list of flowering-plants is by Kotschy, to whom we also owe, with the assistance of others for many of the groups, the list of animals.

Among the Mediterranean islands, Cyprus yields in size only to Sicily, Sardinia, and Candia. Its greatest length is 121 geographical miles, its greatest breadth rather more than fifty miles, its circumference about 250 miles, and its area 2768 square miles. It lies in the centre of a wide bay, which is interposed between the coasts of Asia Minor and Syria, and its longest axis is from east to west. It consists of two distinct masses of mountains separated by a wide plain. The northern mountain-chain is long and narrow, and its higher summits rise only a little above 3000 feet. The eastern half of this chain projects boldly into the sea, in a direction somewhat north of east, in the form of a narrow promontory rather than a peninsula. The southern mountain mass, oval in outline, rises on the south and west almost abruptly from the sea, or is skirted by a narrow belt of level country. Its slopes are steep and separated by deep and narrow valleys. Three hills rise above 5000 feet, and one, Troodos, the highest mountain in the island, is rather more than 6000 feet high. To the north and east lies the wide central plain, about as extensive in area as the south mountain mass, through which the great rivers flow. These rivers are two in number, and rise on the north flank of the mountains nearly in the middle of the island, whence one flows westward, and the other, the larger of the two, eastward to the sea.

The southern mountain mass is mainly plutonic. Its western half its entirely so, but on part of the eastern slopes there rests a coating of sedimentary rocks. The northern chain has an axis of plutonic rocks which rarely comes to the surface, being generally concealed by highly inclined strata of limestone often brecciated and generally not fossiliferous. These are referred with some hesitation to the period of the oolite (Jura). Other limestones, also highly inclined and often dolomitic, are occasionally coralliferous. The coralline remains are, however, imperfect; but from their study, Professor Reuss has inferred that the rock in which they are contained belongs to the chalk, or more probably, to the upper Jura. Highly inclined sandstones and slates, non-fossiliferous, rest upon these and a considerable portion of the lower slopes of the hills, as well as a large part of the central plain consists of gypsum containing marl, also in highly inclined strata. These are, unfortunately, in general without organic remains, a single valve of a *Cytheræa* having been the only fossil found, but they are certainly tertiary. The rest of the central plain and the lower coast deposits, consist mainly of very recent tertiary marls, sandstones and conglomerates, horizontal, or nearly so, and quite unconformable to the older marls below. The highest of these beds is about 600 feet above the sea-level. They are occasionally fossiliferous, and in one locality, near Larnaka, a large collection chiefly of Foraminifera and shells was obtained, of which a list is given. Only four of the shells are not recent. The Foraminifera are remarkable for the predominance of Miliolidæ, agreeing in this respect with beds of corresponding age in Rhodes.

The climate of Cyprus is, on the whole, drier than one would expect from its insular situation, and the elevation of its mountains. The winter months of October, November, and December, are the period of rain, which lasts sometimes 30 or 40 days with little intermission. The spring months are dry, with occasional showers on the mountains, the latest noted being on the 11th of May. The rest of the year is absolutely dry, and the sun shines on the parched ground from a cloudless blue sky. The rivers, which during the winter rains overflow their banks, begin to dry up in spring, and in summer and autumn almost or altogether disappear. In some seasons the winter rain is considerably less, and occasionally there is no rainfall for a whole year, in which case the sufferings of the people, severe enough in ordinary years, become excessive. Once, about the time of Constantine, it is recorded that no rain fell for 36 years, by the end of which time almost all the inhabitants had perished.

In the low country the winter temperature rarely falls to freezing, and after the rain ceases the weather soon becomes warm. On the mountains snow falls in winter, and on the summit of Troodos it remains in some quantity in sheltered spots as late as the middle of May, after which time it rapidly disappears. Early in that month the heat of the plains becomes oppressive, and throughout the summer and autumn it continues intense. The harvest is by that time everywhere over; the air is dry and full of haze, nothing but stubble fields meet the eye, the mulberry trees are leafless, and refreshing shade is looked for in vain.

From the temperature of deep springs we get for the mean temperature of the north side of the island $65\frac{3}{4}°$ Fahr., and of the south side $69\frac{1}{2}°$. This result is quite intermediate between the mean temperature of Athens, 65.3°, and that of Cairo, 72°, and is therefore probably nearly correct. The springs of the northern chain are much more copious and permanent than those of the south, and make their appearance at the point of junction of the limestone with the superimposed sandstone or marl, at an elevation of 500 to 700 feet. As the supply is abundant throughout the year, its source cannot be the southern chain, not only because that is less pierced with springs, but also because the corresponding rocks do not there rise so high, and the hydrostatic pressure must act the other way. It is therefore believed to be derived from the Caramanian mountains on the opposite coast.

In the earlier historic times the island of Cyprus was entirely covered with timber. Long after the axe had been freely applied to the trees of Lebanon, Cyprus was one dense forest. When first colonized by the Phœnicians it must have been well wooded. In these ancient times its mines of copper and iron were extensively worked. The island was long one main source of supply of timber for shipbuilding, and we are told that land was freely granted to settlers on condition of its being cleared of timber. All these causes no doubt rapidly led to a diminution of the forest, and we may fairly infer to an increase of dryness. Unfortunately the clearing was carried on without judgment. Large tracts have been denuded of forest which are quite unfit for cultivation, and now form an arid desert. The area of waste land is now considerably greater than that under cultivation, which amounts to about one-eighth of the whole island, the remainder being forest. Even now, however, in spite of the destructive habits of the people, who cut down and destroy the trees recklessly, and waste them by devastating fires, there is more wood in Cyprus than in other parts of the East similarly situated. The open plains and lower slopes are certainly bare, but the hill tops have often clumps of trees or small woods, and the higher mountains are still well wooded.

Agriculture is mainly carried on by means of irrigation. The rivers, which in the hills run in deep valleys, in the open country cut deep channels in the plains. In winter, however, in their lower course they overflow their banks, and the great eastern river, the Pediás, spreads fertility over the rich alluvial plain like a little Nile. The rest of the country is in general barren, and unfortunately its natural sterility is not compensated for by any display of energy on the part of the inhabitants. Of corn-plants, wheat and barley are most cultivated, and of the two barley is preferred, because it ripens earlier, and is thus more likely to escape the destructive locusts; of the ravages of which our travellers draw a melancholy picture. The mode of cultivation is extremely rude, and the produce scarcely sufficient for the supply of the scanty population. The ground is scratched by a wretched plough, drawn with difficulty by a pair of lean cattle. The grain is sown at the end of September or beginning of January, according to situation. Its chief growth is during the rainy months, and it is harvested at the beginning of May. It is cut with the sickle, the sheaves carried home on the backs of mules or asses, and thrashed in the open air by drawing over the ears of corn a rude sledge formed of a flat board, with projecting teeth below. Many kinds of pulse are also cultivated. Of these the most common is the vetch (*Ervum ervilia*), which succeeds on the poorest soil, and the lentil (*Ervum lens*). The common bean is more rarely cultivated, and the other sorts only occasionally seen. As in Egypt, from which it was in all probability introduced, the *Colocasia antiquorum* is much cultivated for its edible roots.

Cotton was once so great a favourite that it threatened entirely to supersede grain crops. A good deal is still grown, but it requires a good soil, and to be well manured and plentifully irrigated. The best is the produce of the fields of Soli and Evriko, which unfortunately are not extensive. The cotton is sown in May, and the pods are picked in October, just before the rains set in. The plants last two years. Sugar-cane was once an object of cultivation, but has now quite disappeared. Madder is still grown on light, sandy soil, and comes to perfection the second or third year. A good deal of it is used in the island, and about 90 tons are exported annually.

The hilly parts of the island are very well adapted for the cultivation of the vine, which is in fact the most important crop grown by the Cyprians, and might be enormously extended without in any way encroaching on the ground appropriated to other things. The wine is of good quality, some of the better sort being really excellent. There is a considerable export of it, and a large quantity is distilled to yield brandy. The olive is not indigenous, but is cultivated everywhere up to 4000 feet. It grows even on poor and barren soil, but succeeds much better near springs. It is the most useful tree to the inhabitants, yielding the only article of food which the poorer classes add to their bread, especially at the often recurring fast-times. It supplies also the only oil used for burning.

On the subject of the Zoology of the island we find a few observations scattered through the body of the work, and there is at the end a list of all the animals collected. The number of mammals contained in the list is very small. Besides the common domesticated animals, namely, the buffalo and common cattle, the sheep, goat, horse, mule and ass, dog and cat, the last of which is perhaps a native, the only species we find are the fox, a wild sheep called *Ovis Cyprius*, the hare, rat (*Mus decumanus*), and common mouse, the hedgehog, and two species of bats. Of birds 89 species are enumerated. The reptiles are 28 in number, and there are 29 fishes. Only 4 Crustacea are enumerated, but the list of Coleoptera extends to 1384 species. This is the only order of insects which Dr. Kotschy seems to have collected, or at least of which the species have been determined, but he refers to a list of Lepidoptera, published in a Vienna journal, and there is a separate list of Orthoptera given at page 473. The number of land and fresh water mollusks is 25, and with them the list closes.

The graphic picture, drawn by Dr. Unger, of the locust plague of Cyprus, will enable us to make a single extract.

> "In the year 1862, spring set in early. On our first journey from Larnaka to Famagosta, we found the young brood already hatched. Though scarcely larger than gnats, we were horrified at their prodigious numbers, which too manifestly indicated the destructive nature of the foe which the warm spring sun was about to develop, even more rapidly than the young crops. In the neighbourhood of the village of Angoru, our ride lay across a barren table land, on which were a few small fields only. Bushes of *Juniperus phœnicea, Pistacia Lentiscus, Poterium spinosum, Satureia spinosa*, &c., covered the poor soil. On this waste heath great colonies of locusts had established themselves, resting in thousands on each bush, and feeding on them. As we approached, the little creatures sprang lightly away, but soon returned to their social meal. We could not observe that they had as yet done much injury to the shrubs on which they fed, but the complaints which we everywhere heard of their annual devastations, were enough to prove that even in their young state they are a scourge to the cultivated lands."

A fortnight later the travellers met the locusts on the same plateau, but a little further west.

"On the 11th of April the country folks were all occupied with the harvest. The wheat was not quite ripe, but the advanced parties of the dreaded assailants had reached its green stalks, and it was necessary to make haste to anticipate them by removing the ears, leaving them only the stubble. They had increased in size to an incredible extent, and, heaped together as they were, looked most disgusting. Though only half as long as the finger, they were nearly full grown; but as they were not yet able to use their wings, their mode of advance was by moving one leg leisurely after the other, rather walking slowly than springing. Even the wall and ditch of the town with difficulty kept them out. Travellers enquire with curiosity, what is the meaning of the white belt of smooth plaster which runs round the city wall, about its mid height, and learn with surprise, that it is intended to stop the locusts, who can easily ascend a rough wall, but are stopped by a perfectly smooth surface."

The most destructive locust of Cyprus belongs not to the genus *Acridium*, but to *Stauronotus, (S. cruciatus)*. It lays its eggs not in cultivated land, but in waste places. The young insects are hatched about 21st March, cast their skins four times, becoming winged at the last change.

With regard to all branches of the botany of the island, the information in the work before us is much more complete. The climate is certainly not favourable to Cryptogamous plants, which, however, seem to have been assiduously collected by Unger, in whose department, as we have seen, they were included. One new Diatom and a new *Palmella* are figured, and the list contains 29 Diatoms, 31 Algae, 2 Charae, 15 Fungi, of which one Agaric is new to science, 82 Lichens, 4 Hepaticæ, 77 Mosses, of which six are new species; 2 *Equiseta*, both English species, and 11 Ferns, seven of which are English, and widely diffused over Europe and Asia; the other four being *Gymnogramma leptophylla*, *Nothochlaena Marantae*, *Cheilanthes fragrans*, and *Nephrodium pallidum*.

The list of flowering plants contains about 1000 species, of which, however, between 90 and 100 are only known in a state of cultivation. They are all carefully determined by Kotschy. Some of our English botanists might think that there is a slight tendency (it is, however, certainly very moderate in amount) to over-estimate the number of species in some of the more variable genera. The list, which may be regarded as tolerably complete, occupies 220 of the 600 pages of which the work consists, and is a most valuable contribution to our knowledge of Mediterranean botany. Dr. Kotschy has taken pains to point out the extent of its imperfections. For nearly three weeks before the arrival of our travellers, the maritime region was gay with a profusion of magnificent flowers, some of which may perhaps have completed their annual period of vegetation before they had an opportunity of collecting them. The Flora of June and July is also unknown, and some species, published by Boissier, show that even in August Aucher reaped a good harvest. The Flora of September is also wanting, and nothing is known of the vegetation between November and March, though flowers are not entirely wanting, according to the testimony of the inhabitants, during any part of that period.

Forty-two species are enumerated, which are, so far as is known, peculiar to the island of Cyprus, a large proportion, certainly, if we consider its nearness to the continent. Future investigation will, no doubt, reduce it by discovering many of them on the mountains of the neighbouring countries. It is quite possible, too, that on a critical examination, the distinctive characters of some of them may prove when the plants are better known, to be less constant than they are inferred to be, from the examination of a few specimens of a single gathering. Two of the new species are Oaks. One of these, *Q. alnifolia*, a shrub or small tree, in habit very like a Californian species, replaces *Q. Ilex*, throughout the island, and is common on the southern mountain roads, at elevations between 1000 and 5000 feet, occurring most abundantly on the north and west slopes. The other, which is called *Q. Cypria* in the general remarks, is in the list reduced to a variety of *Q. Pfaeffingeri*, a tree which occurs also on the opposite coasts. The variety, however, is only known as a Cyprian plant. It is a large tree, and its favourite locality is in the valleys of the central mountains. It is believed formerly to have formed large forests. The only other new plant requiring special notice is *Bosea Yervamora*, a Salsolaceous shrub, hitherto only known as a native of Jamaica and the Canary islands, and, therefore, quite new to the Flora of the Mediterranean region. This curious plant was met with abundantly on rocks, at Lapethus, on the north coast of the island, and also sparingly at Larnaka, on the south coast. It was not, unfortunately, found in flower, so that it is not yet quite certain that it does not differ specifically from the species to which it is referred.

In his introductory remarks, M. Kotschy has carefully compared the Flora of Cyprus with that of the other parts of the Mediterranean region, but for the detailed results we must refer our readers to the work itself. The number of species is about one-fifth of those contained in the Mediterranean region, and the predominant orders are very nearly the same as elsewhere, and follow nearly the same order. There is a gradually diminishing proportion of species common to Cyprus and other islands and continents, as the distance increases. On a rough estimate we find about 220 British species in the list. Though, as we have seen, Cyprus is on the whole well wooded, there is a great want of what the Germans call *Laubholz*. Several species are rare, being found only in shady valleys, and many are entirely wanting. Thus *Quercus Cerris*, *Carpinus orientalis*, *Celtis australis*, *Elæagnus orientalis*, *Erica arborea*, *Crataegus orientalis*, *Cercis Siliquastrum*, and several others are unknown. To these must be added two Conifers, the Stone Pine and the Yew. All these are common throughout the rest of the Mediterranean region.

The general aspect of the vegetation bears the impress of the hot dry summer, in this respect agreeing with the flora of the whole region, of which Cyprus forms a part. It is different, of course, upon the plains and on the mountains, but there is no trace of an Alpine Flora. The plains and lower hills have no forest, and the extreme heat and drought prevent the growth of plants which rejoice in a humid climate. There are no meadows except in a few boggy places, near springs, but the corn fields, to the gratification of the traveller's eye but to their own serious injury, are gay in spring with a vast number of beautiful flowers, which soon wither away under the scorching summer sun. The waste lands, which form so large a part of the island, bear, on a miserable soil, a scattered herbage of thistles and grasses, *Boragineae*, *Euphorbiae* and *Leguminosae*, mixed with loosely scattered shrubs of Labiates, Cistuses, and other plants, between which there is plenty of room for every new comer. Under the shrubs a great profusion of bulbous plants, dormant under ground during the great heats of summer, start into growth when excited by the winter rains, and passing rapidly through the stages of flower and fruit, disappear with the end of the cool season. Many tuberous-rooted perennial exogens have a similar short cycle of growth above ground. Our readers would not thank us for copying the lists of shrubs and herbs peculiar to each region of the island, but those who wish for accurate details will obtain much valuable information in the work before us. The only plant which our space will now allow us to notice is a gigantic Umbellifer, *Ferula vulgaris* (or a variety of that species), which is a conspicuous feature in the landscape, attaining a height of nine feet, or more, with a stem $1\frac{1}{2}$ inches diameter, finely-cut leaves, and large umbels of yellow flowers in a terminal corymb. This singular plant occurs socially, and likes a poor sandy soil. It withers away with the first heats of summer, leaving only its dry stem, which is used to make a rude kind of chair, much used by the inhabitants. By July, nothing of it is left; the stem, which has become quite dry, breaks to pieces and utterly disappears.

The trees of Cyprus are chiefly Conifers, for the oaks are either under-shrubs, or are confined to the higher hills. The plane hides itself in the shady valleys. The commonest pine on the low levels is the Aleppo pine (*Pinus maritima* or *Halepensis*), which, no doubt, once on a time, clothed with forest a large part of the island, but which now grows scattered, or forms small woods on the less accessible slopes. Next in abundance, in the eastern part of the island, is *Cupressus horizontalis,* which forms small woods on the northern chain of hills, and at one time, probably, covered with forest their southern slope, as *Pinus maritima* did the northern. The wood is much valued for its hardness and perfume, and the tree is therefore much sought after. *Juniperus phœnicea* is also abundant on the desert plains of the eastern part of the island.

All these trees extend from the sea level up to 3000 feet, and the *Pinus maritima* up to 4000 feet, where it overlaps the lowest level of another pine, *P. Laricio.* This pine extends from that elevation to the top of the higher hills, and forms extensive, though open forests, which give a dark green colour to the western mountains of the island, as seen from the sea. Trees of 200 and 300 years are common; younger ones are scattered, and seedlings a rarity. Few of the trees are uninjured, and great numbers are destroyed for the purpose of obtaining the pitch and tar by an exceedingly rude process. The islanders have no saws, and lop off the branches of the trees for their purposes, leaving the trunk standing, which it is too laborious to cut down. Near the summit of Troodos, and above *P. Laricio*, another conifer, *Juniperus fœtidissima*, Willd. occurs. The summit itself is bare and dry, and produces only a few herbaceous plants along the water channels.

In addition to the ordinary products of cultivation, the only remarkable products of the island of Cyprus are, the St. John's bread, Ladanum, Storax, and Mastic, regarding all of which we find in the work before us very curious details, an abstract of which may be interesting to our readers. The Carob, or St. John's bread (*Ceratonia*

Siliqua, L.), is a native of the island, covering the tops and sides of the dry hills, which are incapable of cultivation. In its wild state, however, the fruits are almost dry and scarcely sweet, and the succulent sweetness of the better sorts is the result of careful cultivation. Plants raised from seeds of these better sorts, soon revert to the condition of the wild plant. The cultivated plants are, therefore, all grafted, and this is done not only in gardens, but to the old plants on the hill sides, the branches of which are lopped off, and a twig of the plant to be grafted inserted into the stem of some of the large branches. This rough sort of grafting seems to succeed well with this hardy plant. The Carob cultivation is chiefly carried on on the south coast, and large sheds are built near the ports on the coast, to store the pods in previous to exportation. In the island itself they are not much eaten, but are used for feeding cattle, and the preparation of brandy by distillation. For the latter purpose they are largely exported, chiefly to Trieste. The produce has amounted in some years to about 5000 tons; but as the export is a monopoly in the hands of the Turkish Government, which pays the cultivator a wretched pittance, it has of late been found more profitable to cut down the Carob trees.

Ladanum is an exudation from a species of rock rose (*Cistus creticus*, L.), which abounds on the drier slopes of the northern mountain mass, most abundantly to the westward, at elevations between 2,500 and 5,000 feet. It is also found not only in Candia (where also Ladanum is collected), but in Rhodes, Sicily, and Greece. This resin has been known from remote antiquity, and the mode of obtaining it, still in use in the island, is mentioned by Herodotus and Pliny. It is a secretion from compound hairs, composed of many cells, which cover the under sides and margins of the leaves, as well as the petioles and young shoots, and is collected from the beards of the goats, which feed upon the plant. In Candia, as Tournefort has long ago told us, the Ladanum is collected by a sort of rake, or coarse brush with leathern thongs, with which the brushes are beaten. According to Pococke and others, a somewhat similar instrument is used in Cyprus, in which long strips of wool are the vehicle for detaching the resin; but these instruments are certainly no longer in use in this island.

In connection with the Ladanum plant, Dr. Unger enters into a curious discussion respecting the derivation of the name of the island, upon which depends, as is well known, that of Copper (aes

Cyprium), and of the Cypress (*Cupressus*). The name Κύπρος is identified with Gopher, a Hebrew word, which was applied to a shrub whose flowers and fruit were used to make an ointment. Pliny describes this Gopher or Cupros shrub, and his description evidently points to *Lawsonia alba*, Lam., the well-known Henna shrub, which is certainly not a native of Cyprus, and though abundantly cultivated there 150 years ago, is now scarcely known. As there was never any demand for this plant in western Europe, it could never have been an article of trade between Cyprus and the west, so that Pliny must be in error, and some other plant must be looked for. Now, as Pliny himself, after following Herodotus in giving Arabia as the native country of Ladanum, says that the Arabian sort is now called *Stoholon*, and that the true resin is obtained from Cyprus, and that in both countries it is obtained from the beards of goats, Dr. Unger believes that the name Cupros properly belongs to the Ladanum Cistus, one of the most characteristic shrubs of the island.

The accounts of the production of Storax, and of Mastic, are also very interesting, but our space will not allow of our entering upon them.

In conclusion, we must once again repeat the complaint so often made of the want of an index to the present work, by which the usefulness of an extremely interesting book is considerably lessened.

Original Articles.

XXXIV.—On the Dentition of Rhinoceros megarhinus.—By W. Boyd Dawkins, M.A. Oxon., F.G.S.

Contents:

§ 1. Tichorine, leptorhine *and* megarhine species.

The remains of the fossil Rhinoceros are perhaps more widely spread throughout Europe and Asia than those of any other fossil quadruped, except the Mammoth. From the shores of Siberia in latitude 72°* southwards, as far as the Sivalik Hills,† they are found in greater or less abundance: from east to west the genus ranges from the banks of the Lena to the Straits of Gibraltar. Its range also in time is very extended—from the Miocene as far down as the later division of the Pleistocene, when the low-level gravels and brick-earths were being deposited in Britain.

Passing over the numerous continental and confining ourselves to the British Pleistocene species of the bone-caverns and river-deposits, we find evidence of the presence of three distinct

* Probably also in the higher northern latitudes of the islands of New Siberia, and the Lächow group, the remains of the tichorhine rhinoceros are to be found in the vast accumulation of organic remains, of which—as the energetic Russian explorer Sannikow writes—the *whole soil* of the first of the Lächow Islands appears to consist. The occurrence of large quantities of the bones and skulls of oxen, buffaloes, horses, and sheep, associated with the Mammoth on the hills of the interior of New Siberia (lat. 75-6,) led him to infer that at the time when the island supported such vast herds of these animals, the climate must have been much milder than at present, when the icy wilderness produces nothing that could afford them nourishment.—See Wrangel's Siberia and Polar Sea, 1840. Edit. Major Sabine, Introduction.

† Falconer and Cautley's Fauna Antiqua Sivalensis.

species in Britain. The first of these, and the most common, is the *Rhinoceros tichorhinus* of Cuvier, described by Pallas in the year 1768,* determined by Cuvier in 1812,† and still more accurately by de Christol in 1835,‡ ranges through France, Germany, and Russia, along with the Mammoth from the Pyrenees to the high northern latitudes of Asia. Brandt in the year 1849 published an exhaustive account of this species, in the St. Petersburgh§ Transactions, having at his command the vast collections made by the Russian Government. In a previous number of this Review,|| its dentition has been defined after Brandt's method. The tichorhine species has indeed a literature of its own, more complete perhaps than that of any other fossil mammal.

The second species—the *leptorhine*—on the other hand, is involved in the greatest confusion, arising from the fact that the *leptorhine* of Professor Owen,¶ is not the same as that of Baron Cuvier. Its history is very remarkable. Some time before the publication of the first edition of the "Ossemens Fossiles" in 1812, Baron Cuvier received the drawing of a head of Rhinoceros from the Val d'Arno, in which the osseous septum between the nares, so characteristic of the tichorhine species, was absent. The proportions also of the skull, and the form of the lower jaws from the same deposit, and the slenderness of the bones, led him to found a new species which he named from the supposed absence of the septum, *R. leptorhinus*,** or "*Rhinocéros a narines non cloissonées.*" In 1835, M. de Christol, on the examination of careful drawings of the same skull, came to the conclusion that it belonged to the tichorhine species, and accounted for the absence of the bony septum by the supposition that it had been removed by violence. The drawings sent by Professor Cortesi to Cuvier, he proved to have been incorrect.†† The bones of Rhinoceros found in the same deposit, he ascribed to his species *R. megarhinus*. Whether or no the skull in question belongs to *R. tichorhinus* or *R. megarhinus*, or to *R. Etruscus* of Dr. Falconer, I have no opportunity of judging: but M. de Christol has satisfactorily proved that it is not

* Nov. Comment. Acad. Petropol. Tom. xiii. p. 436.

† Oss. Foss. Tom. ii. Art. Rhinoceros.

‡ Annales de Sc. Nat. 1835.

§ Mem. Acad. St. Petersb. 6 Series, Tom. vii.

|| 1863, p. 552.

¶ British Fossil Mammals. 8vo. 356-382.

** Op. cit. p. 110.

†† Oss. Foss. III. edit. 1825. Tom. ii. p. 71.

what Cuvier supposed it to be, when from his imperfect drawings he made it the type of *R. leptorhinus*.* Desmarest† proposed the name of *R. Cuvieri* for the same skull, and Fischer‡ defined it specifically as "capite bicorni, dentibus primoribus nullis, septo narium nullo; naribus multo gracilioribus, ossibus-que nasalibus tenuioribus quam in *R. Africano*." In this confusion the remains of the non-tichorhine Pleistocene rhinoceros were left until the year 1846, when Professor Owen, after a comparison of the lower jaw, found with skull, teeth and bones at Clacton in Essex, and now in our National Collection, with the lower jaws from the Val d'Arno ascribed by Cuvier to *R. leptorhinus*, came to the conclusion that they belonged to one and the same species. In the British Fossil Mammals, figs. 131 and 138, he gives portions of the skull that exhibit not the total absence of the septum that Cuvier considered characteristic, but its partial development only. Whether the lower jaws from Italy, by which Professor Owen connects his species with that of the great anatomist, belong to the leptorhine as defined by the latter or not, may be an open question. But it is beyond all doubt that the assemblage of remains of Rhinoceros from Clacton belongs to some one species of rhinoceros that is not tichorhine. For that assemblage the name *leptorhinus*, which has stood in the catalogues for eighteen years, has a claim to be maintained: for, though Cuvier's definition of the species as *à narines non cloisonnées* be inapplicable, and the more accurate term would be *à narines demi-cloisonnées* (*R. hemitœchus* of Dr. Falconer), yet, as Professor Owen justly remarks, "since the nasal bones, notwithstanding their partial osseous supporting wall are actually more slender than those of *R. tichorhinus* there can be no valid objection to the Latin 'nomen triviale' *leptorhinus*, and every reason for retaining it." *R. leptorhinus* then, as defined by Professor Owen in 1846, the equivalent of *R. hemitœchus* of Dr. Falconer, is the second Pleistocene species found in Britain. It occurs in the brick-earths and gravel-pits of 'the lower terrace' of the Thames Valley at Clacton, Ilford, Crayford, and Peckham. It is the species that fell a prey to the hyenas of Kirkdale and Wookey Hole, and its teeth have been found in the ossiferous caverns of

* An upper molar tooth of Rhinoceros from the Val d'Arno belongs neither to the tichorhine, leptorhine, nor megarhine species, and possibly may belong to the same species as the skull in question from the same deposit.

† Mamm. 402, 632.

‡ Synopsis Mammalium, p. 416. 8vo. Stutgardtiæ, 1829.

Pembrokeshire, and Durdham Down near Clifton. I have identified the remains from Kirkdale, and the caves of Pembrokeshire in the Bucklandian Collection at Oxford. Those from Durdham Down associated with *Ursus spelæus*, *Hippopotamus major*, and *Elephas antiquus*, are preserved in the Bristol Museum. Both upper and lower jaws, associated with *Hippopotamus major*, have been obtained from the river deposits at Lexden, near Colchester. A comparison of the leptorhine with the tichorhine bones proves the former to have been a smaller and more slender animal.

Closely allied to the *R. leptorhinus* of Professor Owen in many points, but differing materially in its larger size, and the enormous development of its nasals, is the third species named by M. de Christol from its latter characteristic, *R. megarhinus.** In his type specimen, from Montpellier, the bony septum is absent. He enumerates five points of difference between the upper molars of the megarhine and the tichorhine species.† "1. Ces molaires (megarhine) n'ont habituelment que deux fossettes sur la couronne. 2. Le crochet de leur colline postérieure ne se joint jamais à l'anterieure. 3. Ce crochet est bifurqué ou trifurqué dans les molaires de remplacement, et simple dans les arriere molaires. 4. Un crête verticale part l'angle de la couronne et se dirige vers l'issue du vallon. 5. Un large bourrelet est appliqué contre le bord interne des molaires de remplacement." These characteristics apply with but slight modifications to the leptorhine teeth also; but as the latter was not properly defined as a species until the year 1846, M. de Christol, who wrote in 1835, cannot be blamed for not being cognisant of the existence of two species very closely allied in their dentition. The vast accumulation of materials for satisfactorily defining the species of fossil Rhinoceros in our great National Collection, and in many private museums, give the naturalist of the present day opportunities, such as Cuvier, Pallas, De Blainville, and De Christol never had. Out of it I have chosen the *milk* and *permanent* dentition of *R. megarhinus* for the subject of this essay, as being the most imperfectly known of the three Pleistocene species. In mapping out the various parts of the teeth I have followed the system of Professor

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* Recherches sur les caractères des grandes espèces de Rhinoceros fossiles, Ann. Sc. Nat. 2nd series, Zool. Tom 4, 1835, p. 42-112.

† Op. cit. p. 95.

Brandt with a few modifications, as in my first essay on the dentition of *R. tichorhinus.*

The detailed description of the teeth is based upon an examination of between 70 and 80 specimens.

So far as I can make out the synonomy of *R. megarhinus* and from figures and descriptions, it appears to be the equivalent of *R. Schleiermacheri** of Kaup, *R. Kirchbergensis*† of Jäger, and *R. incisivus* (in part) of Cuvier.‡ M. de Blainville confounds it with the leptorhine of Cuvier, and the equivocal species from the Val d'Arno.§

The teeth of *Rhinoceros megarhinus* have been obtained from three localities in the valley of the Thames, in which alone its remains occur in Britain. All the figured specimens were found at Grays Thurrock, and are preserved in the British Museum. In the cabinets of Dr. Spurrell and Mr. Grantham are some upper molars, from the south bank of the Thames, near Crayford, in Kent, while in the beautiful collection of Mammalia, from Ilford, made by Dr. Cotton, F.G.S., are two molar teeth. All the three species—the megarhine, leptorhine, and tichorhine, are found together at Crayford and Ilford.

The three species are bicorn.

§ 2. Enamel Structure.—The sculpturing on the enamel surface affords a ready means of determining the teeth of the three species. In the tichorhine the enamel is traversed by irregular rugæ, with but the faintest trace of parallelism, in the megarhine by fine striæ, for the most part parallel, that scarcely roughen the smooth surface, while in the leptorhine it partakes of the characters of both species, being smoother and more regularly marked than the former, less so than the latter. In the milk dentition, and especially in the lower molar series, these characters are not so well marked.

§ 3. Milk Dentition of *R. megarhinus.*—Analogy would lead us to expect to find but little difference in the milk teeth of the three

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* Isis, 1832, p. 898-904.

† Ueber die Fossilen Saugethiere welche in Würtemberg aufgefunden worden sind Von Prof. Jäger, Stuttgardt, 1835, folio, p. 179.

‡ M. de Serres Bibliothéque Universelle, 1835, in his "observations sur les Rhinocéros Fossiles et Humatiles," and De Christol, in his paper quoted above, prove that of Cuvier's three species, tichorhine, leptorhine, and incisor-bearing Rhinoceroses, the first is the only valid one. The other portion of Cuvier's *R. incisivus*, Kaup relegates to the large hornless rhinoceros of Darmstadt, *Accrotherium incisivum.* 1832, p. 34, tab. xviii.)

§ Ostéographie Art. Rhinoceros, Pl. xiii.

fossil species of the same genus: but though in many points they are remarkably alike—such as in the development of the *combing plates* (G H) in the upper jaw, yet they present considerable points of difference. In the tichorhine milk molars, the thickness of the enamel surface and its sculpturing, in the leptorhine the small size as compared with the megarhine, afford a ready means of differentiation.

R. megarhinus presents us with the same milk molar dentition as the two other species, $\frac{\text{Dm } 4.}{\text{Dm } 4.}$

§ 3 A. Upper Milk Molars.—The posterior wall of the tooth or the third collis (F) (= *collis tertius* of Brandt), in all the upper milk molars is depressed in its middle part instead of bearing a cusp, as in the tichorhine homologues. The grinding surface of the teeth is more excavated by wear than in the tichorhine species, where it is nearly flat. The fangs are four in number, the two outer free, the two inner confluent. They are hollowed beneath by the pressure of the germ of the successional tooth.

The first tooth of the milk series in the upper jaw (Dm 1: Figs. 1 and 2) is remarkable for its large size as compared with its homologue in *R. tichorhinus*. The external surface or lamina, L of Fig. 1 and 2, is smooth, and with a regularly convex contour, both vertical and horizontal, instead of being traversed by costæ as in the above species. The anterior valley, A, is wide, and traversed by two small involutions of enamel. Anteriorly it communicates with the exterior and anterior surface by a deep cleft descending almost to the base of the crown, and insulating the anterior collis, D, from the external lamina. It is smaller than the posterior valley B. There is but faint trace of the development of 'combing plates,' and con-

Fig. 1.

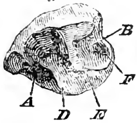
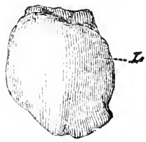


Fig. 2.



sequently there is no accessory valley mapped off. At the base of the cleft that separates the anterior collis, D, from the lamina are two small ridges, the one on the inner surface of the former, the other on the outer surface of the latter.

A comparison of figures 1 and 2 with Fig. 1 of Pl. iii. of the Nat. Hist. Rev. for 1863, will show at a glance the difference between the megarhine and the tichorhine first milk molars.

The second upper milk molar (Dm 2, Fig. 3 and 5) is differentiated from its homologue in the tichorhine species by its size, and by the smoothness of its posterior area, N. The external lamina, L, bears two costæ, K 1 and K 2, of which the second is the higher, and is divided from the broad first by a depression that passes *obliquely backwards* from the base to the summit of the crown.

The anterior collis, D, equals the posterior in size, and is not divided by a cleft from the external lamina as in R. *tichorhinus*. (Conf. Nat. Hist. Rev. 1863, Pl. iii. Fig. 2). The anterior valley has a wide entrance. In one specimen the accessory valley C is mapped off by two combing plates that meet and become fused. In a second the head of the anterior valley is traversed by two involutions of enamel. The posterior wall of the tooth, F, or the third collis (Collis

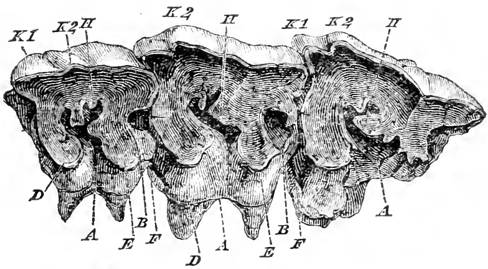


Fig. 3.

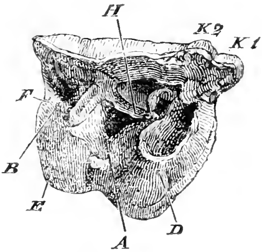


Fig. 4.

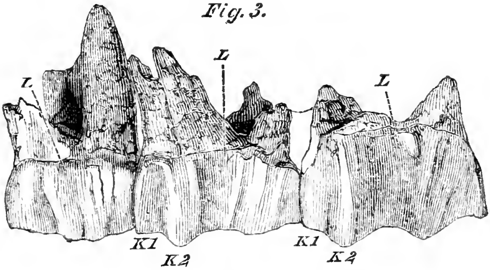


Fig. 5.

tertius of Brandt,) is depressed in its middle part, and without a cusp in the 2nd, 3rd and 4th milk molars.

The third milk molar (Dm 3) is only to be differentiated from the fourth by its smaller size (Figs. 3 and 5). In both the external lamina, L, bears two costæ on its anterior area, of which the second is the higher. The groove between them is deep *and vertical.* The posterior area, N, is faintly undulating and bears but the faintest trace of the costæ visible in the corresponding teeth of *R. tichorhinus.* The entrance of the anterior valley, A, is wide, and the comb-ing plates, G and H, sometimes map off an accessory valley C. In some cases the head of the valley is more or less filled with accessory folds of enamel. The posterior valley is small. The inner side of the anterior and median colles, D and E, slopes abruptly from the base towards the summit of the crown. The guard or obliquely ascending ridge of enamel on the anterior aspect of the tooth is very strongly developed, and circumscribes a deep pit at the inner angle of the anterior collis. On the base of the external lamina of the fourth milk molar (Fig. 4) is a small abnormal cusp.

§ 3 B. Lower Milk Molars.—The large size and the slight development of the ribs on the anterior area differentiate the three last milk teeth from the tichorhine homologues, the former character from the leptorhine.

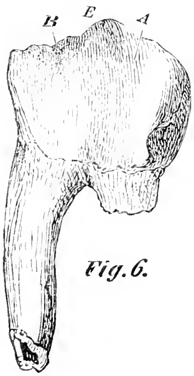


Fig. 6.

The first small trenchant milk molar (Fig. 6.) presents but the faintest shadow of the structure obtaining in the rest of the lower milk series. The external surface or lamina, L, is tumid, with a broad ill defined median ridge bounded on either side by a faint depression as in its tichorhine homologue. Of the anterior valley, A, there is but the merest trace, and the posterior is but slightly mapped off. The median collis, E, is small and very oblique, the anterior can hardly be said to exist at all. The two fangs are stout and cylindrical, and show no trace of the pressure of a successional tooth.

In the second milk molar (Figs. 7, 8), the external lamina, L, is divided into two areæ, M and N, by the median groove of which the larger, the posterior, is tumid, and projects more outwards than the anterior. The latter bears two ill-defined costæ. The anterior valley, A, is more shallow than the posterior, and has its entrance at a much lower level. On its posterior wall is a slight fold. The anterior collis, D, is faintly developed, and is mapped off from the external lamina that extends beyond it by a depression. One tooth, but slightly worn, presents the anomaly of the posterior valley being completely insulated by the normal entrance being blocked up by a wall of enamel.

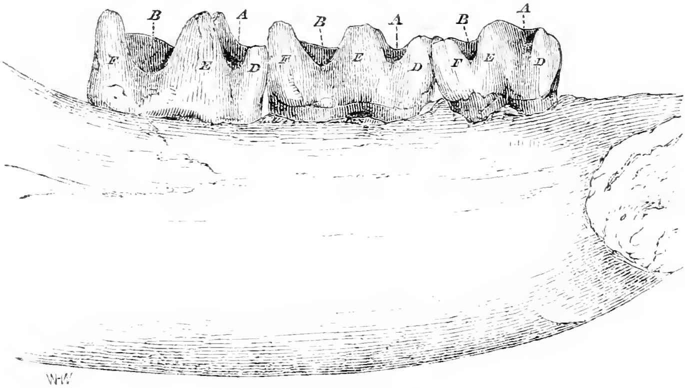
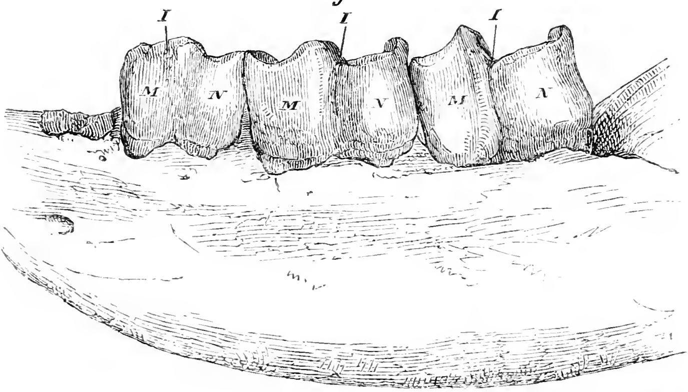


Fig. 7.

The external lamina of the third milk molar (Figs. 7, 8) is divided by a deep groove I into two equal areæ. Anteriorly it projects slightly beyond the point of juncture, with the anterior collis, D. The anterior valley, A, is smaller and more V-shaped than the posterior, B. Of the three colles the median is the larger, and the first and third equal in size. There is a small cusp, probably accidental, on the anterior edge of the median collis.

Fig. 8



In the fourth milk molar, (Figs. 7, 8) the anterior area, M, is flattened, and at a higher level than the posterior. The latter sweeps regularly round from the well defined median groove. The anterior valley, A, is about half the size of the posterior; the anterior collis, D, is the smallest of the three, and the median, E, the largest. The tip of the third is flattened on the inner side and bent forward, leaving a small process in the section afforded by a worn tooth.

§ 4. PERMANENT DENTITION.—The abrasion of the enamel on the anterior surface of premolar two by the pressure of premolar one, proves that in the upper jaw the molar dentition consisted of *Pm* 4, *M* 3, a point in which this species differed from *R. tichorhinus*, where the premolar one was not developed. It is the only megarhine tooth that I have not met with. In the lower jaw the number of the premolars is open to some doubt, as unfortunately the jaws present only premolars three and four, and dependence cannot be placed upon the isolated teeth.

In the upper molars (Figs. 9, 10, 11), the strong development of the guard, the suppression of the anterior combing plate, and consequently of the accessory valley (vallecula accessoria of Brandt), the accessory folds in the anterior valley, A, the pyramidal form of the presence of first and second colles, D, E, the absence of a cusp from the summit of the third, F, and of ribs from the posterior area differentiate the megarhine from the tichorhine species. The grinding surface also is very much more concave in the former than the latter.

The small size, the presence of a third costa on the posterior area, and the excavation of the lower third of the external lamina, characterise *R. leptorhinus*, as compared with *R. megarhinus*. Irrespective of these points and of size and sculpturing, they are remarkably alike.

The fangs are four in number, the two outer being free, the two inner confluent.

The right upper jaw figured (Fig. 9) as a type specimen of the British megarhine Rhinoceros contains three true and three premolars. They occupy an alveolar length of 12.8 inches.

§ 4. A. UPPER MOLAR SERIES 2.—In Premolar two the external lamina, L, is tumid, and with costa two, K 2, faintly developed. The anterior valley, A, is full of involutions of enamel, and communicates with the anterior surface by a deep cleft, not shown in the figure, extending down as far as the cingulum at the anterior and outer angle of the tooth. Its entrance on the inner side is in vain to be looked for, as it is completely blocked up by the inner wall of the tooth.

The difference between Premolars three and four is one merely of size. They are characterised by the tumidity of their external

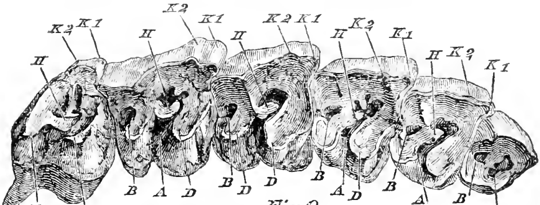


Fig. 9.

lamina, L, and by the absence of any trace of a third costa, that is developed so persistently in their leptorhine homologues. The anterior valley, A, is traversed by irregular processes of enamel, as in the teeth figured by M. de Christol. Its entrance is from 1.05 to 1.0 inches from the base. The ascending ridge or guard on the anterior aspect sweeps round the inner base of the crown and ascends the median collis. This is also the case with the leptorhine teeth of Professor Owen, but the guard in the latter is less prominent, and a glance at the enamel structure affords a ready means of differentiation. The leptorhine teeth moreover throughout are smaller than the megarhine.

The only points of difference between the true molars one and two is, that in the former the stout ascending guard on the anterior aspect extends inwardly as far as the middle of the inner base of the anterior collis, D, in the former, while it never extends so far in the latter. In the latter (Figs. 10, 11) also the posterior lobe is, relatively, smaller in transverse measurement than the anterior.

In both these teeth the second costa, K 2, is strongly developed and is higher than the first. The median depression so constant in the external lamina of the tichorhine homologues is absent, and the posterior area in place of bearing costæ presents a smooth and gently waved contour, N. The entrance to the anterior valley is wide in some, narrow in other teeth, at times it is blocked up by a small cusp. The posterior combing plate, H, developed from the anterior surface of the median collis is constant, and extending forwards partially insulates the head of the anterior valley. This, rounded in some, trihedral, in others, is traversed by vertical folds of enamel. The posterior valley is triangular in outline. The anterior collis, D, is traversed anteriorly by a strongly developed guard that circumscribes a deep pit on its inner and anterior base. The median

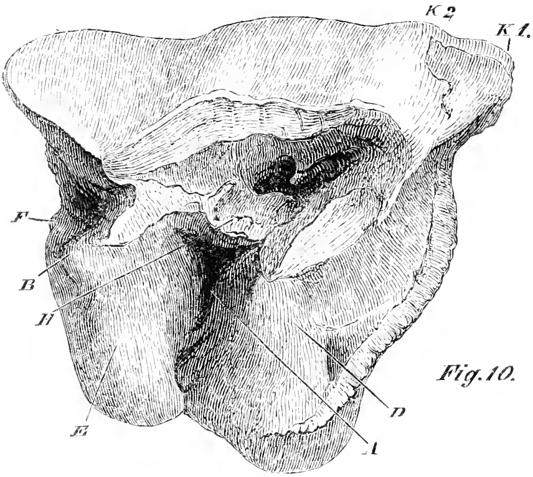


Fig. 10.

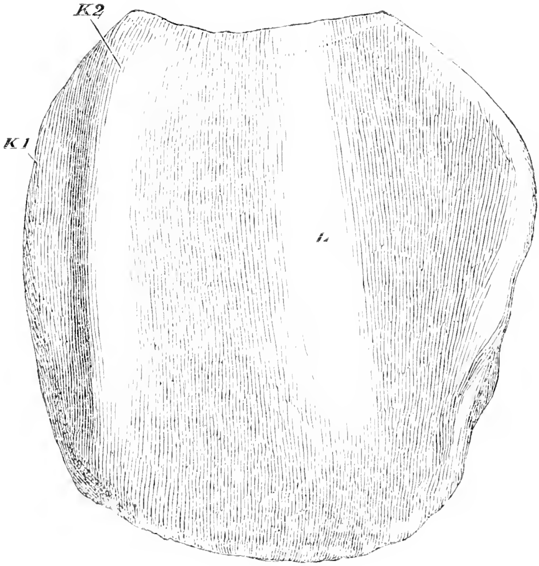


Fig. 11.

collis, E, tumid at the base, is hollowed out in the middle on its inner aspect, which therefore presents a concave vertical contour. This is the case also with the anterior but not to so great an extent.

The posterior collis, F, is divided by a notch from the median in the unworn tooth, and in place of bearing a cusp is widely notched apically.

In the third molar (M 3) the second costa, K 2, of the external lamina, L, is the higher, and the posterior area is slightly waved without trace of ribs. The entrance to the anterior valley is very large and wide, and is sometimes blocked up by a cusp, and the posterior combing plate is very strongly developed. In the portion of the anterior valley mapped off by it are accessory folds of enamel. The anterior collis, D, is narrower than in the tichorhine species. The third collis is represented by a small cusp as in the majority of the tichorhine homologues. The guard on the anterior aspect is very prominent.

§ 4 B. Lower Molar Series.—The lower molar teeth (Fig. 14) are so much like one another, with the exception of the first and last of the series, that size alone is the clue to their exact position in the jaw of the animal. In the premolar series the two valleys are V-shaped, and at a higher level relatively than those of the true molars.

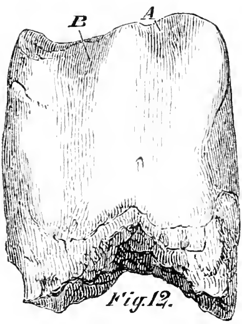


Fig. 12.

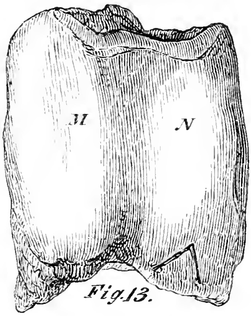


Fig. 13.

The first premolar (Figs. 12, 13) is trenchant, and the external lamina presents a smooth horizontally convex surface with a faint depression apically. The anterior valley is faintly impressed, and the posterior is extremely shallow, the inner surface of the tooth figured presenting a flat square slightly undulating area.

In premolars three and four the median groove traverses the base of the external lamina, which it never does in the tichorhine homologues. In premolars three, four, and true molar one, the inner aspect of the tooth is much more hollowed than in the tichorhine or leptorhine species. In the two latter a ridge passes down from the anterior collis, D, obliquely backwards and inwards as far as the neck of the tooth, and is continuous with the small guard that passes transversely from the outer to the inner side of the anterior aspect. These two points differentiate the megarhine from both the other

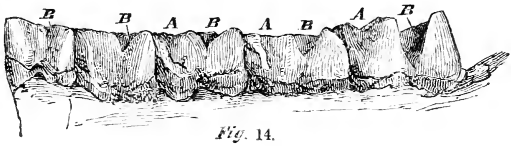


Fig. 14.

species. The tumidity of the areas, M N, which compose the external laminæ, and the absence of ribs from the anterior area are also salient points of difference in the lower molar series (See Fig. 15). The posterior fang of M 3 is cylindrical in section and reflected, which is never the case with the other teeth. The obliquity of the wear of the enamel on the outer aspect, owing to a different habit of mastication, as compared with its even wear in the tichorhine species, is worthy of note.

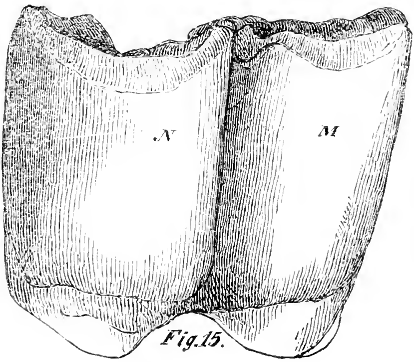


Fig.15.

§ 5. Measurements. The measurements taken at the base of the crown in inches and tenths, are uniform with those used in my essay on the Dentition of the tichorhine Rhinoceros. (Nat. Hist. Rev. iii. p. 525.) They are:—

1. Antero-posterior, taken along the outside of crown.
2. Antero-transverse, taken across the anterior lobe of the tooth.
3. Postero-transverse, " " posterior " "

TABLE OF MEASUREMENTS.

Milk Dentition.

No. in Cat. Brit. Mus.		1.	2.	3.
	Upper Jaw			
18755	Dm 1	1·08	0·95	0·95
	—	0·86	0·62	0·9
18791	Dm 2	1·35	1·6	1.65
18798	—	1·53	1·79	1·78
18791	Dm 3	1·69	1·98	1·8
18755	—	1 6	1·91	1·72
18751	Dm 4	1·86	1·97	—
18755	—	1·9	2·02	1·86
	Lower Jaw			
27902	Dm 1	0·85	0·49	0·55
18790	Dm 2	1·22	0·64	0·75
	Dm 3	1·65	0·91	0·87
	Dm 4	1·8	1·02	1·02

Permanent Dentition.

No. in Cat. Brit. Mus.		1.	2.	3.
	Upper Jaw			
22020	Pm 2	1·29	1·6	1·8
	—	1·32	1·41	1·7
	Pm 3	1·6	2·5	2·35
	Pm 4	1·9	2·7	2·27
	M 1	2·0	2·76	2·55
	—	2·05	2·79	2·64
	M 2	2·5	2·95	2·46
	—	2·1	2·65	2·2
	M 3	2·35	2·6	2·4
	—	2·1	2·34	2·25
	Lower Jaw			
18753 c	Pm 2	1·18	0·61	0·72
	Pm 3	1·55	0·93	1·08
	Pm 4	1 69	1·14	1·42
	M 1	1·9	1·28	1·4
	M 2	1·98	1·39	1·33
	M 3	2·09	1·28	1·28

§ 6. A minute comparison of the megarhine teeth with those of the living species of Rhinoceros proves the truth of Professor Owen's* remark, that each recent species may be identified with absolute certainty by one isolated upper molar. In the fossil species also the maximum amount of specific variation is to be found also in the upper molar series. Choosing the salient characters of the megarhine teeth, we find remarkable points both of agreement and difference.

1. *The accessory valley.* The anterior combing plate meeting the posterior insulates the accessory from the anterior valley in the †Unicorn Rhinoceros of India, the *R. simus* (Burchell's Rhinoceros) of South Africa; and in *R. bicornis*, true molars one and two being excepted; while in the *R. Sumatranus* and *R. Javanus* the anterior combing plate is undeveloped, and therefore there is no accessory valley defined, as in the leptorhine and megarhine species.
2. *The Colles.* The anterior and middle colles taper from the base towards the summit of crown; and the latter of them is slightly hooked, in the bicorn African, bicorn Sumatran, and

* Odontography, Article Rhinoceros.

† Fischer (tom. cit. p. 414 et seq.) and Van der Hoeven (Handbook of Zoology, Vol. ii.) give the synonymy of the various living species of Rhinoceros, to which reference can be made. The names used in the text are those of the catalogues of the Hunterian and British Museums.

Unicorn Javan species. The third collis is notched and cusp-less in *R. Javanus*, and *R. bicornis* of Sennaar: all of which are points of agreement. In the Sumatran species, on the other hand, the third Collis bears a cusp, as in the tichorhine Rhinoceros.

3. *The guard.* The *R. unicornis* of India, *R. Javanus*, *R. bicornis* and *R. Sumatranus*, bear a strongly defined guard on their anterior aspect as in the megarhine species.
4. *The external lamina.* In the four last-named species, as in the megarhine, the second costa of the external lamina, in *R. simus* on the other hand and *R. tichorhinus* the first, is the higher.

In fine, the dentition of the megarhine species presents a combination of characters now scattered among widely-isolated species of the same genus. The curious problem as to how the characters of the extinct became shared among the living species, and how others, not found in the former, were superinduced in the latter, is, to my mind at least, incapable of any other solution than that offered by Mr. Charles Darwin's "Theory of descent with modification." The unicorn *R. Javanus*, and the bicorn *R. Sumatranus* approach more closely to the extinct bicorn *R. megarhinus* than any other living species.

LIST OF WOODCUTS.

XXXV.—On portions of a Cranium and of a Jaw, in the slab containing the fossil remains of the Archæopteryx. By John Evans, F.R.S., F.G.S.

It will be remembered that in the admirable and exhaustive account of the slab containing the unique remains of the *Archæopteryx lithographica* of Von Meyer (*A. macrura*, Owen) read before the Royal Society in November, 1862, by Professor Owen, it was stated that beside some other less important portions of the skeleton, the head of that marvellous bird was wanting on the stone; and it was suggested that as the front margin of the slab had been broken away short of the anterior border of the impression of the outspread left wing, the head or skull of the specimen might have been included in that part of the quarry or stone from which the slab had been detached.

But upon a careful examination of the slab made on two separate occasions soon after the reading of that paper, I discovered two objects which appeared to have escaped Professor Owen's notice, one of which I thought might with safety be referred to the head of the Archæopteryx, and the other, though of much more doubtful attribution, might possibly belong to it also.

I at once brought this discovery under the notice of Professor Owen, and on the publication of his paper in the Philosophical Transactions for 1863, he called attention to the subject by engraving the objects in the margin of the plate of the slab containing the Archæopteryx remains, and also appended the following succinct remarks in his explanation of the plate.

n. Concretionary nodules: the larger one consists of matrix, which filled a cavity, *n'*, formed by a thin layer of brownish and crystalline matter; which may be, as suggested by Mr. John Evans, F.G.S., part of the cranium with the cast of the brain of the *Archeopteryx.*

n' Cavity with a layer of brown matter, in the counterpart of slab, which was applied to the nodule *n'*.

Fig. 3. *p'*. Premaxillary bone, and Fig. 1 *p*, its impression, resembling that of a fossil fish.

Professor Owen has also engraved for comparison, a cast of the fore-part of the brain-cavity of a magpie which I left with him, but has abstained from offering any decided opinion as to the correctness of my attribution of the corresponding object on the slab to the head of the Archæopteryx.

As some time has now elapsed, and I have seen no reason to make any change in my views, I venture to bring the subject again before the public.

The fossil bird, as is well known, is preserved on two slabs of the Solenhofen lithographic stone. One of these, containing the principal bones and the clearest impressions of the feathers, I shall speak of as the principal slab; and the other, which though containing but few of the bones, is still of the utmost importance for completing our knowledge of the character of the fossil, I shall term the counterpart.

On the principal slab, between the posterior margin of the right wings and the lower extremity of the right *tibia* of the bird, is a rounded protuberance, in general outline forming a crescent, with a depression in the centre of its convex side, dividing it into two lobes. On the concave side of the crescent, the limestone of the slab rises to a higher level than it does on the convex side, so that the outline of the lobes is not so well defined on that side, and the upper portion of one of them has moreover been broken off together with a portion of the matrix. Around the margin of the crescent-shaped protuberance may be discerned a section of a thin film of sparry matter, representing the place where bone has been, which is continued on in a curved line beyond the outer end of the more perfect lobe, forming as it were a long thin horn of the crescent.

The counterpart does not exactly correspond with the principal slab, as a portion of the matrix has been chipped away from the latter since the block was split, causing the injury to one of the lobes, which I have already mentioned; but in it, is a crescent-shaped portion of the sparry layer which takes the place of bone in the slab, showing the two concavities in which the rounded lobes on the principal slab were moulded, with a projecting ridge between them.

There can, I think, be but little hesitation in recognizing in this crescent-shaped object, a portion of the anterior part of the missing cranium of the Archæopteryx, while on the slab itself is a cast of a portion of the brain-cavity, showing distinctly the two hemispheres of the brain and the median line, corresponding with the intercerebral ridge, which is so plainly visible on the counterpart.

Indeed, so evidently is this the case, that Mr. Carter Blake recognises upon the cast of the brain "the site of the olfactory lobes,"* and perhaps "some trace of the optic lobe beneath the brain."

* Geologist, Vol. vi. p. 7.

To those who have carefully examined the fossil, it may seem superfluous to attempt to prove that these remains are really organic; but as I understand that some doubts have been expressed upon this point, I would call attention to the following facts—

1st. That the presence of a layer of calcareous spar of exactly the same character as that which distinguishes the bones upon the slab is evident around the bilobed projection on the principal slab, and the mould in the counterpart in which they were formed is a continuation of the same sparry layer.

2ndly. That assuming this sparry layer to represent the former existence of bone, as to my mind it undoubtedly does, there is no bone which presents an analogous bilobed cavity with the exception of the skull; and

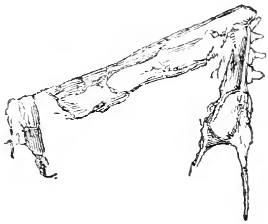
3rdly. That the position of the remains refers them to the Archæopteryx, while the ornithic character of the cast of the brain cavity is in perfect accordance with the other portions of the skeleton of this curious creature.

I therefore regard the evidence on which rests the attribution of this part of the fossil to the head of the Archæopteryx as sufficiently conclusive to justify some further speculation upon the subject. I would, however, rather leave this to others better versed in anatomy, and will only venture upon a single suggestion with regard to the position of the brain in relation to the beak.

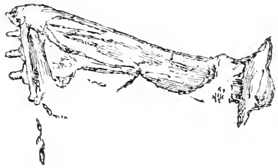
Although from the nature of the matrix in which the skull was imbedded, there has probably been some compression and distortion of its form, yet these appear to have been but slight and not sufficient to affect in any material degree the shape of the interior cavity, of a portion of which we have here a cast in indurated mud. For the sake of comparison I have made plaster casts of the brain-cavities of a number of birds belonging to different orders; and though I find a considerable range in the proportion of the brain-cavity to the other parts of the skull, and also in the character and extent of the inter-cerebral ridge, yet the general resemblance of the anterior portion of the brain of all the birds which I have examined to that of the Archæopteryx is most distinct. The casts of the interior of the forepart of the skulls of the Jay and the Woodcock (*Garrulus glandarius* and *Scolopax rusticola*) more particularly exemplify this resemblance. We may from this and from the presence of feathers (as was so well pointed out by Professor Owen), infer that the Archæopteryx was provided with a beak more or less analogous in character with that of other birds.

There is, however, great variation in the position of the brain with regard to the beak in different families of birds; the base of the brain being in some cases nearly at right angles to the opening of the bill, and in others inclined at but a slight angle to it. This more or less vertical position of the brain appears to be dependent on the greater or less development of the orbits of the eyes. In the Woodcock, for instance, where the eyes are very large in proportion to the brain, the base of the latter is nearly vertical to the opening of the beak, and when the skull of such a bird, even with both mandibles removed, rests with its under side upon a horizontal surface, the position of the base of the brain is nearly vertical. From the position of the skull of the Archæopteryx upon the slab it would appear to have been detached from the neck before being finally embedded in the mud from which the Solenhofen limestone was formed. There is, as will subsequently be seen, some reason also for supposing that the mandibles had become detached; but at all events the skull appears to have lain upon the shore, with the base downwards, as probably presenting the best surface on which to rest, and with the frontal region upwards. But the base of the cast of the brain appears to be nearly vertical to the slab, which is split so as to display the old shore surface. It seems, therefore, probable that the base of the brain may in the Archæopteryx have formed nearly a right angle with the opening of its beak, and if so, that as is the case with most other birds with the same peculiarity, its eyes were of large size, and the brain placed quite at the back of the head. But enough has been said of a hypothesis built upon such slender foundations, and I will therefore now describe another object upon the same slab, some of the details of which appear to have escaped the attention of previous observers.

On the principal slab in the angle between the right femur and tibia is a small V shaped object, the longer of the two limbs about $1\frac{1}{2}$ inches in length, made up partly of mineralized bone and partly of impressions of other portions of the same bones preserved in the counterpart slab. From its form it had, I believe, been considered as possibly representing the beak of the Archæopteryx; but great was my surprise when I detected along its right hand margin, towards the apex, the distinct impression in the slab of four teeth still attached to it. The teeth themselves remain engaged in the counterpart, and are easily recognized by the lustre of their enamel. There seems also to be a portion of a fifth tooth visible, which has been displaced and lies across the base of that nearest the point of the jaw. The portion of the jaw to which they are attached is unfortunately much injured, and there is no appearance of any teeth in connection with the other limb of the V. The woodcut below gives both views of the object.



Jaw as seen on Principal Slab.



Jaw as seen on Counterpart.

Whether the whole is a lower jaw, with the teeth or rather a few of them, remaining in one half only, and with the symphysis of the jaw at the point of the V; or whether it is a portion of an upper jaw in which the second limb of the V would be probably part of the facial and nasal bones, I cannot pretend to determine; and I am afraid that the whole is in too fragmentary and obscure a condition for any positive conclusions to be drawn on this point.

The character of the teeth, however, appears to me to be well-defined. The three which remain in a vertical position with regard to the jaw are about ·10 inch long, and at intervals of about ·20 inch. They consist of a slightly tapering flattened enamelled crown, about ·04 inch in width and obtusely pointed, set upon what is apparently a more bony base which widens out suddenly into a semi-elliptical form, so that at the line of attachment to the jaw, the base of one tooth comes in contact with that of the next. So sudden and extensive is this widening of the base, that at first it gave me the impression that the teeth were tricuspidate with the middle cusp far longer than the others.

The front tooth of the four which slopes forward from the rest, and is rather smaller than the others, shows little if any similar enlargement of its base. Of the fifth, which lies across the base of the foremost of the other four, only a part is visible. There appears to be a well defined line at the base of the teeth along their junction to the jaw; but I can offer no opinion as to the method of their attachment. It is of course contrary to all our existing notions to suppose that a jaw, such as this, armed with teeth, could belong to a creature so truly bird-like in most respects as the Archæopteryx;

but assuming it to be that of a fish—and it has many analogies with the jaws of some species of fish—or of some other animal accidentally deposited in the very midst of the remains of that singular creature, it appears to me that fragmentary as it is, its characters are sufficiently defined for any one well-versed in the fossils of the Solenhofen state to come forward and identify it.

Up to the present time, however, I have not heard of any one having been able to do so, and certainly the jaws and teeth of the Lepidotous and Pholidophorous fishes from the same beds, such as I have been able to examine, all differ from this in some more or less important particulars. It appears to me also, that the teeth and jaw on the Archæopteryx slab, are rather slighter in structure than those of fishes of corresponding size, though this is a point on which I would by no means insist.

Looking at the usual dispersion of the fossils in the Solenhofen slates, looking also at the general rule (to which, however, there are some exceptions) that the fossils in it are found singly, so that all the remains of a reptile or a fish upon a single slab, may usually be assigned with some degree of confidence to a single individual, the chances against a single extraneous jaw being mixed up with the remains of the Archæopteryx, without any other bones of the animal to which the jaw belonged, being also present, are great indeed. But how enormously are the chances against such an occurrence increased if the jaw thus accidentally present is that of a species of fish or reptile hitherto unknown ?

In order to obtain information from the best possible source, as to whether the jaw and teeth were of a character well known to those acquainted with the Solenhofen fossils, I prepared a careful drawing of it and placed it in the hands of my lamented friend, the late Dr. Falconer, who kindly wrote to the illustrious Hermann von Meyer upon the subject.

The following is a translated extract from his answer (dated from Frankfort the 4th April, 1863) which Dr. Falconer kindly placed in my hands.

"In Palæontology it is difficult to judge from drawings, but the "two supplementary objects which Mr. John Evans has succeeded "in discovering upon the Archæopteryx slab, are certainly of the "greatest importance. Upon the part which may belong to the hinder- "part* of the skull I hazard no opinion." "Much more important

* This is probably an error for "fore part of the skull," but no drawings of the head were sent to Herr von Meyer.

"is the jaw. Teeth of this sort I do not know in the lithographic "stone. There exists no similarity between them and the teeth of "Pterodactyles. The nearest likeness is to the teeth of my family of "*Acrosaurus*, namely, to the *Acrosaurus Frischmanni*, Meyer (Reptilien des. lithog. Schiefers, p. 116, t. 12, f. 7-8) from the lithographic "slate of Bavaria, in which however the crown is lower and longer "from back to front. In *Pleurosaurus Meyeri* (Pal. x. p. 37, t. 7.) "which belongs to the same family, the teeth possess less likeness. "One might also be reminded of the teeth of the *Geosaurus Soemmeringi*, Meyer. (Deutsch. Akad. Munich, 1816, p. 36. Cuvier, "Oss. foss. Pl. 249, fig. 2—6) which however are much longer. "From this it would appear that the jaw really belongs to the "Archæopteryx. An arming of the jaw with teeth would contradict "the view of the Archæopteryx being a bird or an embryonic form of "bird. But after all, I do not believe that God formed his creatures "after the systems devised by our philosophical wisdom. Of the "classes of birds and reptiles as we define them, the Creator knows "nothing, and just as little of a prototype, or of a constant embryonic condition of the bird, which might be recognized in the "Archæopteryx. The Archæopteryx is of its kind just as perfect a "creature as other creatures, and if we are not able to include this "fossil animal in our system, our short-sightedness is alone to "blame."

It will, of course, be observed that this opinion of Von Meyer is founded on my drawings alone, and is therefore of course subject to a revision on an examination of the slab itself. But there certainly appears to be a case made out for careful investigation by those more competent than I am to form an opinion in such a case. Its extreme importance as bearing upon the great question of the Origin of Species must be evident to all, and I for one can see no reason why a creature presenting so many anomalies as the Archæopteryx, all of which however tend to link together the two great classes of Birds and Reptiles, should not also have been endowed with teeth, either in lieu of, or combined with a beak, in the same manner as in the *Rhamphorhynchus* with which it exhibits other affinities. The tooth-like serrations in the beaks of many birds—and notably in the Merganser Serrator, where they closely approach in character to real teeth though connected only with the horny covering and not with the bones of the mandible,— are sufficient to prove that the presence of feathers does not of necessity imply that the beak with which to preen them should be edentulous.

XXXVI. Proceedings of the Scientific Societies of London.

1. Ethnological Society. (4, St. Martin's Place.)

Feb. 21st, 1865.

The following paper was read:—1. "On Cannibalism in Relation to Ethnology." By Mr. J. Crawfurd, F.R.S.—The author's conclusions, from the facts stated in his paper, were, that it is highly probable that the races of man, in their tedious march towards civilization, must have passed through all the usual stages, not excepting that of cannibalism. Man was more naked than the beasts of the field, and in this respect came only to be on an equality with them after he had robbed them of their clothing. His food consisted of raw flesh or of raw fish cast dead on the shore. To this he added a few wild roots and fruits, also eaten raw. His dwelling consisted of caves and the hollows of old trees. In this matter, therefore, he was on a parity with the bear and the opossum, but far worse accommodated than the beaver or even the fox or hyena. The superior qualities of his brain were now called into exercise. Then were invented implements of stone and bone, with fire; and man lived almost exclusively by hunting and fishing. In this state of difficult subsistence, and rancorous hatred of one tribe against another, contending for food, most probably induced the practice of eating one another's flesh. In the third stage, to the implements, still of bone or stone, there were added the net and the canoe, and a few plants began to be cultivated, and in some places a few animals to be domesticated. This was found to be the state of society in the great islands of Hispaniola and Cuba, and of several of the islands of the Pacific Ocean, in some of which cannibalism had ceased, whilst it continued in others. In Asia and its islands we have no examples of a people in the stage just named, and we are only assured of its having existed in Europe through the discoveries of modern science. The pile-builders of the Swiss lakes appear to have been exactly in this stage. In France, Germany, Spain, and the most civilized parts of Britain, 2000 years ago, cannibalism had ceased, but human sacrifices continued in France and Britain to a hideous extent. With the exception that they did not partake of the flesh of their victims, the ancestors of most of the present civilized nations of Europe were in the same state as are now the Bataks of Sumatra, and the Dyaks of Borneo, due allowance being made for the vast superiority of the race they belonged to. It is obvious that the progress made by man towards civilization and the abolition of cannibalism must depend on the quality of the race, and the conditions, favourable or unfavourable, in which its lot has been cast, and the means of receiving instruction from people more advanced than themselves. The two last conditions were totally wanting to the Australians and New Zealanders, and hence they were savages and anthropophagi, and left to themselves, must have ever continued to be so. In the islands of the Pacific, and in the greater part of the American continent, the conditions existed but very partially and imperfectly, but to the extent to which they did, they were a considerable improvement on the Australians and New Zealanders, yet still without producing the general extinction of cannibalism. The conditions of physical geography, including fertility of soil and the possession of animals amenable to domestication and of plants to cultivation, were highly favourable to Italy, Greece, Egypt, Assyria, Persia, India, or China, and in these civilization is of high antiquity, the progress made by each varying with the quality of the race. In Northern and Western Europe, the quality of the race of man was of the highest order, but the conditions under which he was placed were unpropitious, and his advance was proportionately slow, and would have been still slower, had he not been aided by the instruction of the oldest civilizations of Europe. It was in this quarter of Europe that cannibalism probably, and human sacrifices certainly, lingered the longest.

March 7th, 1865.

1. A letter was read from M. Larribe, communicated by Sir Roderick Murchison, President of the Geographical Society, noticing certain Roman antiquities found at the sources of the Seine, one of the most remarkable being a large Amphora, found in 1842, with the inscription 'Deæ Sequanæ Rufus donavit,' and containing nearly 800 *ex voto* medals of bronze. The object of the writer was to inquire if any such Roman temple or antiquities had been met with or were likely to be found at the sources of the Thames.

2. "On the Aborigines of Chatham Island." By Mr. Travers; communicated by Sir Charles Nicholson. Waitangi is the chief Maori settlement on Chatham Island; a small but deep river flows close by it into Petre Bay. The huts of the Maories are on the low

ground, on the east side of the river, and are built of fern posts lashed together with strips of supple-jack and thatched with toi grass, resembling in all respects those found in the old pahs in New Zealand. The population, including a few Moie-oie slaves, numbers about 115 all told. Their huts are surrounded by well-fenced paddocks laid down with English grasses, but the grass is now almost smothered with the common English daisy, mustard, and dock, which are spreading rapidly over the whole island. The Maories generally possess considerable numbers of horses, cattle, and pigs, which run in common on the open lands and in the bush. They cultivate large quantities of potatoes, maize, pumpkins, and onions, which they supply to American whaling ships resorting to the island, and occasionally they export to New Zealand. There are also Maori settlements at Subong, on the north-western, and at Taupeka and Kaingaroo, on the north side of the island, having altogether a population of some 400 souls. The remnant of the Moie-oies—the name given to the aboriginal inhabitants—exclusive of the few who are still retained in slavery, is settled at Ohangi, on the south-east of the island. They do not exceed 200 in number, and are said to be rapidly decreasing. In their habits they now assimilate to the Maories, and speak a language compounded of their own and of the New Zealanders. Before the invasion of the island by the latter, which took place about 1832 or 1835, the Moie-oies were very numerous, numbering very little short of 1500 people. They are much shorter, but stouter built than the New Zealanders, and have darker skins, but the same coarse, straight hair. They never tattooed; and although they originally practised cannibalism, they had discontinued it before the arrival of the New Zealanders. They appear to have been a very cheerful people; their habits of living, however, were originally very rude and improvident. They built no huts, merely using a few branches of trees stuck into the ground as a shelter from the wind. Their food chiefly consisted of fish, shell-fish, birds, and fern-root. They had no canoes, there being no wood on the islands sufficiently large for constructing them, but they formed rafts of the flower-stalks of a native plant, lashed together with supple-jack, and having an upright wooden stern ingeniously carved. They had no hereditary chiefs, the most successful fisherman, or bird-catcher, or some member of the community remarkable for extraordinary stature or some other prominent quality, being regarded as the authoritative leader.

3. "Note on Chatham Island." By Mr. W. Leed. The statements in this letter were confirmatory of the accounts in the preceding paper.

4. "On the Inhabitants of Asia Minor previous to the Time of the Greeks." By Mr. Hyde Clarke. The question of who were the aboriginal inhabitants of Asia Minor is one that has naturally occupied many inquirers, and led to a wide diversity of opinion. This discrepancy is to be traced back to the early times of Herodotus and Strabo; and the difficulty of dealing with the subject is indeed great, as we have no known or accessible historical relations of the migrations or proceedings of the populations of that tract until long after the period when the Greek colonies were introduced. The author sought in those sources which have been found to yield successful results in other cases for the means of investigation—viz. the monuments and remains, human relics and bones, mythological records and topographical nomenclature. Mainly relying on the last in the present paper, he arrived at some general conclusions as to the Iberian character of the ancient inhabitants of Asia Minor.

March 21*st*, 1865.

The following papers were read.—1. "On the Arctic Highlanders." By Mr. Clements R. Markham. The ethnological results to be expected from North Polar exploration having been under the consideration of the Council, the author submitted a review of all that is known of the most northern inhabitants of the earth, as a subject of sufficient interest to engage the Society's attention. Such a review would have the effect of taking stock, as it were, of our present knowledge, and of recording the data on which an opinion may be formed of the value and importance of future research. By the "most northern" inhabitants of the earth, the author did not mean the whole Esquimaux race, but only that interesting tribe which dwells far to the northward of any other, at the head of Baffin's Bay. The country which may be called the home of the "Arctic Highlanders" is that strip of land on the eastern side of Baffin's Bay and Smith Sound which is bounded on the south by the Melville, and on the north by the great Humboldt glaciers. The voyages which have been made to this region are as follow: First, Baffin, in 1616, in the "Discovery," but it is not stated that he landed. Secondly, two centuries after him, Captain John Ross (1818), who was the first European who had intercourse with the natives. Sir John was followed in Baffin's Bay for many years by fleets of whalers, but of their communications with these people no record has been made. In 1849-50 the "North Star" wintered in Wolstenholme Sound, and her crew had most friendly relations with the natives throughout their stay. In 1850 the "Assistance," Captain Ommaney, communicated with the natives at Cape York. The "Intrepid" also went into Wolstenholme Sound, and took on board a young "Arctic Highlander." The other discovery ships of 1850-1 had also intercourse with the people of Cape York. In 1852, Captain Kellett, in the "Resolute" also touched there; and in the same year Captain Inglefield, in the "Isabella," visited the natives at the Petowah glacier, and at a settlement about twenty miles from Cape Parry. Dr. Kane did not see them until his schooner was frozen in on the eastern shore of Smith's Sound; but he afterwards formed most intimate relations with them in 1853-4-5, one of his officers, Dr. Hayes, living amongst them for several months. Finally, Sir Leopold McClintock, in the "Fox," communicated with eight natives of Cape York in 1858. The flora of their country consists of 44 genera and 76 species as yet discovered, amongst which are four kinds of ranunculus; fourteen crucifers, including three kinds of scurvy grass, several pretty little stellarias, potentillas, and saxifrages, seven of the heath tribe, a dwarf willow, a fern *(Cystopteris)*, and numerous mosses and grasses. But it is on the condition of the sea, much more than that of the land, that the suitability of a region for human habitation depends within the Arctic zone, and although Greenland is infinitely richer in vegetation, and abounds more in animal life, than the dreary archipelago to the westward, yet without open water in the winter it would be uninhabitable. The ice drifting south in the spring, leaves a large extent of navigable sea at the head of Baffin's Bay during the summer, known as the "North Water," while the currents and the innumerable icebergs always in motion and ploughing up the floes keep open pools and lanes of water throughout the winter. Such is the country which supports a multitude of living creatures in a temperature where the mean of the warmest month is 38°, and that of the coldest —38°; in a climate subject to furious gales in winter, where the year is divided into one long day and one long night, but where in the glorious summer, in the calm and silent sunny nights, may be seen some of the most lovely scenery on this earth. No rich woodland tints, little diversity of colouring; all its beauty dependent upon ice and water, and beetling crags, and strange atmospheric effects, but still most beautiful. The land between the shore and the glaciers is the abode of reindeer, musk-oxen, wolves, bears, foxes, hares, and lemmings; of ravens, falcons, owls, ptarmigan, willow-grouse, snow-buntings, dotterels, and phalaropes; while aquatic birds come in tens of thousands to breed in the crags and islands. Above all, so far as means of existence is concerned, the open pools and lanes of water are crowded with seals, walruses, white whales, narwhals; and these again betoken the existence of fish, molluscs, and minute marine creatures in myriads. Here, then, is a region where man, too, might find subsistence, and here, too, accordingly, we find hardy tribes, numbering 140,000 souls, distributed in some eight or more permanent winter settlements. In summer they pitch their tents wherever they are likely to find the best hunting grounds. This remarkable tribe is decidedly, the author considers, of Asiatic affinities. Their winter habitations mark them as a peculiar people, quite distinct from the Esquimaux of America; for while the latter always live in snow huts, the "Arctic Highlanders" build structures of stone. These stone "igloos," though quite unlike the winter homes of the American Esquimaux, are precisely the same as the ruined "Yourts" on the northern shores of Siberia, and as the ruins found in all parts of the Parry Islands. They thus furnish one of the several clues which point to Siberia as the original home of these people.

2. "On the Esquimaux." By Dr. John Rae. There are few races of men about whom a greater diversity of opinion has been expressed than the Esquimaux. By some writers they have been described as stupid, slow, dirty, lazy, false, and idle—in fact, little if at all raised above the brute creation. By others, who possibly may have had opportunities of seeing these people on a different part of the coast, in all their various relations to each other, in their every-day life, and at all seasons of the year—for the winter is the time when the Esquimaux is seen to most advantage, and winter with him forms two-thirds or three-fourths of the year—a higher position has been assigned to them amongst their fellow men. Having visited the Danish settlements in Greenland, Churchill, in Hudson's Bay, the mouths of the Copper-mine and McKenzie Rivers, on the Arctic coast, and passed two seasons at Repulse Bay, and seen the Esquimaux at all those places, the author had had opportunities of noticing and comparing their peculiarities. The lands southward of Churchill, in lat. 59°N., having been claimed by the Indians, the Esquimaux

do not go south of that place, and those who trade there may be considered as partially civilized, as they have to a great extent assumed European dress and habits, and are employed by the Hudson Bay Company on various services requiring care and attention, which they perform in a satisfactory manner. They are sober, steady, faithful, and generally speaking, honest; never begging, as is the practice of the Red Indian; comparatively speaking, provident of their own property and careful of that of others when under their charge. With a few exceptions they are short in stature, but not dwarfish, being well-built and powerful, long-bodied, exhibiting great strength in lifting weights. Their expression of face is pleasing; their foreheads low and broadish; cheekbones high, features rather flat, and the inner angle of the eye pointing rather downwards, in the manner commonly noticed in the Chinese. Their hair is straight, black, and coarse, cut short on the men, who generally have not much beard. They say their numbers are decreasing; more especially has this been the case of late years, many having died from a disease resembling, according to their descriptions, influenza, and others from starvation. That they are a well-disposed people, may be inferred from the fact that for some weeks a number of families had encamped beside the three persons left in charge of the author's property at winter quarters; and although this property was placed on the rocks and protected by oil-cloth only, not an article was touched, nor the slightest annoyance given to his men, although sometimes only one of them could remain at home. When the snow thawed about his winter huts in spring, many articles that had been lost or thrown aside came into view. When the natives found any of these, they were brought to him, to know if they were required. Of the Esquimaux of McKenzie River, Dr. Rae, however, speaks in very different terms. When in 1848 he accompanied the expedition in search of Sir John Franklin, they chased the boats in their oomiaks and boarded one that had lagged behind the rest, committing the boldest acts of pillage. A more fierce, daring set of fellows could not be conceived; and any one seeing these savages when angry or excited, could readily believe that a horde of them might well have destroyed the Norsemen who peopled the ancient settlements of South Greenland. All the men wore cheek ornaments made of stone, ivory, or large coloured beads.

April 11th, 1865.

The first paper was "On the African or Occidental Negro," by Mr. J. Crawfurd, F.R.S.

The author in this paper gave a brief account of the physical characteristics of the negro races of Africa, and endeavoured to estimate their intellectual capacity as compared with that of other races of man.

By the term negro, in so far at least as it is applicable to Africa, we understand a human being with the hair of the head always black, and more or less of the texture of wool, with a black skin of various shades; dark eyes, a flat face, depressed nose, projecting jaws, thick lips and large mouth, and with oblique incisor teeth. To this may be added a peculiar odour of the skin, offensive to and unknown in the other races of man.

The true African negro is of the average stature of Europeans, and perhaps even of their average physical strength; and in the last quality is the only race of man that is so. The continent of Africa, reckoning on its western side from the southern limits of the Great Desert to the tropic of Capricorn, and on the eastern from the equator to the thirty-third degree of south latitude, is inhabited by the negro race. To the south of the limits mentioned we exclude the squab yellow Hottentots, although with woolly hair; and to the north, the Abyssinians, the Samauli, and the Galla, who have crisped, long hair, and elevated features, albeit of dusky or black complexions. Although all African negroes partake of the general character ascribed to them by the author, there is still much diversity, consisting chiefly in the greater or less predominance of the typical features above enumerated. As we know nothing to the contrary, we must assume that all the races of man are of equal antiquity, or that, in so far as mere time is concerned, every race has had the same length of time for making advancement in civilization. The great diversity of social conditions in which we now find them must therefore depend either on quality of race or on difference of opportunity.

The negroes of Africa are unquestionably the most advanced of all the woolly-headed races. They have been immemorially in almost exclusive possession of the greater part of a vast continent, most of it within the tropics, but a considerable part also in a temperate climate. It would be needless to compare the civilization of the

African negro with that of the races of Europe. They have not even reached the civilization of the other races of their own continent. They have not only not reached that of the second-rate nations of Asia, but they are even far below that of the third-rate civilization of that continent, and even of its islands. Their agriculture is rudimental and unskilful to the last degree, and their arts are confined to the manufacture of a coarse pottery by the hand, to the weaving of a very coarse fabric from cotton, and to the fabrication of malleable iron. The elephant is more abundant in the country of the negroes than in any other part of the world, yet they hunt it only for its flesh and its tusks, and have never tamed and reduced it to servitude, as have done all the nations of Asia in whose country the elephant is indigenous. Negro literature is an absolute blank. No negro people have ever invented letters, symbolic or phonetic, and rarely have negroes adopted the writing of other races.

The negroes of Africa are eminently a home-keeping, unadventurous race. Neither war, commerce, nor colonization has ever tempted them to transgress their native bounds. Unambitious and unenterprising, they have, notwithstanding, become involuntary colonists on a great scale. In America and its islands, which before knew no indigenous negro race, there now exist probably not fewer than twelve millions of African negroes, a considerable number of whom are free, but the majority still in the same state of slavery in which they were when first imported. We have here, then, a tolerably fair opportunity of observing them in a state of servitude under stranger masters, in freedom under the same description of masters, and in a state of political independence, their own masters. The comparison of the conditions of slavery and freedom does by no means yield results as favourable as we could have hoped. Increase of population is certainly no test of social advancement or happiness, but it is at least a proof that material wants are adequately provided for. The negroes in the United States of America, where the experiment is seen on the largest scale, are well fed, clothed, and housed, while even the intercourse of the sexes is kept under some wholesome restraint. They are looked after, in fact, very much as a prudent and intelligent farmer looks after his working and breeding cattle. The increase of numbers with them keeps pace very nearly with that of the free white population, although the latter is aided by large immigration. The emancipated negroes living among Europeans, still pursued by the proscription of race, are under political and social disabilities, and looked upon as outcasts; in fact, as a nuisance, of which the commonwealth ought to get rid. In our own colonies the antipathy of race is as strong as in America; but social and political proscription are not carried to the same length, and the freedman is more his own master.

Notwithstanding their emancipation, the Africans of our colonies, instead of increasing rapidly, like the bondsmen in America, increase very little, if at all. Their numbers are, in fact, understood to be kept down, not from want of the means of subsistence, but by a promiscuous intercourse of the sexes, by infanticide with corresponding vices, and the neglect of children. In 1833, the period of slave emancipation in our colonies, the total number of the slaves of our principal colony (Jamaica) was 310,000; and by census taken in 1844 the free negro population had fallen to 196,000, a decline of 37 per cent. A contrast to this is the rapid increase of the slave population of the United States of America. In 1850 its total amount was 3,200,000, and by the last decennial census it was, in round numbers, 4,000,000, an increase of 25 per cent. In one of the greatest and, perhaps, the very finest island of the Antilles, the African negroes have been their own masters for half a century. Notwithstanding these advantages, and a free and independent intercourse with the civilized nations of Europe, the success of the experiment has not been remarkable. In the comparatively short period which has elapsed Hayti has had many revolutions, the Government oscillating between a republic and an empire, in humble mimicry of the great nation whose yoke they threw off. The sensual vices would seem to prevail in Hayti as among the emancipated negroes of the British colonies, and the result is that increase of population has been stayed, as in these. A census of the population of Hayti in 1821, seven years after the people had become their own entire masters, gave a population of 235,000, and the present number by estimate is thought not to exceed 250,000, a miserable increase in forty long years of no more than between one and two per cent. The facility with which the African negroes submit to slavery, even their contentedness, nay their cheerfulness in servitude, seems far to exceed that of any other race of man. This temper is evinced not only in their own country and abroad under foreign masters, but even under masters less civilized than themselves. Thus, at present some of the tribes of Red Indians who have made some advance in the arts of civilized man are found in possession of negro slaves. The Hindus have been ruled or domineered over by strangers for more than eight centuries, yet still consider themselves the first of mankind; and the Chinese can despise the Europeans, heedless of the defeats and humiliations they have inflicted on them. Not so the African negro, who after his emancipation looks up and humbly imitates the master that once held him in slavery. The free negroes of America and its islands exhibit the same unenterprising, unambitious, and home-keeping character as those of the parent country. Barbadoes is greatly over-peopled, and Jamaica greatly under-peopled, but the higher wages of the latter do not tempt the people of the former to emigrate.

April 25, 1865.

The first paper read was "On the Domestication of certain Animals in England between the 7th and 11th Centuries." By Mr. J. Thrupp.

There are in animals three recognized and distinct degrees of capacity for domestication. The first class are animals of a "domesticated nature," being those which, when thoroughly domesticated, continue habitually with man, will not *willingly* leave him, and if they do so accidentally, will probably return; among these are cows, horses, sheep and poultry. The second are animals capable of only an *imperfect* domestication. They breed freely in the homestead, and are useful to man, but if they escape from him will *probably not return;* among these are tamed deer, hawks, pheasants, and partridges bred at home, and gold and silver fish in private waters. A third class, which are sometimes called domesticated, such as hares, canaries, rabbits, monkeys, parrots, &c., are altogether incapable of domestication, for whatever an eccentric member of the species might do, they will, *as a rule*, escape to savage life on the first opportunity, unless coerced by climate or starvation. The author ventured to repeat these very well-known distinctions because, in ignorance of them, our ancestors made a series of experiments in domestication, which were either failures or but partially successful, and also because in those cases which succeeded the species were always semi-domesticated (sometimes for centuries) before they were completely so.

The hog was the earliest animal domesticated. He became the great staple of national food, and one of the most important elements of national wealth. Swine were bequeathed expressly by wills, when other animals were not, were paid as coin to ministers for masses for the dead, and often constituted the marriage portion of the noblest ladies. An increased value was given to swine by being home-bred, as appears by the compensation to be paid for stealing them. A pig reared at home was worth 15*d.*, but the same pig when turned into the woods to feed might be stolen for 6*d.* Although a large proportion of swine were at the time of Alfred home-bred, it is probable that a larger number were not so, but roamed the boundary forests of districts or shires. These animals were a constant cause of bloodshed, for, being but semi-domesticated, they were not absolutely private property, but only so in a limited sense. The clearance of the forests and the formation of hunting parks, which took place in the time of Canute, tended to increase domestication.

The Anglo-Saxons were later than the Welsh in training horses. They had no saddle horses till the middle of the seventh century, when the foreign bishops introduced the use of palfreys. But this example was very slowly followed. In the ninth century Alfred the Great tells us that no man ever rode on horseback for pleasure, though some did so for exercise or expedition. Persons entitled to fines or rent payable in produce refused to accept horses in payment, and the clergy, who tithed everything domesticated, did not tithe them. They were sometimes, but not generally, eaten; but a considerable export trade was done in them.

The domestication of bees was early attempted. The clergy earnestly encouraged it, teaching that bees "had been sent from heaven, because the mass of God could not be celebrated without wax." They probably desired an increase of produce from economic reasons. About the middle of the tenth century, slaves whose duty it was exclusively to attend to bees, and were called beesherds, were ordinarily attached to wealthy establishments; and from the position of slaves they soon became servile tenants, whom their lords provided with a stock of bees, for which they paid a fixed amount of produce for life, the swarms continuing the property of the lord. We also find about this time the Anglo-Saxon word *bee-cest* (bee-chest) and the Latin *alvearia* (beehives) usually substituted for "*rusca*," from which it may be inferred that these rough constructions were superseded by regular hives. Not long afterwards the clergy induced Edward the Confessor to tithe beehives—an evidence that they had become numerous and valuable, which is confirmed by "Domesday Book," where they are repeatedly mentioned.

The first mention of hawks occurs in documents of the eighth century, when two falcons were sent by Boniface, Bishop of Mons, to Ethelbert, King of Mercia, which induced a Kentish king to apply to the same prelate for a similar present, and, in doing so, he stated that he could not obtain hawks of the quality he required in his own kingdom. From about this time the kings and nobles laboured to domesticate hawks, though at first in very limited numbers, and with no great skill. They formed, nevertheless, a regular part of their establishment. In the tenth century the custom of more completely training them was introduced, and many persons kept them through the summer, that they might be ready for the winter.

It would be easy to add much more on these subjects, for the laws and charters contain an immense amount of interesting information as to oxen, sheep, dogs, cats, goats, poultry, and other animals, all the evidence of which the author thinks points to the conclusion that in the tenth century the more important animals made progress towards, or arrived at, perfect domestication, while attempts which had, up to that time, proved futile, were generally abandoned.

2. Geological Society, (Somerset House.)

March 8th, 1865.

The following communications were read:—1. "On the Echinodermata from the South-east coast of Arabia, and from Bagh on the Nerbudda." By P. Martin Duncan, M.B., Sec. G.S.—In this paper Dr. Duncan described eight species of Echinoderms, only one of which was new, from Ras Fartak and Ras Sharwên on the south-east coast of Arabia, and four from Bagh on the Nerbudda. He also mentioned five determinable species of other classes from each locality. Of these fossils, *Hemiaster similis*, D'Orb., and *Pecten quadricostatus*, Sow., were alone common to the two localities; but with the exception of the new Echinoderm, which was named *Cottaldia Carteri* by Dr. Duncan, all the species occur in European Cretaceous rocks. He considered the fossils of the two localities to belong to the same period, and discussed the question of the correlation of the deposits containing them with those of Europe, coming to the conclusion that they were most probably of Cenomanian rather than Neocomian age, and of later date than the Pondicherry series; but he also remarked that it is impossible to determine their exact contemporaneity, the vertical range of many of the species being so great, and the parallelism of the allied European Cretaceous beds not exact. In conclusion, Dr. Duncan discussed several questions arising out of a comparison of fossils from distant localities, especially the specific identity of similar specimens occurring in different formations, or in distant regions; also the variability of certain species, and the idea of "homotaxis."

2. "On the Fossil contents of the Genista Cave at Windmill Hill, Gibraltar." By George Busk, Esq., F.R.S., F.G.S., and the late Hugh Falconer, M.D., F.R.S., F.G.S. Communicated by the Secretary of State for War.—This was a letter addressed by the authors to His Excellency the Governor of Gibraltar, General Sir W. J. Codrington, K.C.B., &c., and containing the results of their examination of the Genista Cave. Referring first to Captain Brome's report for a description of the general features of that cave, the authors stated that the Rock of Gibraltar abounds in both seaboard and inland caverns, the Genista Cave being one of the latter class. It has been traced downwards to a depth of 200 feet; but the external aperture has not yet been discovered; it was stated to be full of the remains of quadrupeds and birds, some of the former being now wholly extinct, others extinct in Europe and repelled to distant regions of the African continent (as the *Hyæna brunea*), while others again live now either on the rock or in the adjoining Spanish peninsula. A list of the species to which these remains were referable was then given, and it was inferred that there had been a connexion by land, either circuitous or direct between Europe and Africa at no very remote period. The authors observed that the wild animals, the remains of which were discovered, lived and died upon the rock during a long series of ages, and they gave a detailed account of the manner in which they considered the bones were introduced into the cave. They also recommended the formation of a local collection of these and other specimens, and urged the appointment of a geologist to make a geological survey of the rock. They concluded by expressing their opinion of the value and importance of Capt. Brome's exploration of the Genista cavern.

March 22nd, 1865.

The following communications were read:—1. "Notes on the Caves of Gibraltar." By Lieutenant Charles Warren, R.E. Communicated by the Secretary of State for War through Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—The principal caves at Gibraltar are St. Michael's, Martin's, Glen Rocky, Genista, Asylum Tank, Poco Roco, and three under the Signal Station, on the eastern face of the rock. The author describes the salient features of St. Michael's Cave, stating that it is a portion of a transverse cleft through the rock, and was probably open to view at no very remote historical period; and he briefly noticed the cave at Poco Roco, which he considers to be a portion of the fissure which extends from Bell Lane, in the town, to the village of Catalan Bay, the noise of blasting having been heard on more than one occasion through the apparently solid rock. In conclusion, Lieut. Warren offered his services in the event of a geological survey of Gibraltar being undertaken.

2. "On the asserted occurrence of Human Bones, in the ancient fluviatile deposits of the Nile and the Ganges, with comparative remarks on the Alluvial Formation of the two Valleys." By the late Hugh Falconer, M.D., F.R.S., F.G.S.—In this communication the author brought together the few instances on record of the occurrence of mammalian fossil remains in the Valley of the Nile; and instituted a comparison between the Alluvial deposits of the Nile and those of the upper part of the Valley of the Ganges which had come under his own observation. According to certain statements, fossil human bones have been met with in both of these subtropical valleys; and Dr. Falconer remarked that at the present time the consideration of the general inferences to which these cases lead may probably be of some use. After discussing at some length the cases in which human and other mammalian bones had been stated to occur in the Valley of the Nile, Dr. Falconer described the general features of the Alluvial deposits of the valleys of the Ganges and Jumna, stating what organic remains had been found in them. In a comparison of the two regions, Dr. Falconer observed that there is a striking analogy between the Alluvial deposits occurring along the banks of the Nile on the one hand, and the Ganges and Jumna on the other, the most obvious being the great abundance, in both cases, of argillaceo-calcareous concretions, forming an impure kind of travertine, and in the lower-

most beds horizontal deposits of the same material; but that in its poverty of vertebrate remains the former, so far as it has been explored, is a remarkable contrast to the latter. Dr. Falconer then reverted to an opinion expressed by Sir Proby Cautley and himself many years ago, namely, that the *Colossochelys Atlas* may have lived down to an early epoch of the human period, and become extinct since; and he concluded with some general observations on the antiquity of the human race, suggested by more recent discoveries.

April 5th, 1865.

The following communications were read:—1. "On some Tertiary Deposits in the Colony of Victoria, Australia." By the Rev. J. E. T. Woods, F.L.S., F.G.S.—The author first referred to a former paper on the Australian Tertiary strata, and then described the beds of Muddy Creek, near Hamilton, mentioning the principal fossils occurring therein, especially a species of *Trigonia;* he also stated that the same formation occurs at Harrow, on the river Glenelg, about sixty miles to the north-east, as well as in Tasmania. In discussing the age of these beds he adopted Professor M'Coy's views, that they are of Lower Miocene date; but he considered the Mount Gambier limestone to be more recent, probably older Pliocene, and the Murray River deposits as possibly holding an intermediate position; the latter he therefore considered to represent the Upper and Middle Miocene of Europe. Older than all these are certain strata occurring at Port Phillip and elsewhere, which the author referred to the Upper Eocene period. In conclusion, Mr. Woods gave a sketch of the salient features of the Bryozoon-faunæ of the deposits occurring at Hamilton and Mount Gambier, chiefly for the purpose of showing that the latter is much the more modern of the two. In a note, Dr. Duncan enumerated the species of Corals which had been sent him by Mr. Woods, but he stated that, although they had a very recent aspect, no exact geological date could safely be assigned to them.

2. "On the Chalk of the Isle of Thanet." By W. Whitaker, Esq., B.A., F.G.S., of the Geological Survey of Great Britain.—In this district a bed of comparatively flintless chalk overlies one with many flints. The higher division, or *Margate Chalk*, contains but few scattered flint-nodules, and shows well-marked N.W. and S.E. joints. The lower division, or *Broadstairs Chalk*, on the other

hand, is less jointed, and has many continuous layers of flint. The beds form a very flat arch, as may be seen along the coast from Kingsgate to Pegwell, between which places the flinty chalk rises up from below that with few flints. It is remarkable that in this neighbourhood the Thanet beds are conformable to the Chalk, the green-coated nodular flints at the bottom of the former resting on a peculiar bed of tabular flint at the top of the latter.

3. "On the Chalk of Buckinghamshire, and on the Totternhoe Stone." By W. Whitaker, Esq., B.A., F.G.S., &c.—In carrying on the geological survey of Buckinghamshire, the Totternhoe Stone, with its underlying chalky marl, which had been sometimes thought to be the representative of the Upper Greensand, was traced south-westward into a part where that formation was fairly developed, and was then found to overlie it. The divisions of the Chalk in Buckinghamshire are, in ascending order,—

(1) Chalk-marl, with stony layers here and there, and at top.
(2) The Totternhoe Stone, generally two layers of rather brownish sandy chalk, hard, with dark grains of small brown nodules.
(3) Marly white chalk, without flints.
(4) Hard-bedded white chalk without flints, forming generally a low ridge at the foot of the great escarpment.
(5) The thick mass of white chalk without flints, or with a very few flints in the uppermost part and at top.
(6) The "chalk-rock," already described in the Society's Journal, a thin hard bed or beds, with green-coated nodules.
(7) The Chalk with flint, the lowermost part only coming on near the top of the escarpment, the rest bed by bed over the table land southwards, the angle of dip being rather more than that of the slope of the ground.

4. "On the Chalk of the Isle of Wight." By W. Whitaker, Esq., B.A., F.G.S., &c.—The chief object of this paper was to show that here, as in Oxfordshire, &c., the division between the chalk with flints and chalk without flints is marked by a peculiar bed ("chalk-rock") hard, of a cream-colour, and with irregular-shaped, green-coated nodules, which may be seen in many of the pits on the southern flank of the chalk-ridge, where, however, it is very thin. The author disagreed with the inference that the chalk was eroded before the deposition of the Tertiary beds, which has been drawn from the irregular junction of the two in the cliff-sections, and thought that the irregularity had been caused rather by the formation of "pipes" after the deposition of the latter, although he did

not deny that there was other evidence of denudation of the chalk before the deposition of the Tertiaries upon it.

April 26th, 1865.

The following communications were read:—"1. "On the Character of the Cephalopodous Fauna of the South Indian Cretaceous Rocks." By Dr. F. Stoliczka. Communicated by the Assistant-Secretary.—In this paper the author gave a summary of the more important facts brought to light by the examination of the Cretaceous Cephalopoda of Southern India, which was begun by Mr. H. F. Blanford, and continued by himself, giving, first of all, a brief notice of what had been done previously by other observers, and a sketch of Mr. Blanford's subdivision of the strata into the Ootatoor (or Lower), the Trichinopoly (or Middle), and the Arrialoor (or Upper) groups. All the genera characteristic of European Cretaceous faunæ were stated to be well represented, the whole assemblage having a Middle Cretaceous aspect. The number of species of the different genera occurring in each of the three subdivisions was then given, as also the distribution of the groups of the genus *Ammonites*, the most striking and abnormal feature being the intimate association of three species of that genus, belonging to the Triassic group "*Globosi*," with true Cretaceous fossils. Dr. Stoliczka then discussed the relation of this Indian fauna to those of the European Cretaceous rock, and illustrated his remarks by a table showing the geological range in India and in Europe of the species that are common to both areas. He came to the conclusion that for the present the lowest of Mr. Blandford's subdivisions (the Ootatoor group) may be considered to be of the age of the European Gault, while the uppermost (the Arrialoor group) does not seem to correspond to a higher division than D'Orbigny's Sénonien.

2. "On the Growth of the Flos Ferri, or Coralloidal Arragonite." By W. Wallace, Esq. Communicated by W. W. Smyth, Esq., F.R.S., Sec. G.S.—The author first described the physical features of the Meldon Mountains, in Westmoreland, and endeavoured to show that they bore certain relations to the geological structure of the country, and that the number and size of the joints varied with the elevation of the rocks, and their position in relation to the valleys. After the formation of the joints, the minerals occurring in the veins in their neighbourhood were stated to be acted upon by decomposing

agents, and it was therefore inferred that the amount of decomposition in veins and in rocks is proportional to the amount of their elevation above the sea. Mr. Wallace then stated that Arragonite is produced only after the strata are traversed by joints, and that the branched Arragonite very rarely occurs, being found only in caverns and old workings. Two of these caverns have come under his notice, and were described in detail; one of them is in the north vein of the silver Band Mine, and the other near one of the principal veins of the Dufton Fell Mine. Finally, he discussed the causes and conditions necessary to the formation of this Coralloidal Arragonite, and came to the conclusion that the theory of a circulation, through the pores of the spar, of fluids holding its component parts in solution, is the only one that harmonizes with the varied phenomena observed in the two caverns he had described.

3. "Notes on Presenting some Rhomboidal Specimens of Ironstone, &c." By Sir J. W. F. Herschel, Bart., K.C.H., F.R.S., F.G.S., &c. With a Note by Captain T. Longworth Dames. Communicated by Sir C. Lyell, Bart., F.R.S., F.G.S.—Most of these specimens came from a quarry at Clanmullen, near Edenderry, King's County, and the remainder from the Collingwood Quarry, in the Weald of Kent. The Irish specimens are siliceous, containing some oxide of iron and a little manganese, and are homogeneous throughout. They all agree in the sharpness of definition and the exact parallelism and evenness of the flat surfaces; but, like those from the Weald, they are not constant in form or size, and sometimes are very irregular in angle and in the parallelism of opposite sides. The Wealden specimens, however, are all closed boxes, each containing a rhomboid of hardened sandstone, the outer case being highly ferruginous—in fact, the "Ironstone of the Weald." Sir John Herschel endeavoured to account for the formation of the boxes, and Captain Dames added a note stating the circumstances under which the Irish specimens occur.

May 10*th*, 1865.

The following communications were read:—1. "On the Azoic and Palæozoic Rocks of Southern New Brunswick." By. G. F. Matthew, Esq. Communicated by Dr. J. W. Dawson, F.R.S., F.G.S.—After briefly narrating the History of the Geology of the Region, the author described each of the formations successively in detail; namely the Laurentian (Portland series), Huronian (Coldbrook group), Lower Silurian (St. John group), Upper Silurian, Middle and Upper Devonian (including the Bloomsbury group, Little River group, and Mispeck group), Lower Carboniferous and Carboniferous. The only important hiatus is, therefore, that wherein the Trenton limestones and Hudson River shales should fall, and those formations probably form part of the Lower Silurian rocks already known. Mr. Matthew then stated that it is now a well-established fact that throughont Palæozoic time the centre of the North American continent was comparatively stable, the whole series of formations being found in continuous and conformable succession, from the base of the Silurian to the summit of the Permian. The stratigraphical peculiarities of the several formations in regard to their mutual relations were next described, and the author inferred the existence of at least three breaks, and possibly a fourth (between the two sections of the Carboniferous system) in the Palæozoic series of Acadia—namely, between the Huronian and the Silurian, between the Lower and Upper Silurian, and between the "Middle and Upper Devonian" and the "Lower Devonian and Upper Silurian."

2. "Results of Geological Observations in Baden and Franconia." By Dr. F. Sandberger, For. Cor. G.S. Communicated by the President.—In this paper Dr. Sandberger communicated the results he has arrived at by the study of the Palæozoic, Triassic, and Jurassic Beds of Baden and Franconia. The so-called "transition formation" of the Black Forest he had previously ascertained to be Lower Carboniferous; it is immediately succeeded by the strata of Berghaupten near Offenberg, which also occur in Alsace. Near Oppenau occurs a species of *Pterophyllum* three feet long, which affords a new proof of the close connexion between the Triassic and Palæozoic floras; and to this fact may be added the discovery of a true *Schizopteris* in the Letten-coal near Würzburg. This connexion Dr. Sandberger also considers more perceptible in the fauna than has hitherto been supposed. The Wellenkalk, Muschelkalk, and Letten-coal appear better developed in Franconia than elsewhere in Germany, and the clearness of the stratification leaves no doubt about the order of succession. Amongst the results of a comparison of the Thüringian and Swabian types with those near Würzburg is the discovery of the fauna of Recoaro and Mickelschütz in the Middle Wellenkalk; and the author remarks that as the rocks of the Alpine so-called

Muschelkalk entirely agree with the Wellenkalk of his district, that rock ought henceforth to be called Wellenkalk; for no representative of the true (Upper) Muschelkalk has hitherto been observed in the Alps. The Jurassic rocks occurring in Baden he refers to the Cornbrash and the Inferior Oolite.

3. "On the Changes rendered necessary in the Geological Map of South Africa, by recent Discoveries of Fossils." By Dr. R. N. Rubidge, F.G.S.—Dr. Rubidge first called attention to a former paper, in which he pointed out the occurrence of horizontal beds of sandstone resting on the upturned edges of gneiss, and continuous with inclined sandstone of like kind interstratified with gneiss. He therefore conjectured that the Clay-slate and Bokkeveldt schist, which Bain considered distinct, belonged to one formation, that they are of the same age as the gneiss, and that the "Carboniferous rocks" of the Eastern province were not separable from the Clay-slate, which Mr. Bain had called Primitive clay-slate. It follows from this that if the clay-slate proved Devonian, as Dr. Rubidge believed it would, the horizontal quartzite must be much newer, and probably an outlying mass of the Dicynodon-rocks. He explained these phenomena by supposing that rocks of widely different ages had been metamorphosed into masses having the same mineralogical characters. The discovery of certain fossils has lately verified the conjecture respecting the Devonian age of the clay-slates and Bokkeveldt rocks; and Dr. Rubidge therefore infers that the rest of the old rocks are of the same age. Finally, the discovery of a Calamite in the sandstone, not unlike some specimens belonging to the same genus found in the Dicynodon-rocks renders the probability of the truth of the second conjecture very great.

3. Linnean Society, (Burlington House.)

March 2nd, 1865.

The following papers were read:—1. "On the Surface-Fauna of Mid-ocean. No. 1. *Polycistina* and other Allied Rhizopods." By Captain Samuel R. J. Owen.

2. "On a New Dye-wood of the genus *Cudranea*, from East Tropical Africa." By Dr. J. Kirk, F.L.S.

3. "Letter from Mr. C. A. Wilson, of Adelaide, South Australia, containing some observations on the natural history of South Aus-

tralia, including a numerous list of birds, &c., recently brought from the Northern Territory, by Dr. B. Ninnis, surgeon to the Beatrice.

March 16*th*, 1865.

The following papers were read:—1. "Notes on Lichens, collected by Sir John Richardson in Arctic America." By the Rev. W. A. Leighton.—2. On the "Palms of East Tropical Africa." By Dr. J. Kirk.—3. "Descriptive List of Plants of the Anamallay Hills, in the Madras Peninsula." By Capt. R. H. Beddome, Officiating Superintendent of Forests.

April 6*th*, 1865.

The following papers were read:—1. "Notes on the Flora of the Desert of Sinai." By R. Milne Redhead, Esq.—These notes were collected during a tour in the East, in February, March, and April, 1864. The paper contained some very interesting remarks on the plants observed during the journey, but does not admit of extract. At Cairo everything was then suffering from recent severe frost, a most unusual occurrence. The plantains and sugar canes were almost destroyed. The desert was generally devoid of vegetation, while in the sandy wadys, which in rainy seasons are water courses, a variety of plants appeared more or less profusely—among them the Retem, (*Spartium monospermum*), supposed to be the Juniper bush of the prophet. Near a pool of bitter water, called 'Ain el Hawâra, and supposed to be the Marah of Scripture, where a few Palms and thick tufts of a prickly shrub, the *Nitraria tridentata*, the Ghûrhûd of the Arabs, which produces small oval scarlet berries, with a sub-acid flavour. The camels eat this plant greedily. At night the air was laden with the delicious perfume of *Mathiola odoratissima*. As regards Ferns, *Adiantum Capillus-veneris* was stated to grow abundantly at the Pools of Solomon, in an old well on the Mount of Olives very luxuriantly, also at Aceldama; *Ceterach officinarum* on rocks and walls near Bethlehem; *Cheilanthes fragrans* in profusion at Beth Jala and in the valley of Hinnom near En Rogel; *Nothochlæna lanuginosa*, on rocks between Jaffa and Jerusalem; *Gymnogramma leptophylla* on Mount Gerizim, and *Lastrea Filix-mas* at Bamas—making in all six species seen in Palestine.

2. "On the Vegetation of the Western and Southern Shores of the Dead Sea." By B. F. Lowne, Esq. Communicated by Dr. Hooker.

April 20th, 1865.

The following papers were read:—" On *Gripidea*, a new genus of Loasaceæ, with an account of some peculiarities in the structure of the Seeds of that Family. By John Miers, Esq.

2. " Cabul, its Flora and Vegetable Products, &c." From communications received from the Rev. H. Jaeschke, of the Moravian Mission. By J. E. T. Aitchison, M.D.

May 4th, 1865.

Mr. R. Milne Redhead exhibited dried Specimens of Plants collected in Palestine and the Desert of Sinai; also Specimens of *Anastatica hierochuntica*, living and in the dry state. The following papers were read:—1. " On two species of Guttiferæ." By Thomas Anderson, M.D.—Among the many rare species cultivated in the Botanic Garden of Calcutta, which have escaped the devastation of the Cyclone of the 5th of October last, there were stated to occur two species of Guttiferæ of considerable interest. The first of these *Calysaccion siamense* of Miquel (*Mammea birmannica*, Anderson), the author now described from living specimens, under the name of *Mammea siamensis*. M. Teijsmann says that the Siamese make necklaces of the flowers, and also offer them to the images of Boodh. The second was a *Garcinia* from the eastern coast of Africa, and named *G. Livingstonei*. The author stated that it was remarkable on account of its very peculiar habit, and also, though a true *Garcinia*, for its departure from one or two of the characters of the genus. The plants were raised from seeds sent to Dr. Thomson by Dr. Livingstone in 1859. This year one small tree has produced a great profusion of pseudo-hermaphrodite flowers, and another has produced a few flowers of the same character. This fruitless flowering was said to occur among other species of Guttiferæ while in a young state, or at least during the first years of flowering, fruit-producing plants being those only that have arrived at full maturity. According to Dr. Livingstone the natives about the Zambesi eat the fruits, which are about the size of a walnut.

2. " Descriptions of some new Genera and Species of Tropical Leguminosæ." By G. Bentham, Esq.

4. Zoological Society, (11, Hanover Square.)

March 14th, 1865.

The Secretary called the attention of the meeting to several recent interesting additions to the Society's Menagerie, amongst which were specimens of a three-banded Armadillo (*Tolypeutes conurus*) and a male Siamese Pheasant (*Euplocamus prælatus*).—Mr. Alfred Newton exhibited specimens of several new or little-known Birds' Eggs, and gave descriptions of others, amongst which were those of *Elanoides furcatus*, *Nucifraga caryocatactes*, *Didunculus strigirostris*, *Phalaropus fulicarius*, *Opisthocomus cristatus*, *Mareca americana*, and *Fulix affinis*. Mr. Newton believed that the eggs of the Nutcracker (*Nucifraga caryocatactes*), which had been obtained from the island of Bornholm, were the first really authentic examples of this species that had reached this country.—Mr. Sclater exhibited and made remarks on the eggs of several birds, laid in the Society's Menagerie, amongst which were those of the Horned Pheasant *Ceriornis satyra*).—A paper was read by Mr. W. S. Dallas, on the feathers of *Dinornis robustus*, in which a full description of their structure, as exhibited in a portion of the skin of this extinct bird attached to a skeleton, lately acquired by the Yorkshire Philosophical Society, was given. The remnants of the large accessary plume attached to each feather, manifested a near relationship between *Dinornis* and the Emeus and Cassowaries.—Dr. Crisp read a paper on the Anatomy of the Bactrian Camel, in which a description of certain intestinal glands, not before noticed in this animal, was given.—Dr. J. E. Gray gave a notice of a Common Porpoise (*Phocæna communis*), which had lately died in the Society's Gardens, and which was remarkable for having a row of tubercles on the upper margin of the dorsal fin. This structure did not appear to have been previously noticed in the Common Porpoise, although a species from South America, lately described by Dr. Burmeister, possessed it in a highly developed degree.—Three communications were read from Dr. P. P. Carpenter, entitled—(1.) Descriptions of new species or varieties of *Chitonidæ* and *Acmæidæ*, from the Panama collection of the late Professor C. B. Adams. (2.) Diagnoses of a new species of Mollusks, from the West Tropical region of North America. (3.) Diagnoses of a new species and a new genus of Mollusks, from the Reigen Mazatlan collection, with an account of additional specimens.—A communication was read from Mr. G. S. Brady, describing sixty-six new or imperfectly-known species of Marine *Ostracoda*, and accompanied by elaborate drawings of the various species.—Mr. Sclater pointed out the characters of a new species of bird of the genus *Basileuterus*, from British Guiana, and gave a synopsis of the known species of the genus.

March 28*th*, 1865.

The Secretary called the attention of the meeting to some recent additions to the Society's Menagerie, amongst which were a King Penguin (*Apterodytes pennantii*), and two examples of a rare Fruit Pigeon from the Seychelles (*Erythrœnas pulcherrima*).—Dr. Murie and Mr. St. George Mivart communicated a joint paper on the myology of *Hyrax capensis*, in which various muscles of this curious type were described, and comparisons between the corresponding muscles in the orders Rodentia and Ungulata were given.—A communication was read from Mr. Gerard Kreft describing a new species of Rock Kangaroo, proposed to be called *Petrogale longicauda*, from New South Wales.—Dr. J. E. Gray gave a notice of a new species of Porpoise from the British seas, proposed to be called *Phocæna tuberculifera*, founded on a specimen lately living in the Society's Menagerie. Besides external characters, of which the principal consisted in a row of tubercles bordering the upper edge of the dorsal fin, an examination of the skeleton of the present animal betrayed a striking difference in the shape of the occipital foramen.—Dr. J. E. Gray also gave a notice of an apparently undescribed species of Porcupine (*Erethizon rufescens*), from South America.—Mr. Sclater pointed out the characters of a new genus and species of Passerine Birds, from Madagascar, allied to *Pachycephala*, which he proposed to call *Hylophorba ruticilla*.—Dr. Günther read a paper on a new Pipe Fish from the Australian seas, proposed to be called *Phyllopteryx eques*, of which a specimen has been recently obtained for the British Museum from Mr. G. F. Angas.—Dr. J. E. Gray communicated a notice of a new genus and species of Tortoises of the family *Trionychidæ*, from West Africa, for which he proposed the name *Heptathyra marmorata*, and also a notice of a new species of *Tupaia*, from Borneo, proposed to be called *T. splendidula*.—Dr. Cobbold exhibited and made remarks on some specimens of Entozoa and other parasitic animals collected by Mr. Devis, of Manchester.

April 11*th*, 1865.

Professor Huxley read a notice of the singular form of the stomach in the Bats of the genus *Desmodus*, in which the cardiac end of this organ assumes the form of a greatly elongated cœcum, reflexed upon itself. This and the peculiarities of the dentition seemed to Professor Huxley to indicate the probable necessity of constituting the genus *Desmodus*, and its allied form *Diphylla*, a separate section of the order Chiroptera, under the name Hæmatophilina.—Dr. Crisp read a paper on the form, weight, and structure of the eye, including the colour of the iris in vertebrate animals. Dr. Crisp also exhibited a drawing of the Aard Vark (*Orycteropus capensis*), and a figure of the Placenta of the Giraffe.—Dr. Murie communicated some remarks on cases of deformity in the lower jaw of the Sperm Whale (*Physeter macrocephalus*), which he had found occurring in several specimens in the Museums of this couutry and America.—Mr. Sclater gave a description of new species of Indian Porcupine, proposed to be called *Hystrix malabarica*, distinguished from the ordinary Indian species *H. leucura*, by its orange-coloured spines. Four living examples of this new species had lately been presented to the Society by His Excellency Sir William Denison, K.G., Governor of Madras. —Dr. J. E. Gray communicated some notes from Mr. E. L. Layard, of Cape Town, Corr. Memb., on the specimens of Whales contained in the South African Museum, Cape Town. This was accompanied by characters of two new species of the group, founded upon examples in the South African Museum, which Dr. Gray proposed to call *Ziphius layardii* and *Hyperoodon capensis*.—Dr. Gray also communicated a revision of the genera and species of Entomophagous Edentata, founded on an examination of specimens of this group contained in the British Museum. Amongst these were the characters of three species believed to be new to science, and proposed to be called *Pholidotus africanus*, *Dasypus vellerosus*, and *Cyclothurus dorsalis*.

April 25*th*, 1865.

A letter was read from Professor William Nation of Lima, Peru, in reference to certain specimens of Reptiles intended to be transmitted to the Society's Menagerie.—Mr. Sclater made some remarks on a collection of Birds-skins, made in the vicinity of Vera Cruz, Mexico, by the Society's Corresponding Member, Monsieur A. Boucard.—A letter was read from Mr. W. Alford Lloyd, describing the new Aquarium House lately erected in the Zoological Society's Gardens at Hamburgh, and the improved system of management of Aquaria pursued in that establishment.—Two communications were read from Dr. W. Peters, For. Mem. The first of these related to the species of Mammals collected by Dr. Welwitsch during his recent travels in Angola. The second consisted of some notes on the Indian Rodent, described by Mr. Blyth as *Platacanthomys lasiurus*, which, Dr. Peters was of opinion, had nothing to do with the Dormice (Myoxinæ), but appertained strictly to the Murine family, being nearly allied in many respects to *Phlæomys* and *Meriones*.—A communication was read from Dr. J. V. Barboza du Bocage, For. Memb., containing notes on some rare and little known Mammals from Angola, of which specimens had lately been received by the National Museum of Lisbon.—A letter was also read from Mr. E. L. Layard, Cape Town, Corresponding Member, describing a new species of Zebra, discovered by Mr. James Chapman in the interior of South-Western Africa, about 200 miles from Walwich Bay, which Mr. Layard proposed to call *Equus Chapmanni*.—Dr. J. E. Gray made some further observations on the Whale, which he had lately proposed to name *Macleayius australiensis*.—A paper was read by Messrs. A. R. Wallace and H. Adams on the Land Shells, collected by Mr. Wallace in the Malay Archipelago. This list, which enumerated 125 species, 50 of which had been first obtained by Mr. Wallace, had been drawn up principally with a view of recording the exact localities of each species, and thus furnishing materials towards a more accurate knowledge of their geographical distribution.

April 29th, 1865.

Anniversary Meeting.—The Right Hon. Sir George Clerk, Bart., President, in the chair. The usual preliminaries having been transacted, the report of the Auditors was read and adopted by the meeting. The report of the Council was then read by Dr. P. L. Sclater, F.R.S., the Secretary of the Society. It stated that the number of Fellows, Fellows-elect, and annual subscribers of the Society on that day, amounted to 1955, showing an increase of 201 members since the last anniversary. During the year 1864 no less than 264 new Fellows and annual subscribers had been elected, a greater number than had joined the Society in any one single year for the previous twenty-eight years. Seventeen corresponding members and two foreign members had also been elected since the previous anniversary. The report then proceeded to state that the Council had again the pleasure of reporting a considerable increase in the income of the Society. The income of the year 1863 had amounted to £20,284. 12*s* 11*d*, a sum unexampled except in the two Exhibition years; but the income of the past year had exceeded that sum by £1429, the total receipts for 1864 having amounted to £21,713. 13*s* 10*d*. This increase was due to the augmentation of nearly all the principal sources of receipt, amongst which that of admission to the gardens and annual subscriptions (resulting from the increased number of members) were the most noticeable. The number of visitors to the Society's Gardens had also largely increased during the year 1864, the entrances having amounted to no less than 507,169, a number which placed the year 1864 as exhibiting a more favourable aspect, in this point of view, than any of the preceding years, except the two Exhibition years. After adding to the income of 1864 the sum of £2,043. 10*s* 6*d*, being the balance carried forward from the previous year, and the sum of £2677. 10*s*, being the proceeds arising from the sale of £3000. Reduced 3 per Cents., there remained a total sum of £26434. 14*s* 4*d* available for the expenditure of the year 1864. The ordinary expenditure of the Society paid during the year 1864, under which head had been placed every item necessary to keep the Society's establishment in a perfect state of efficiency, had been £17,207. 10*s* 7*d*. The extraordinary expenditure paid during the same period had amounted to £7,681. 12*s* 9*d*, making a total expenditure of £24,889. 3*s* 4*d*, and leaving a balance in the banker's hands, at the end of the year, of £1,544. 9*s* 6*d*. The report then stated that the reserve fund of the Society invested in Three per Cents. Reduced amounted to £10,000., and that while the Council had no intention of diminishing this reserve fund, they did not think it necessary or even desirable to increase it beyond that amount; that the cash assets of the Society, on the 31st of December, 1864, had amounted to £10,900. 12*s* 4*d*, and that liabilities at the same period had been estimated at £3434. 17*s* 7*d*, leaving a balance in favour of the Society of £8,871. 16*s* 6*d*; that the sum of £403. 8*s* had been devoted to expenses connected with the Society's library during the past year. The Council had resolved on fitting up the upper portion of the Old Museum building in the Society's Gardens as a gallery for the exhibition of the Society's collection of water-colour drawings by

Mr. J. Wolf, during the summer months of the present year. The report then proceeded to speak of the Society's Gardens in the Regent's-park, and stated, in reference to them, that the new entrance lodges, aviary, and monkey-houses, concerning which full details and explanations had been offered to the Society in the last annual report, had been all completed and brought into perfect order during the course of last year. That as regards the latter building, the new monkey-house, which was only brought into full working order during the latter part of last summer, the Council could not refrain from congratulating the Society upon the very important amelioration that had been thus effected in what had been heretofore one of the most defective parts of their garden establishment. That this building had not only proved most attractive to the public, but that also as regards the health and welfare of the animals to the use of which it was devoted there could be no question that it had likewise proved an entire success. In striking contrast to the constant mortality that had prevailed in the old monkey-house, the deaths among the quadrumana during the late long and severe winter had been very few, and the greater number of them had remained in an excellent state of health. The cost of the erection of the new monkey-house had been £3382. 18*s* 3*d*, and a further sum of £1459. 7*s* 3*d* had been spent in fittings and works connected with it. The most important event connected with the Society's menagerie that had occurred since the last anniversary had been the successful mission of Mr. Thompson to India. Several of the Society's corresponding members in India having announced that they had collections waiting for transmission to the Society (amongst which were a pair of young Rhinoceroses and other valuable animals), the Council had determined on sending out to Calcutta, to receive and bring back those proffered donations, Mr. James Thompson, the Society's head-keeper, who had previously made the same journey with such signal success on the occasion of the introduction of the Himalayan pheasants in 1858. Mr. Thompson had arrived in the Thames on July 28, 1864, bringing with him a very fine series of animals, amongst which might be specified two rhinoceroses, one rhinoceros hornbill, two concave hornbills, three green-necked pea-fowl, three lineated pheasants, two rufous-tailed pheasants, and other valuable animals. The total cost of Mr. Thompson's expedition had amounted to £808., whilst the lowest estimate that could be set upon the value of the collection thus acquired amounted to

£1516. The animals exhibited for the first time during the year 1864 comprised eight mammals, twenty-three birds, two reptiles, and two fishes. Amongst these particular notice was directed to the orange-quilled porcupine (*Hystrix malabarica*), a new and very interesting addition to this group (for which the Society were indebted to their corresponding member, his Excellency Sir William Denison, Governor of Madras), and to the *Didunculus strigirostris*, or Tooth-billed Pigeon of the Samoan Islands in the Pacific, perhaps the rarest specimen ever exhibited alive in the Society's menagerie, as it had been supposed until recently to be quite extinct. For the latter the Society were indebted to their indefatigable correspondent, Dr. George Bennett, of Sydney, who had made so many valuable donations to the menagerie. The report then gave a list of animals which had bred in the Gardens of the Zoological Society between the 1st of January, 1864, and the 1st of January, 1865, amongst which were twenty-two species of mammals, twenty species of birds, one reptile, and three fishes; and also an alphabetically-arranged list of donors, and of their several donations to the menagerie during the year 1864. The Council anticipate that the yearly income of the Society is likely to reach the amount of £20,000. Allowing £17,000. for the ordinary expenses of the present large establishment, a surplus of £3,000. remained, which might be devoted to extraordinary works, without intrenching on the Society's reserve fund. At the same time, the roll of the members of the Society seemed likely to attain a considerable increase, showing that the objects of the Society and the state of its affairs were generally approved of, while the numerous visitors to the Gardens, particularly on Mondays and holidays, showed the interest taken in the Society's collection by the public at large. The Council's report having been received and adopted, the meeting proceeded to elect the new members of the Council for the year. The ballot having been taken, the following five Fellows of the Society were elected into the Council, in place of five others removed therefrom: the Right Hon. Viscount Bury, M.P., Mr. Charles Buxton, M.P., Mr. J. Travers Smith, Mr. R. H. Vyvyan, and Mr. G. R. Waterhouse. The ballot for the officers resulted in the election of the Right Hon. Sir George Clerk, Bart., as President, Dr. P. L. Sclater, F.R.S., &c., as Secretary, and R. Drummond, Esq., as Treasurer, for the ensuing year.

XXXVII.—Miscellanea.

1. Dr. W. Peters on *Cholœpus Hoffmanni.*

A serious error occurred in the notice of Dr. Peters' recent discovery of the abnormal number of the cervical vertebræ in this animal in our last number. Linnæus, in the last edition of his Systema Natura, associated the Walrus and the Manatee together in one genus, calling the former *Trichecus rosmarus* and the latter *Trichecus manatus*. By modern systematists the term *Trichecus* is usually retained for the Walrus, and the Manatee is called *Manatus*, after Cuvier. Dr. Peters, however, following what is, perhaps, a more correct usage, calls the Manatee *Trichecus*, and uses Illiger's name, "*Odobœnus*," for the Walrus. In translating Dr. Peters' note, referred to above, this was unfortunately overlooked, and the Walrus, instead of the Manatee, was stated to have one cervical vertebra less than the ordinary number.

2. Death of Dr. Thomas B. Wilson.

Our brother naturalists in America have lately sustained a severe loss in the death of Dr. Thomas B. Wilson, of Newark, Delaware, President of the Academy of Natural Sciences of Philadelphia, which occurred on the 15th of March last. Although Dr. Wilson never distinguished himself by his writings, he was, as many of our friends are aware, one of the most judicious and liberal patrons of Zoological science that has ever lived. The Museum of the Academy of Natural Sciences of Philadelphia, which rivals, and in some points surpasses, those of the principal cities of Europe, was brought to its present condition mainly by the munificent and unparalleled contributions of this generous benefactor. For many years Dr. Wilson was in the habit of making constant visits to Europe, and of purchasing, by himself or his agents, all the most rare and costly objects of Natural History that came from time to time into the market. Amongst other acquisitions thus made was the whole of Mr. Gould's collection of Australian birds, containing the originals of the figures given in that naturalist's great work on the Ornithology of Australia; Mr. O. Des Mur's unique series of birds-eggs; and the vast collection of Natural History formed by the late Prince Massena. These and many other similar objects were all purchased by Dr. Wilson, and transferred to the Academy of Natural Sciences of Philadelphia free of expense. Further, the magnificent library attached to that establishment, believed to be the best Zoological library in the world, was also nearly altogether the gift of the same generous donor. The juxta-position of the library, and the museum in the same building, the complete freedom from official trammels, and the great facilities given to all students in the Academy of Natural Sciences of Philadelphia, whether members of the Institution or not, render that Institution, as we can testify from personal experience, the most convenient, perhaps, of any in the world for the working naturalist.

3. Lions in India.

During the whole of my stay of nearly twenty-two years in India not a single instance was recorded in the local periodicals of a Lion having been observed in any part of the country, excepting in the province of Kattywar, in the peninsula of Guzerat, to which locality, in the general opinion of sportsmen and others, the species is now restricted as an Indian animal. In the *India Sporting Review* for January, 1856, I called the attention of its readers to this subject, and endeavoured to elicit the latest authentic dates of the known existence of *Felis Leo* in other parts of India. The meagre result of this inquiry was embodied in the following passage which appeared in my Catalogue of the Mammalia in the Museum of the Asiatic Society of Bengal, published in 1863 :—"The Lion was extirpated in Hurriána about 1824. A female was killed at Rhyli, in the Dumaoh district, Sâgur and Nerbudda territories, so late as in the cold season of 1847-8, and about the same time a few still remained in the valley of the Sinde river, in Kotah, Central India. The species would appear to be now exterminated in that district." I might have added that I saw a caged young Lioness that had been brought from Sindby in 1844, or thereabouts, which died on the voyage to England. Greatly to the surprise of Indian naturalists and sportsmen, Lions have since made their appearance in parts of the country where they had been supposed to have been long exterminated. In the *Delhi Gazette* for August 23rd, 1864, we are informed that "Lieutenant Clarke, Royal Artillery, whilst out shooting near Deesay, on the borders of Rajpootana, was sadly mauled by a Lioness, and had to suffer amputation of the right arm." And in a letter dated March 19th, 1865, Lieutenant-Colonel Tytler informs me of "two Lions having been shot within about six miles of Gwalior, the other day. A party of officers were out small game shooting on foot, when to their horror three lions sprung up before them, two males and a female. They fired, one of the males fell dead, the other was wounded, and found dead the next day, and the female has not been heard of since. The one that was shot dead charged most furiously. Lions had not been heard of in that part of the country for at least thirty years." In the early part of the sixteenth century the Mogul Emperor Báber mentions that the wild Elephant, the Rhinoceros, the wild Buffalo, and the Lion, inhabited the Benáres district. Within the present century the Lion inhabited the N.W. parts of Hindustân, from Buháwulpur and Sindh to at least the Jumna (about Delhi), southward as far as Khándeish, and in Central India the Sâgur and Nerbudda territories, and so far west as Palamow; but the supposed "Bengal Lion" of Bennett's *Tower Menagerie* was from Hurriána. The particulars of the capture of that individual are given somewhere in the old *Bengal Sporting Magazine.*—E. Blyth.

4. Reproduction of the Axolotl (*Siredon mexicanus*).

Although the Axolotl (*Siredon mexicanus*) has been long known to Naturalists, and its anatomy has been well described by Cuvier, we have hitherto had no information concerning the reproduction of this singular Batrachian. The want of this knowledge, and the great resemblance of the Siredon to the larval form of *Ambystoma* has caused it to be regarded by Professor Baird* and Dr. Gray† as probably only the larva of some gigantic species of the latter genus. Recent observations made in the Jardin des Plantes at Paris have now, however, solved all doubts upon this point. Numerous specimens of the Siredon were obtained by the Jardin d'Acclimatation from Mexico in the course of last year, and some of these having been transferred to the Jardin des Plantes have bred in the tanks of the reptile-house of that establishment during the past spring. M. Auguste Duméril has carefully watched the development of the *ova* in this Batrachian, and has given an account of the phenomena observed in a recent number of the Comptes Rendus,‡ which he promises to supplement by future observations. The egg of *Siredon*, like that of all batrachians yet observed, consists at first of a black vitelline sphere placed in the centre of a second sphere, which constitutes the vitelline membrane, and which is as clear as crystal; this, in its turn, being enclosed within an envelope of an albuminous character. The earlier phases of

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* J. A. n. S. Phil. 1849, p. 292.

† Catalogue of Amphibia, part ii. p. 49.

‡ C. R. LX., No. 16, p. 765, (April, 1865).

development of the ovum are analogous to those perceived in the case of other amphibian ova. The first appearance of the embryo externally takes place from twenty-eight to thirty days after the deposition of the eggs, and is preceded by violent movements, which cause the rupture of the shell and liberation of the young animal. When first hatched out, and disengaged from its envelopes, it measures about 0·015 of a millimetre, and the vitellus is at this period represented by a small sac the diameter of which is only equal to 0·002 of a millimetre. The *branchiæ* at this stage consist of three very short cylindrical appendages, with a certain number of ramifications, and do not present that extreme division which is characteristic of the adult condition. The second period of development, which dates from the rupture of the envelope of the ovum, may be said to terminate at the time the posterior limbs make their appearance. This stage has not yet been completely investigated. M. Duméril cannot state the number of weeks it embraces. In specimens hatched on the 19th of February last, and therefore more than two months old, no traces of posterior limbs had been observed, and the anterior extremities which were developed from behind the branchial appendages before the rupture of the egg membrane, had not increased in length.

A single adult specimen of the *Siredon* is now in the Fish-house of the Zoological Society's Gardens, and well merits the attention of those who have not seen this singular perenni-branchiate form in a living state.

5. Proposed new Expedition in Search of Dr. Leichardt.

From our active correspondent Dr. F. Mueller, the distinguished Director of the Botanic Gardens at Melbourne, we hear that great exertions are now being made in that city to get up a new expedition in search of Dr. Leichardt and his party, who are generally supposed to have perished in the interior of Australia some sixteen years ago. Intelligence obtained by Mr. McIntyre during his recent trans-Australian journey is said to have completely disproved the generally acquiesced-in statements of Leichardt's fall under the hands of savages near Cooper's Creek; and it is urged that even after this long lapse of time it is possible that some of his brave band may yet be living. We cordially wish success to the undertaking. Although it is of course most probable that the whole of the party have perished long since, it is very desirable that the question as to their real fate should be definitively set at rest.

6. List of Publications received.

[*Continued from page* 304.]

(55.) Ueber die Geographische Verbreitung der Pulmonaten. Von Wilhelm Keferstein, M.D. Aus d. Nachr. v. d. K. Gesellsch d. Wiss. zu Gottingen, 1865. No. I.
(56.) Homes without Hands, &c. By the Rev. T. G. Wood, M.A., F.L.S. Parts XV., XVI., XVII. London, Longman. 1865.
(57.) The Geological Magazine. Edited by T. Rupert Jones, F.G.S. April, May, 1865. Longman, London. Vol. II., No. 4.
(58.) Annuaire de l'Académie Royale de Belgique. 1865. Bruxelles.
(59.) Bulletin de l'Academie Royale des Sciences, des Lettres, et des Beaux Arts de Belgique. 34 Année, 2e série, tome 19. No. I., III. Bruxelles. 1865.
(60.) Sitzungsberichte der Königl. Bayer Akademie der Wissenschaften zu München. 1864. II. Heft II. III.
(61.) Ofversigt af Kongl. Vetenskaps Akademiens Forhandlingar. Tjugondeförsta Argangen. No. 8. Stockholm. 1864.
(62.) Applications of Geology to the Arts and Manufactures. By Professor D. T. Ansted, M.A., F.R.S. London, Hardwicke. 1865.
(63.) Correspondenz-Blatt des Zoologisch-Mineralogischen Vereines in Regensburg. Achzehnter Jahrgang. Regensburg. 1864.
(64.) The Popular Science Review. Edited by Henry Lawson, M.D. No. 15. April, 1865. Hardwicke, London.
(65.) Die Vulkanischen Erscheinungen der Erde. Von Dr. C. W. C. Fuchs. Leipzig and Heidelberg. 1865.
(66.) The Canadian Naturalist and Geologist, with the Proceedings of the Natural History Society of Montreal. Nos. 4, 5, 6. 1864. Montreal.
(67.) Official Catalogue of the New Zealand Industrial Exhibition, 1865. Dunedin.
(68.) Memoirs read before the Anthropological Society of London, 1863-4. Vol. I. London, Trübner and Co. 1865.
(69.) List of Diatomaceæ occurring in the neighbourhood of Hull. By George Norman. Hull.
(70.) The Anthropological Review. No. 9. May, 1865. London, Trübner and Co.
(71.) Essay on the Trees and Shrubs of the Ancients. By C. Daubeny, M.D., F.R.S., Professor of Botany, &c., in the University of Oxford. Oxford and London, Parker. 1865.
(72.) The Fate of Dr. Leichardt, and a proposed new Search for his party. By F. Mueller, Ph. D., M.D., F.R.S. Melbourne, 1865.

THE

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Reviews and Notices.

XXXVIII.—The Zoology of Siberia.

Reisen im Süden von Ost-Sibirien in den Jahren 1855-59 im Auftrage der kaiserlichen Geographischen Gesellschaft ausgeführt von Gustav Radde. Band II. Die Festlands Ornis des Sudostlichen Sibirien. St. Petersburg, 1863.

In a former number of this Journal* we have spoken at some length of the important expedition sent out to Eastern Siberia in 1855 by the Imperial Geographical Society of St. Petersburg, and of the valuable contribution made to our knowledge of the Mammal-fauna of that country by Herr Gustav Radde, the Zoologist of the expedition, in the first volume of the work now before us. The second volume, relating to the birds of the same country, also prepared by Herr Radde, who appears to have devoted special attention to this branch of zoology, has lately been received in this country, and now demands our attention.

Pallas's Zoographia Rosso-Asiatica—until lately our only standard authority on the birds of Russian Asia,—gave but few notices of the ornithology of the vast territory now known by the name of Amoorland. Middendorf's "Sibirische Reise" and Maack's journey to the Amoor in 1855, were the earliest of our more recent sources of information concerning the natural products of this region. But the results of all previous investigations, as well as a great mass of new and original materials, were contained in the recent publication of Dr. Leopold von Schrenck entitled "Reisen und Forschungen in Amurlande," the second volume of which gives us information concerning 190 species of birds met with in this country and on the adjoining sea-coasts. Upon this last work Herr Radde has grounded

* See Nat. Hist. Rev. 1864, p. 204.

the present volume, which treats especially of Amoorland and the adjoining districts of Mongolia and Mantchuria, traversed by our author during his four years' journeyings, of which an outline has been already given in our former notice.

Herr Radde commences his volume with a general catalogue of the Birds of South-eastern Siberia, giving in parallel columns the different dates of the earliest arrival of each species in the Eastern Sajan, Baikal, Dauria, the Upper and Lower Amur, and the Stanowoj Mountains, as recorded by himself and other observers. The list embraces 328 different species, and an additional supplementary catalogue contains the names of 40 others, which also probably belong to this Avifauna, although of more or less rarity. These 368 species, which may be taken as a tolerably accurate estimate of the Ornis of this region as far as we are at present acquainted with it, belong to the following orders, according to Herr Radde's arrangement.

Rapaces	36	
Scansores	19	
Oscines	140	
Gallinaceæ	18	368
Grallatores	74	
Natatores	81	

We now proceed to give an abstract of Herr Radde's general remarks on the 33 families of birds to which he refers these 368 species—at the same time introducing a few criticisms concerning his nomenclature, arrangement, and other points.

The Vultures (Vulturidæ) have only one representative in South-eastern Siberia—namely, the Lämmergeier of the Alps, *Gypaëtus barbatus*—which indeed is a very aberrant form of this family, if it belongs to it at all. Herr Radde remarks that this bird is moving southwards in Inner Asia, and it is not now found in Dauria, where it was formerly met with.

The Falconidæ of South-eastern Siberia are 22 in number—mostly European species—partly of circumpolar distribution (such as *F. gyrfalco*)—partly composed of South-European species—such as *Aquila nævia*, *Milvus niger* and *Buteo ferox*, which push forward in a north-easterly direction into the high steppes of Mongolia. A well-marked East Indian form is also present in the shape of *Circus melanoleucus*, which is a summer visitant to the middle Amoor Valley, and on the Onon and Argunj. Herr Radde's *Aquila nævia*, which is stated to be very abundant on the high steppes of Dauria, and in fact the most common species of eagle in Eastern Siberia is the large well-marked Eastern *variety* (to say the least of it) of *A. nævioides* commonly called *Aquila clanga,* after Pallas. Again Herr Radde's *Falco vespertinus* var. *amurensis,* is a very curious representative—*(tectricibus subalaribus niveis)* of our *Erythropus vespertinus.* The typical European form was met with as far east as the Tunkinskian Steppe in Western Siberia, but not subsequently seen until var. *Amurensis* appeared on the middle Amoor, where it is very common, and nests abundantly on the islands in the river.

The nocturnal birds of prey (Strigidæ) have 10 representatives in South-eastern Siberia. The Snowy Owl *(Strix nyctea,* Linn.) is very abundant on the high steppes in winter. It arrives from the north about the end of September, and remains until towards the end of April, feeding principally upon the Piping-hares (*Lagomys ogotona*).

Of the Swifts (Cypselidæ) two species are found in South-eastern Siberia—called by Herr Radde *Acanthylis caudacuta* and *Cypselus apus.* The first of these is perhaps rightly identified by our author with the Australian species, and it was, doubtless, a straggler from Amoor-land, the capture of which in England was recorded some years since, and which has caused the "Australian Spine-tailed Swift" to be enrolled in the list of "British Birds." Under the last name, however, seem to have been confounded two species—the European *Cypselus apus,* or a slight variety of it, and the smaller white-rumped Chinese Swift, *Cypselus vittatus,* Jard. The latter bird, which might well be expected to occur in Eastern Siberia, may be probably identical with *C. australis,* Gould, but is certainly quite different from our *C. apus.*

The only Goat-sucker met with in Amoorland and the adjacent countries was *Caprimulgus jotaka,* described by Temminck from Japan—an eastern representative of the European *E. europæus.*

Besides the common Cuckoo of this country (*C. canorus*) which is very abundant in South-eastern Siberia, two other species of this group were met with. The first of these is referred by our author, following von Schrenck, to the *Cuculus Sparvernoides*—a well-known Himalayan species, but as stated by Mr. Swinhoe (P.Z.S. 1863, p. 66) is probably more correctly referable to the smaller *C. fugax,* Horsfield. The other is identified (probably quite incorrectly) with Gould's Australian *C. optatus.* It is nearly allied to *C. canorus,* but larger, and with broader breast-bands ; and also readily distinguishable from the common Cuckoo by its note, which is regular and 4-syllabled. This Cuckoo first occurred on the upper Amoor in June, and was very abundant in certain localities.

Of the Woodpeckers (*Picidæ*) the common Wryneck (*Jynx torquilla*) and 7 species of the typical group *Picinæ* are inserted in Herr Radde's list. Six of the latter are well-known European species—the remaining one being *Picus mitchellii*, Malherbe, heretofore known as Chinese, which was obtained by Dr. Wulfius at Port Bruce—the most southern Russian harbour upon the eastern coast of Mantchuria.

The families Alcedinidæ, Coraciidæ and Upupidæ have each a single representative in S.E. Siberia—namely, *Alcedo bengalensis*—the eastern form of *A. ispida*—*Eurystomus orientalis*, and *Upupa epops*. The *Eurystomus* although well-known as a summer visitant to China,* but not hitherto recorded further north, was obtained by Dr. Wulfius, on the South-Mantchurian coast.

We now enter the great Order Oscines, so abundant in genera and species, and commence it with the family of Larks (Alaudidæ), which are most abundant on the high steppes of Mongolia. Four species are given by our author—of which one only, the *Alauda mongolica*, Pallas, is extra-European. This fine lark, which is a near ally of the well-known Calandre-lark of the Continent, is a favourite cage-bird throughout China, and has, we believe, upon more than one occasion been brought thence alive to Europe. The Shore-lark (*Otocorys alpestris*) is a permanent resident in these parts, breeding on the lowlands surrounding Lake Baikal, and passing the winter in little flocks on the high steppes of Dauria, where it haunts the edges of the salt lakes. Herr Radde gives a figure of the immature plumage of this bird, of which, however, he did not succeed in discovering the nest.

We next enter upon the family of Finches (*Fringillidæ*), of which 33 species occur in S.E. Siberia. The first 15 of these belong to the group of Buntings (Emberizinæ), one of the most beautiful and characteristic forms of the Palæarctic Ornis. Amongst them are two of especial interest—*Emberiza elegans*, as having only hitherto been known from Japan, but found abundant and breeding, by Radde on the Bureja-mountains, and *E. chrysophrys*, hardly known since the time of its describer, Pallas, except from a specimen obtained by Mr. Swinhoe, near Pekin, and a stray individual recorded, by De Selys-Longchamps,† as having been taken in Belgium. Another of these Siberian Buntings—*Emberiza pusilla*, Pallas, has also lately distinguished itself by appearing for the first time in England,‡ and

* See Swinhoe in P. Z. S. 1863, p. 269.

† Faune Belge, p. 81.

‡ See Proc. Zool. Soc. 1864, p. 377.

curiously enough this is considered by Radde to be an exclusively East-Siberian species, ranging up to the shores of the Northern Pacific.

The Tit-mice and Nuthatches (Paridæ and Sittidæ) are represented in Eastern Asia by 8 species, all associated by Radde with European forms. In the next family, however, the Ampelidæ, we meet with a most interesting novelty for the Asiatic mainland-Fauna, in the shape of the *Ampelis phœnicoptera* of Temminck, or Crimson-winged Cedar-bird hitherto only known from Japan. There can be little doubt that this Cedar-bird breeds in the Bureja mountains north of the Amoor, as the little flocks met with by Radde in August and September in the woods of this district contained numbers of lately fledged young, in which plumage the species is figured in the present work. Of the Crows (*Corvidæ*), which follow next, our author enumerates 10 Siberian species. The only one of them allowed by Radde to be specially distinct from other western representative forms is *Corvus japonensis*, Bp., although most ornithologists will recognize the claims of *Garrulus brandtii*, Eversman, and *Corvus dauricus*, Pallas, to the same rank, and as being separable forms from the European *Garrulus glandarius* and *Corvus monedula*. On the other hand among the Starlings (Sturnidæ), but one European form, the common Starling, (*Sturnus vulgaris*) is found; the two other Siberian members of this group being both purely eastern in their range, and descending in winter into Southern China.* The only Tree-creeper of Eastern Siberia is again the European species, while of the Cinclidæ besides the European *Cinclus aquaticus*, (which is present in Siberia both in its normal form, and in the plumage called *Cinclus leucogaster* by Eversman,) the uniformly coloured *Cinclus pallasi* was also met with on the middle Amoor. We have not space here to go into the difficult question of the various species of Pipits (*Anthus*) and Wagtails, (*Motacilla*) which Herr Radde now enters upon. It may suffice to say, that Herr Radde refers all the members of these two groups met with in Eastern Siberia to well-known European forms, except the very distinct *Motacilla citreola* of Pallas, which has, however, also been recorded as an occasional straggler into the west. Of the genus *Oriolus* the European *O. galbula* appears to range eastwards only so far as the neighbourhood of Irkutsk, the prevalent if not the only species, in the Amoor-region and Eastern Siberia generally being one of the black-capped section, no doubt the same that is re-

* Cf. Swinhoe, P. Z. S., 1863, p. 301, et seq.

corded by Swinhoe, as a "common summer visitant to the whole of China."*

Of the genus *Turdus* Radde records 7 species as met with in these countries, amongst which are several known as rare and occasional visitants to Europe, but of which Eastern Siberia is the true home. And here we may remark that Herr Radde has as we believe, committed a serious error in identifying *Turdus naumanni*, Temminck, so well distinguished and illustrated in the last supplementary volume of Naumann's Vogel Deutschlands with *Turdus ruficollis* of Pallas; the latter being a very distinct species more nearly allied to *Turdus atrigularis*. Nor can we believe that the bird figured on plate viii. of his work is really a bastard between *T. fuscatus* and *T. ruficollis*. It appears to us to be nothing more than a young *Turdus naumanni*. Although the young birds of the latter species are somewhat difficult to distinguish from those of *T. fuscatus*, yet a large suite of specimens renders this task comparatively easy, as we have occasion to know from our examination of the very extensive series of thrushes procured by Mr. Swinhoe in various parts of China.

The true Singers, in which division Herr Radde places the genera *Accentor*, *Saxicola*, *Sylvia*, *Regulus*, *Zosterps*, *Salicaria*, *Muscicapa*, and *Lanius*, number 43 species in South-eastern Siberia. To this group one of the few supposed novelties obtained by our author belongs—namely, a new *Phyllopneuste* allied to *P. sibirica*, and proposed to be called *P. schwarzi*. This, however, may very probably be the same as one of the several new species of this form obtained by Mr. Swinhoe in China, and previously described in this country—it would be difficult to say which without actual comparison of specimens. The list of Passerine birds of Eastern Siberia is closed with the Swallows, of which four species are included in Herr Radde's work.

The next order of birds, the Gallinaceæ, among which our author includes the Pigeons, numbers 18 species in this Fauna. Of these, perhaps the most remarkable is the Pallas, or Three-toed Sand-grouse, (*Syrrhaptes paradoxus*), which has of late years created so much excitement in Europe by appearing in large flocks all over the westernmost parts of our continent, even up to the shores of the Atlantic.† This species is at the same time one of the most

* *Oriolus chinensis*, Linn., Swinhoe, P. Z. S., 1863, p. 282.

† The best *general* account of the "invasion of this Tartarian horde," as it has been termed, is that given by Mr. Alfred Newton in last volume of the "Ibis" for 1863.—See "The Irruption of *Syrrhaptes paradoxus*." Ibis, 1863. p. 1.

characteristic birds of the high steppes of Eastern Asia. Herr Radde devotes to its illustration the frontispiece of his work, which represents the breeding locality of the bird on the Tarei-nor, besides giving the only complete account that has yet been published of its habits, migrations, and nidification.* The *Syrrhaptes paradoxus* winters in large flocks on the southern parts of the great desert of Gobi, extending as we know from the records of English observers as far southward as Pekin and Tientsin.† It migrates northwards very early for the purpose of nidification, appearing by the 10th of March at its breeding stations on the northern edge of the steppes in small flocks composed of birds already paired. By the last days of March eggs are already deposited. The nest is carelessly constructed, being placed on the ground, and consisting of a slight depression in the surfaces surrounded by sprouts of *Salsola* and grasses. The young of the *Syrrhaptes* run as soon as hatched—thus showing that the nearest affinities of this family of birds (Pteroclidæ) are with the Gallinaceæ—not with the Pigeons—to which, however, they present several undoubted points of alliance. The eggs of this bird which are figured by Radde from specimens obtained by him on the Tarei-nor, were first made known to science in 1861 from examples laid by birds in the Aviaries of the Zoological Society of London.‡ They have the same general characters as those of other members of the family Pteroclidæ.

Besides our five well-known European species of Grouse (*Tetrao* and *Lagopus*), which are all distributed throughout Siberia and North-eastern Asia reaching mostly to Japan—two other distinct members of this group—so characteristic of the northern Faunas of both hemispheres—occur in Amoorland. These are the *Tetrao urogalloides* of Middendorf, and the *Tetrao falcipennis*, Hartlaub. The latter is persistingly referred by Radde (and, without doubt, erroneously) to the American *Tetrao canadensis*, although the very marked differences which separate these two allied species have been long since pointed out by Hartlaub,§ and a third member of the section (*Tetrao franklinii*) actually intervenes in range between it and the true *T. canadensis*. Of *Tetrao urogalloides* of the Apfel-mountains and its singular habits, the younger von Nordman has lately published some curious details, which prove that it is by no means so

* Previously published details of Herr Radde on the same subject have been given in the account of his journey in the 23rd volume of the "Beiträge zur Kenntniss der Russischen Reiches," p. 415.

† See P. Z. S. 1861, p. 196. ‡ See P. Z. S. 1861, p. 593, pl. xxxix., fig. 1.

§ Journ. f. Orn. 1855, p. 39.

close an ally of our Capercailzie (*T. urogallus*) as its name would lead one to suppose.

The only Pheasant recorded by our author in his work is the *P. torquatus*—the closely allied eastern representative of our *P. colchicus*. We are somewhat disappointed not to find the magnificent Eared Pheasant of Pallas (*Crossoptilon auritum*) included in the list. There is now no doubt that the true home of this splendid bird is the Mongolian Desert north of Pekin,* and we had hoped that it might have extended far enough northwards to have come within the grasp of the Russian explorers.

A fine representative of our European Partridge inhabits Transbaikalia and Amoorland, for which Herr Radde retains the Pallasian name "var. *rupestris daurica*." According to our ideas, however, it has good claims to rank as a species, and indeed it has recently been described and figured as such in the Zoological Society's "Proceedings."†

We now come to the numerous Order of the quasi-cosmopolitan Grallæ, in which, as might have been expected the greater number of the species are old European friends. But there are not wanting many very interesting Eastern forms in this group—such as three species of Cranes besides the western *Grus cinerea* and *G. virgo*. Two of these (*G. leucauchen* and *G. monachus*) were previously only known from Japan. In the same category we should also have placed the beautiful *Ibis nippon* of the "Fauna Japonica" obtained by Herr Maack on the Ussuri, and also seen by Herr Radde himself, had not Mr. Swinhoe already recorded its occasional appearance in China and Formosa.‡

Amongst the 68 Natatores included by Herr Radde in his work, by far the greater part are again species well known in Europe. Yet among the Anatidæ we find a few exclusively eastern birds—such as *Anas grandis*, *A. glocitans*, *A. galericulata*, and the new *Fuligula baeri* of the Amoor-valley—an interesting novelty allied to *F. nyroca* and *F. cristata*, of which a good figure is given (pl. xv).

Having now concluded our survey of the different Orders, we must endeavour to state shortly the deductions arrived at by the author as to the general character of the Eastern Siberian Ornis. Of the 328 species included by Herr Radde in the main portion of his work, 43 are considered to be Japanese and South Asiatic. These, however, are, with one exception only, summer-visitants to the North-Mantchu-

* Cf. Swinhoe, P. Z. S., 1862, p. 286, and G. R. Gray, P. Z. S., 1864, p. 258.

† *Perdix barbata*, Verreaux, P. Z. S., 1860, pl. ix., p. 62.

‡ See P. Z. S., 1863, p. 318, and "Ibis," 1861-3, p. 416.

rian Fauna, the winter Avifauna of this region being purely Europæo-Asiatic. The remaining and larger portions of the Eastern-Siberian species may be divided into two categories—the first (45) consisting of purely Siberian species or such as only occur in Europe as rare stragglers—the second (240) of species common to Europe and Siberia.

Again, of the 328 Eastern-Siberian species, 50 only can be considered as true permanent residents of this country, and but nine of these remain during the long and severe winter on the high and bare steppes of Northern Mongolia, These are

1. Aquila chrysaëtos.
2. Strix tengmalmi.
3. ——— bubo.
4. Alauda Mongolica.
5. ——— alpestris.
6. Passer domesticus.
7. ——— montanus.
8. Corvus corax.
9. Perdix cinerea.

To these, however, may be added the names of about seven winter-visitants of greater or less frequency, so that the whole winter Ornis of the Mongolian high-steppes may embrace some sixteen species. But when we descend from the steppes into the lower wooded region of Eastern Siberia the winter Avifauna is considerably augmented, embracing as many as 61 species—the permanent residents being slightly added to by a few immigrants from the north.

We have not now space left to enter upon the very full and interesting particulars given by Herr Radde concerning the arrival and departure of the migratory birds of Siberia, to the observation of which he appears to have devoted almost unparalleled care and attention. It may be sufficient to say that the results arrived at by von Middendorf in his learned memoir "Die Isepiptesen Russlands," are abundantly confirmed by Radde's observations. The most important of them are—

1. The high table-land of Asia and the bordering ranges of the Altai, Sajan, and Dauria, retard the arrival of the migratory birds.

2. Eastward of the Upper Lena towards the east coast of Siberia a considerable retardation of migrants is again noticeable.

3. The times of arrival at the northern edge of the Mongolian high-steppes are altogether earlier than those of the same species on the lower Amoor.

We have thus endeavoured to give a brief account of some of the more remarkable facts relating to the Siberian Avifauna put forward by Herr Radde in the present volume. Of the value of this, as of the previous works of a similar character published by the Russian Naturalists, and of their material influence on the progress of science there can be but one opinion. The labours of Von Middendorf, Von Schrenk, Radde, and their associates in their several expeditions, have resulted in giving us a very complete knowledge of what was previously one of the least known portions of the Eastern hemisphere as regards its natural products. This knowledge will be particularly acceptable to those engaged in the study of the Fauna and Flora of Europe, as the area referred to forms part of the same great natural division of the Old World, to which our islands and the rest of the so-called continent of Europe belongs. Without this knowledge, therefore, the perfect elaboration of the Fauna and Flora of Europe would not be possible. But the feelings of satisfaction with which we regard the operations of our Russian fellow-labourers must not blind us to the defects of their work, which are perhaps more apparent in the present volume than in any of those which have preceded it. These, we believe, are mainly due to the short-comings of the Imperial Museum of Natural History at St. Petersburg. Rich as that celebrated collection is in all the natural products of the vast empire of Russia, it would seem to be very poor as regards zoological specimens from the adjoining parts of Asia and other countries of the Old World. This has rendered it necessary to attempt the identification of many of the newly-discovered species of Eastern Asia by reference solely to figures and descriptions, which, as all naturalists know in the case of nearly allied species, are frequently by no means a sufficient guide. Had Herr Radde enjoyed access to a well-determined series of specimens of the Birds of China, India, and Australia, we are sure that he would not have committed so many errors in identification. As regards his practice of treating well-marked geographical forms as varieties instead of species, we have little reason to complain, inasmuch as the differences are usually clearly pointed out, and it matters little, therefore, under which category they are ranged—indeed, where intermediate forms occur there can be no question that this is the right course to pursue.

We cannot close this notice without recording our thanks to the Russian Government for the enlightened patronage bestowed upon this as upon several former valuable contributions to Natural Science, of which we have already spoken in this journal. When we consider the many important scientific works that have been carried on of late years under the patronage of the much vilified Governments of Russia and America, it is certainly humiliating to consider how little is to be obtained from our own "enlightened" authorities when such objects are in view, and how difficult it is to obtain that little.

XXXIX.—The Gare-fowl and its Historians.

(1.) Et Bidrag til Geirfuglens Naturhistorie og særligt til Kundskaben om dens tidligere Udbredningskreds. Af J. Jap. Sm. Steenstrup. Kjöbenhavn: 1857. (Naturh. Foren. Vidensk. Meddelelser. 1855. Nos. 3—7.)

(2.) Abstract of Mr. J. Wolley's Researches in Iceland respecting the Gare-fowl, or Great Auk (*Alca impennis, Linn.*). By Alfred Newton. The Ibis, 1861, pp. 374—399.

(3.) Ueber *Plautus impennis*, Bruenn. Von William Preyer. Journal für Ornithologie, 1862, pp. 110—124, 337—356.

(4.) Ueber das Aussterben der Thierarten in physiologischer und nicht physiologischer Hinsicht, &c. Von K. E. v. Baer. Bulletin de l'Academie Impériale de St. Pétersbourg. Tome VI. pp. 513—576.

(5.) Description of the Skeleton of the Great Auk, or Garfowl, (*Alca impennis, L.*) by Professor Owen. Transactions of the Zoological Society of London. Vol. V. pp. 317—335.

Some twenty years ago no one, except in a select circle of ornithologists, would have had the courage to utter the name of the Great Auk. It is ten to one that anybody in general society mentioning such a bird would have been taken for an aspirate-murdering cockney, and the subject of his remark supposed to be some large *Falconinæ*. Now-a-days this is all changed. *Alca impennis* has found its way into works of fiction, such as the *Water Babies*, and the *Travels of Umbra*, and has even penetrated into the columns of *Punch* and *The Times*, so that there are few persons of ordinary information who have not some notions of its nature and peculiarities. Yet, as we shall presently try to show our readers, the general knowledge concerning this singular bird is extremely defective, and we find even zoologists of the highest reputation making a curious succession of blunders when they treat of its history.

In Mr. Yarrell's account of this species—first published in December, 1842—it is properly enough termed, "a very rare British Bird," but no hint of its probable fate is conveyed to the reader, as indeed need not much be wondered at, for the exterminating process is generally one that excites little or no attention until the doom of the victim is sealed. Furthermore, as naturalists, almost without exception, had chosen, without the least good reason, to account *Alca impennis* an inhabitant of the very highest northern latitudes, and the regions of "thick-ribbed ice," it did not seem very extraordinary that, in the then desuetude of arctic exploration, no voyager had of late met with it. Besides, too, as we shall presently see, there was at that time a constant, though very limited, supply of specimens which kept dribbling one by one into the market, so that now it is not at all easy to say when people became alive to the fact that the bird, if not extinct, was gradually approaching the verge of complete destruction.

Perhaps, among our own countrymen, the alarm first spread when, in 1846, a gentleman much addicted to the fascinating pursuit of birds'-nesting went to Iceland, and found the idea there taken root, that an end had come to the whole race. Indeed, we happen to know that only a few years before this period less than thirty shillings was the price for which a specimen of the egg was sold by a London ornithologist, who never had the reputation of making a bad bargain, while, not many years later, we ourselves saw another knocked-down at public auction for as many pounds.*

It now seems to be the prevalent opinion that *Alca impennis* is entirely extinct. Whether this opinion be well founded or not is a matter we shall consider further on, as we propose, in noticing some monographical papers which have of late appeared in this country and others, to take a general survey of its history.

The first paper in our list, so modestly called a "Contribution" to the natural history of this bird, and bearing the honoured name of Professor Steenstrup, is, we think, the only complete treatise on the subject that may be entirely relied on, and it is greatly to be regretted that no translation of it has ever appeared in England. Herr Preyer's labours, extending over the same ground, are unfortunately not so trustworthy. Professor von Baer's paper is simply a German translation of the larger and more interesting portion of the Danish naturalist's essay, with the addition of only two or three original but unimportant remarks; the fact, however, of the Imperial Academy of St. Petersburg allowing a translation of it to appear in their *Bulletin* shows the high value attached to Professor Steen-

* It may be remarked that no reference to the impending fate of *Alca impennis* is made by an ornithologist so well informed as the late Hugh Strickland, though in his 'Dodo and its Kindred,' published in 1848, he mentions the Irish Elk and Northern Manatee as instances of species becoming extinct within the human epoch.

strup's researches. The other two papers we have named are, as their titles indicate, more special in their scope.

It has been already told by Sir John Lubbock, in the pages of this 'Review,' (1861, p. 497) how that remains of *Alca impennis* have been found in the kitchen-middens of Denmark. This discovery turned Professor Steenstrup's attention to the subject, and setting to work with much zeal, he, after long and careful investigation, compiled the admirable history of the bird we have mentioned. Of the information thus collected we intend to give as concise a summary as we are able, supplementing it by what we can draw from other sources, but we shall diverge somewhat from the Professor's arrangement of his matter. We take it for granted that our readers would not care to know precise details of every individual occurrence of the bird on record, except in the case of British specimens, though it is no vain boast on our part to say that we could give nearly all of them "chapter and verse," and as we have placed at the head of this article the titles of the five papers whence we derive most of our facts, we shall for brevity's sake only add references to those authorities of which no mention is therein made.

That *Alca impennis*, in pre-historic times, frequented the shallow firths and straits which then, still more than now, intersected Denmark, is proved by the discovery, to which allusion has been already made, of the bones of two individuals at Meilgaard in Jutland, and of a third at Havelse, in Zealand. When we reflect on the very small proportion which the number of preserved, and still less of recovered remains must bear to that of the lost ones, these facts are enough to justify the inference that the bird was not uncommon there in those days. But we need scarcely say that within the period of either tradition or of books, we have no record of its resorting to this district, and the only instance of its occurrence there, is that mentioned by Benicken, who says that one was shot in Kiel Harbour, about 1790. On the other side of the Cattegat, however, several examples have been met with. In Bohus län an old fisherman assured Professor Nilsson that in his youth he had seen the Gare-fowl on Tistlarna, while Dr. Œdman (the correspondent of our Pennant) wrote to the same naturalist, that at the end of the last century one was killed off Marstrand, and another is said to have been found dead, so lately as the winter of 1838, near Frederiksstad, in Norway. Elsewhere, in that country, there is no good testimony of its occurrence, for though Hans Ström positively identifies the

"*Angle mager*" (hook-maker) of the Sondmör fishermen, with Linnæus' description of *Alca impennis*, it seems more than probable that he has confounded that bird with the *Harelda glacialis* of modern naturalists, and the kind of evidence offered by other witnesses as to some supposed appearances of the Gare-fowl further to the north must be rejected, not merely as inconclusive, but when taken in connexion with our actual knowledge as highly improbable.

Turning now to our own island, we have an instance of what has of late happened several times, namely a discovery here of like nature to those already made in other countries. Last year (1864) in a kitchen-midden, on the coast of Caithness, the remains of at least two Gare-fowls were found, and it may, as in the case of Denmark, be fairly presumed from this circumstance, that in days of yore, the bird was not uncommonly met with on our northern shores, while its incapacity for flight, its size, and its sapidity, would of course render it a much sought prize for the men of the Stone period.

Historic records of its occurrence in the British isles, do not, however, date very far back. In Pinkerton's Collection of Voyages and Travels (vol. iii. p. 730), in an 'Account of Hirta [better known now-a-days as S. Kilda] and Rona, &c., by the Lord Register, Sir George M'Kenzie, of Tarbat,' the writer says of the former as follows:—"it is incredible what number of feed fowls frequent the rocks there. * * * There be many sorts of these fowls; some of them of strange shapes, among which there is one they call the gare-fowl, which is bigger than a goose, and hath eggs as big, almost, as those of an ostrich."*

For a man to think his own geese swans is nothing, but for his Gare-fowls to lay eggs almost as big as Ostriches', is a stretch of imagination indeed, for the worthy knight of Tarbert. However, his friend and brother knight, Sir Robert Sibbald, to whom this 'Account' was given, cuts it down laconically, and contents himself with enumerating, in 1684, in his 'Scotia Illustrata,' among the birds of North Britain:—

"Avis *Gare* dicta, Corvo Marino similis, Ovo maximo."

* Pinkerton gives us no clue to the date of this communication, or to the source whence he reprinted it. It was clearly, however, written prior to the next passage we quote.

On the 1st June, 1697, "M. Martin, Gent." landed on S. Kilda, where he resided three weeks, and in his naive description of the inhabitants of this island, feathered and featherless, remarks:—

"The Sea-Fowl are, first, *Gairfowl*, being the stateliest, as well as the largest Sort, and above the Size of a *Solan* Goose, of a black Colour, red about the Eyes, a large white Spot under each, a long broad Bill; it stands stately, its whole Body erected, its Wings short, flies not at all; lays its Egg upon the bare Rock, which if taken away, she lays no more for that Year; she is whole-footed, and has the hatching Spot upon her Breast, *i.e.* a bare Spot from which the Feathers have fallen off with the Heat in hatching; its Egg is twice as big as that of a *Solan* Goose, and is variously spotted, Black, Green, and Dark; it comes without Regard to any Wind, appears the first of *May*, and goes away about the middle of *June*."

Professor Steenstrup considers that this description of Martin's bears the mark of being that of an eye-witness. But to us the point seems not so certain. If he himself did see the Gare-fowl it was probably only from a distance, or he would surely have never imagined that the bird was "red about the Eyes." But, indeed, the matter is of little importance. He lived long enough upon the island to have obtained a very good account of it from the natives, and his evidence with regard to most other subjects which we are still in a position to test is extremely trust-worthy, more so probably than the next we have to quote. This is from the 'History of St. Kilda,' by Kenneth Macaulay, who, at the instance of the Christian Knowledge Society, passed the month of June 1758 upon the island. He certainly did not see a Gare-fowl, but he mentions it as "an absolute stranger I am apt to believe, in every other part of Scotland," and then goes on to say that "The St. Kildians do not receive an annual visit from this strange bird as from all the rest. It keeps at a distance from them, they know not where, for a course of years. From what land or ocean it makes its uncertain voyages to their isle is perhaps a mystery in nature. A gentleman, who had been in the West Indies,* informed me, that according to the description given of him, he must be the Penguin of that clime, a fowl that points out the proper soundings to seafaring People."

Whether the bird was even then beginning to show premonitory

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* It will of course be recollected that a hundred years ago the use of the term "West Indies" was not restricted to the Greater and Lesser Antilles.

symptoms of actual disappearance, or whether these assertions (so different from those of Martin sixty years before) are to be attributed to less accurate information on the part of Macaulay, we shall now never know.

In 1821 or 1822* Fleming accompanied Mr. Robert Stevenson in his annual voyage to inspect the northern lighthouses. The former writes:—

"When on the eve of our departure [18th August] from this island [Glass, more commonly known as Scalpa], we got on board a live specimen of the Great Auk (*Alca impennis*), which Mr. Maclellan, the tacksman of Glass, had captured some time before off St. Kilda. It was emaciated, and had the appearance of being sickly; but, in the course of a few days, it became sprightly, having been plentifully supplied with fresh fish, and permitted occasionally to sport [!] in the water, with a cord fastened to one of its legs, to prevent escape. Even in this state of restraint, it performed the motions of diving and swimming under water, with a rapidity that set all pursuit from a boat at defiance. A few white feathers were at this time making their appearance on the sides of its neck and throat, which increased considerably during the following week, and left no room to doubt, that, like its congeners, the blackness of the throat feathers of summer is exchanged for white, during the winter season."—(*Edinb. Phil. Journ.* vol. x. pp. 96, 97.)

And in his 'History of British Animals' (p. 130) he adds, "When fed in confinement it holds up its head, expressing its anxiety by shaking the head and neck, and uttering a gurgling noise." This example is said, by various authors of late, to have made its escape, but we are unable to discover the original source of the statement. Prof. William M'Gillivray, after referring to its capture off S. Kilda, declares that "Another was obtained there in 1829 by Mr. Murdoch M'Lellan, and presented to the late Mr. Stephenson (qu. Ste*v*enson ?) who intended it for the Edinburgh Museum; but it afterwards made its escape." We are inclined to think that some confusion has been made, and it is possible the alleged specimen of 1829 was in reality only that of 1821 or 1822.† Nothing more remains to us of the

* In the series of papers in the 'Edinburgh Philosophical Journal,' in which Fleming describes the voyage, the date 1821 is uniformly given, but in the same author's 'History of British Animals,' the following year is assigned. We have no means of determining which statement is correct, nor does it much matter.

† The assertion respecting the alleged S. Kilda bird of 1829 may have had its origin in the misunderstanding of a statement made by Dr. Edward Moore, who

Gare-fowl in this locality. Mr. John M'Gillivray, who visited the Outer Hebrides in 1840, was informed that the bird was by no means of uncommon occurrence about S. Kilda, but that none had been known to breed there for many years past, and that the "oldest inhabitant" only recollected the procuring of three or four examples.

In 1812, the enterprising Mr. Bullock went on a collecting expedition to the Orkney Islands, and according to the statement of Montagu, published the following year, he was told by the natives that "one male only had made his appearance for a long time, which had regularly visited Papa Westra for several years. The female (which the natives call the Queen of the Auks) was killed just before Mr. Bullock's arrival. The King, or male, Mr. Bullock had the pleasure of chasing, for several hours, in a six-oared boat, but without being able to kill him, for though he frequently got near him, so expert was the bird in its natural element, that it appeared impossible to shoot him. The rapidity with which he pursued his course under water, was almost incredible." (*Orn. Dict. Appendix.*) Latham adds to the story that the bird "was sufficiently familiar with the boatmen about those parts, but would not admit of his [Bullock's] coming, as a stranger, within gun-shot, though in their company, but afterwards suffering the boatmen, by themselves, to approach so near, as to knock it down with an oar." (*Gen. Hist. Birds*, vol. x. pp. 56, 57.) Bullock having left the island, the specimen was sent after him; and at the sale of his museum, 5th May, 1819, it was bought by Dr. Leach, for the sum of £15. 5*s* 6*d*, and deposited in the National Collection.* Another account furnished us by a relative of the lady who transmitted the bird to Bullock, states that one of the two which about this time frequented the "Auk Craig," on Papa Westra, was killed by some boys or lads with stones, and that it was not got at at the time, but sometime afterwards washed on shore. The excellent

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speaking (Charlesworth's Mag. N. H., i. p. 362) of a specimen procured in 1829, to which we shall presently refer, says: "Professor Jameson suggests that it might have been one which had been obtained by Mr. Stevenson in St. Kilda, and escaped from the light-house keeper of Pladda, about that time, on its way to Edinburgh. (See *Edinburgh New Philosophical Journal*, Oct. 1831.)" We cannot discover that Prof. Jameson ever published a line on the subject, certainly not in the number of the Journal to which reference is made.

* The British Museum, in 1856, obtained from the collection of Professor Van Lidth de Jeude a second example. This, though marked on its stand "Labrador," was procured from the Royal Museum, of Copenhagen, whither it was sent from Iceland subsequently to 1830.

condition of the specimen now in the "British Gallery" of the British Museum, leads us to suppose, independently of Latham's testimony, that if this story be correct, it refers to the female bird.

It is a proof of how little negative evidence may sometimes avail, that Low, who died in 1795, in his "Fauna Orcadensis," states (p. 107) that he has "often enquired about the *Great Auk* especially, but cannot find it is ever seen here." We may as well in this place briefly state what we know of other examples of the bird, taken on the shores of the seas which surround the British islands.

The statement made by Shepherd and Whitear, in the 'Linnean Transactions,' (vol. xv. p. 61), on the asserted authority of the late Sir William Hooker, as to one having been killed near Southwold, has been declared by Sir William himself (Ibis, 1861, p. 398, *note*) to have originated in error, and it is nearly certain that the reported capture, recorded by Fleming (Brit. Anim. p. 130), of one in such an extraordinary locality as Buckinghamshire, must have been equally a mistake. More probable, yet still requiring further proof, is the story (already alluded to) told by Dr. Edward Moore (Charlesworth's Mag. Nat. Hist. i. p. 361), from the information of a certain Mr. Gosling, of Leigham, that a specimen "was picked up dead near Lundy Island." But the best authenticated account is, that relating to the occurrence of a Gare-fowl, in May, 1834, at the entrance of Waterford Harbour; strange as some of the circumstances (related by Mr. Thompson, on Dr. Burkitt's authority) are,— "According to the captor, it was apparently almost starved. When in his yawl off the coast, he saw the auk swimming about near him, and held out some sprats, for which it came close to the boat. It was taken with little difficulty. He kept it for some days, feeding it chiefly with potatoes mashed in milk, which were partaken of greedily. After having the bird for ten days, he sold it to Mr. Davis, by whom it was sent to Mr. Gough of Horetown, county Wexford, where it lived about four months. For a considerable time, perhaps three weeks, it was not known to eat of anything at its new destination, but potatoes and milk were then forced down its throat, from which time it ate voraciously, until a day or two before its death. This auk stood very erect, and frequently stroked its head with its foot, especially when any favourite food was permitted. When in Mr. Gough's possession, it was chiefly fed on fish, of which fresh-water species (trout, &c.) were preferred to sea-fish: they were swallowed entire. It was rather fierce." (*Birds of Ireland*, vol. iii. p. 238.)

This specimen, when dead, passed into Dr. Burkitt's possession, and by him was liberally presented to the Museum of Trinity College, Dublin; where, the last time we saw it, it was carefully enshrined in the professorial sanctum, in company with Brian Boru's harp, and some other *palladia* of the sister island.

It was afterwards ascertained, Thompson tells us, that a second *Alca impennis* was procured on the same coast, about the same time as the one just noticed, but, falling into the hands of ignorant persons, it was not preserved; and he adds that he has very little doubt that two more were seen in Belfast Bay, in 1845—rather an important date as we shall see by-and-bye—by a fowler there, in whose accuracy of observation that deeply-regretted naturalist places much confidence.

If we have unpardonably intruded upon our reader's patience with all these details, we must cite as our excuse, that the most recent of the papers at the head of our article concludes by saying:—

"The more recent testimonies of the Garfowl, in the N. W. coasts of Scotland, may be seen in MACAULAY, 'History of Kilda,' 1764; and in SIBBALD, 'Scotia Illustrata,' 1684." ! !

Before proceeding to dwell upon the more northern and western localities for *Alca impennis*, we may as well mention here that it seems to have been met with in modern times not unfrequently on the French side of the English Channel. Degland, writing in 1849, and after, by the way, making the singular assertion that "il se trouvait en assez grande nombre il y a une quinzaine d'années aux Orcades; mais le ministre presbytérien dans le Mainland, en offrant une forte prime aux personnes qui lui apportaient cet oiseau, a éte la cause de sa destruction sur ces îles," (Orn. Eur. ii. p. 529), goes on to say that forty or fifty years ago three were killed near Cherbourg,* and quotes from M. Hardy's 'Catalogue des Oiseaux de la Seine-Inférieure,' that two have occurred in the month of April in as many different years near Dieppe. One was killed, the other found dead.

In the Færoes the "Gorfuglir"—as it was called—was formerly common. Sysselmand Müller, writing in 1862, thinks it was sixty

* One of these, Degland says, was in De Lamotte's collection. This is highly improbable, for the specimen in that collection, which now belongs to the town of Abbeville, like most of those at present existing in museums, was procured from Copenhagen.

years since the last was killed (Vid. Meddel. Nat. For. 2 ser. vol. iv. p. 58) there, but we believe one or more have been seen later, though the precise year is not to be ascertained. Olaf Worm, in 1655, describes how that he possessed three specimens of the bird, one of which he kept alive at Copenhagen for some months:—

"Ex Feroënsibus Insulis delata ad me erat avis, quam vivam domi per aliquot menses alui; junior erat, quia ad eam non pervenit magnitudinem, ut anserem communem mole superaret. Halecem integrum unâ vice deglutire valuit, & quandoque successive tres, antequam ingluviem expleret. Dorsi plumæ adeò molles & æquales, ut holosericeum nigrum æmularetur, venter eximio erat candore. Supra oculos aream rotundam, candidam, Daleri magnitudine habuit, et perspiciliis dotatam jurares (quod non animadvertit Clusius). Nec alæ eam obtinuere figuram, quam idem exprimit, latiores enim paulo erant, cum limbo albo. Quocirca meam avem ad vivum depingi curavi, ut Icon esset accuratior." (*Mus. Worm. p.* 300)

The figure indeed is sufficiently accurate, except that the artist has embellished its throat with a narrow white collar.*

Debes, whose 'Færoa Reserata' was published in 1673, merely mentions the "Garfogel" as occurring in these islands, adding that he had several times had them, that they were easily tamed, but would not live long inland (p. 130). Mohr, a Færoese by birth, in 1786, speaks of some being caught there most summers (*Forsœg Isl. Naturhist.* p. 28). Landt in his 'Beskrivelse over Færœerne' in 1800, states that the "Gaarfuglur" was then beginning to become rare there (p. 254). Graba, who voyaged thither in 1828 prematurely thought it was extinct, and declared that most of the natives did not even know the bird by name, though some old people believed they had formerly seen it at Westmannshavn, and one man, lately dead, told him he had there killed with a stick an old one as it sat on its egg (*Reise nach Färö*, pp. 198, 199). When Professor Steenstrup visited the islands, he saw, as he now tells us, the head of a bird preserved upon one of them. In 1849, Wolley (Contrib. Orn. 1850, p. 115) was told by an old man that he had seen one sitting on the

* It may be remarked that Worm, who rightly enough identifies the species with the *Anser Magellanicus* of Clusius, makes the mistake of assigning the name "*Geir-fugl* Islandorum," to the "*Merganser*" of Gesner, which, as the description and Gesner's figure show is the *Mergus merganser* of modern authors. There is small blame to Clusius for confounding *Alca impennis* with the *Spheniscidæ*, as some few naturalists even now-a-days refuse to the latter the distinction of a family.

low rocks fifty years before, at which time, undoubtedly, it was very rare.

With regard to Iceland, we need not go so fully into details as we have hitherto done, for the researches into the Gare-fowl's history carried on in that island by Wolley, have been very recently laid before English readers in one of the papers quoted at the head of this article. But it will be well to point out some of the discrepancies between the statements therein made, and those contained in M. Preyer's treatise, for as this gentleman was in Iceland since Wolley's visit, it might perhaps be supposed otherwise that the information he furnishes is founded on better authority, as it is of later date. The reverse is the case. M. Preyer seems to have had his time fully occupied with other matters during his stay in Iceland, while Wolley's voyage was undertaken with the sole purpose of ascertaining the fate of this species, and of hunting up traditions respecting it; so, that while the former was apparently content with obtaining such information as he could from persons in Reykjavík, who had never visited its haunts, the latter was living for two months at the miserable fishing-village whence all the later Gare-fowling expeditions had started, pertinaciously and laboriously examining, cross-examining, and re-examining every survivor who had taken part in them. It is also the fact that M. Preyer's principal informant was the same merchant who gave Wolley a statement containing some "details which are certainly inaccurate." Thus then not the slightest credence should be given to the assertion that Karlsklippe was formerly an abiding-place of the Gare-fowl. It is a little stack of rock, nearly perpendicular on every side, situated hardly more than a stone's throw from Cape Reykjanes, and were it not that the shopkeepers of Reykjavík are as imperfectly acquainted with the minute topography of their coasts as the citizens of London are with that of the Nore, it could hardly be thought possible for any man in his senses to ascribe such an abode to the bird. M. Preyer also shows but little knowledge of the remarkable skerries which run out from Reykjanes. The rock known as Kerling, or more properly Kelling, is part of the mainland, and not an island at all. Karl, as we have already said, is only just separated from the land, and is never counted by sea-faring Icelanders as one of the Fowl-skerries; while it is Geirfugladrángr and not Eldeyjardrángr (a little insignificant islet, over which the waves break) which lies the furthest to seaward. In addition to these manifest inaccuracies, we have also very great misgivings as to the existence of M. Preyer's "Geirfuglaskér IV."—off the Breidamerkursandr—which is not laid down upon any chart of Iceland that we have seen, and we are strengthened in our suspicion by Professor Steenstrup's suggestion (pp. 115, 116), which has been overlooked by M. Preyer, that the statement of Olafsen —who alone mentions it—originated in a mistaken notion as to the true position of the skerry off Breiddalsvík, the "Geirfuglaskér III." of M. Preyer. This last locality, about the existence of which Professor Steenstrup, when he wrote could get no confirmation, was circumnavigated in 1858 by a young Icelander, whom Wolley despatched for that purpose.

The sum of the ascertained particulars of the Gare-fowl in Iceland is this.—Off the coasts of that island there were three skerries, each known by the name of 'Geirfuglaskér,' on all of which we may presume that it formerly bred. The first of these lying to the South-East, was probably rendered desolate many years ago, no tradition of its having been occupied by the bird now existing among the natives of the opposite shore. From the second, one of the Vestmanneyjar, the Gare-fowl has apparently been long driven. Though traditions of the bird lasted until a generation ago, it may be inferred with justice, even about the year 1800 to have become very rare there. The last and best known Gare-fowl-skerry, lying off Reykjanes was on clear evidence exceedingly productive of these birds for some part of the last century. In 1732, expeditions to this islet, which had been discontinued for twenty-five years, were resumed, and kept up for several seasons, till from some cause or other they again fell into disuse about 1760. In 1813, the crew of a Færoese vessel, becalmed near the skerry, made a descent upon it, and slaughtered a large number of Gare-fowls. At the end of June, 1821, Faber, the well known Faunist of Iceland, set out for the rock with some companions, one of whom, Count F. C. Raben, a Dane, landed upon it, but whether the birds had already completed their season's work or what, it is certain that no examples of *Alca impennis* were seen. Yet this very same year two birds were shot on the shore of the mainland (as others had often been before) not very far off, so that the breed was still existing on this station. In the spring of 1830, a submarine eruption took place off Reykjanes, during which the skerry completely sank under water, and, immediately after, a colony of Gare-fowls was discovered on another rock lying nearer the mainland. and known as Eldey. In the course of the next fourteen years, their numbers annually dwindling, probably not less than sixty of these birds were killed on the newly selected locality, and it is from this source that nearly all the specimens of skins and eggs of the species now exhibited in various collections were derived.* The very last captured (two in number) were taken alive, at the beginning of June, 1844. They were sent to the Royal Museum, at Copenhagen, and preparations of their bodies may be seen preserved in spirit in that city.

Of other localities in the island at which the bird has casually occurred, we may mention Látrabjarg, where, in 1814, seven were killed, and according to M. Preyer, about the time of the eruption in the sea off Reykjanes, of which we have spoken, some twenty were killed on Grimsey, an island on the north of Iceland, which is just cut by the Arctic Circle. Further confirmation of this story would be very desirable, as Mr. Proctor, a most trust-worthy authority, who was weather-bound for several weeks on that wretched spot, in 1837, when there would, of course, have seen many eye-witnesses of such a fact still living, seems never to have heard of it. It is far, however, from being improbable that the birds which formerly dwelt upon the now submerged Reykjanes Geirfuglasker, would on its destruction betake themselves to other quarters, and it is not likely they all went to Eldey. Some venturesome individuals in seeking for a home may have wandered to a place so distant as Grimsey, but it is clearly more probable that the bulk of them would resort to the Geirfugladrángr—about the same distance as Eldey is from their sunken rock—and there, if any where in the *northern* seas, we believe their successors may still be leading a peaceful existence, for the dangerous surf which breaks upon that lone islet, coupled with its distance from the mainland, has hitherto prevented any Icelander from setting foot upon it. Reports have more than once reached Europe of the discovery of some new haunt of the Gare-fowl—one such is nearly the sole original remark appended by Professor Von Baer to his paper, but hitherto none have been true. That the islet we have named will be reached at last there can be no doubt, and then—we shall see what we shall see.

Greenland is the next quarter to which we must invite our

* With but very few exceptions they were sent by the Icelandic merchants, who instigated the fowling expeditions, either to Copenhagen or to Hamburg, and thence distributed in the ordinary course of trade.

reader's attention, and here, though their hopes may often have led them to think otherwise, we can assure them they will find no land of promise. Since the beginning of the fifteenth century, when the Danish colonies on the east coast of Greenland are supposed to have been shut off from the mother-country, by a remarkable change in the configuration of the polar ice (Scoresby, *Arctic Regions*, i. pp. 262, 263), that part of the world has been seldom visited, but on every occasion save one—the exceptional year, when Scoresby made his remarkable survey of the portion extending northward from lat. 69° N.—this coast has been found blockaded by ice, so that even now, between lat. 65° N. and the southern limits of Scoresby's exploration, it remains on our charts a complete blank. M. Preyer has disinterred, from the collection of records published in 1838, and known as 'Grönlands Historiske Mindesmærker' (vol. i. pp. 123-134), the interesting fact that somewhere about the year 1574, an Icelander, hight Látra Clemens, visited certain islands then called Gunnbjörnsskjærene, and since identified with Danell's or Graah's Islands, laying in lat. 65° 20′ N., whereon he found so many Gare-fowls, that he loaded one of his boats with them. This is the only information, we believe, on record, that the bird ever occurred on the east coast of Greenland. On the west coast it has certainly never been known otherwise than as an occasional straggler. Brünnich, in 1764, makes no mention of its being found in Greenland; and Fabricius, in 1780, while giving us its Eskimaux name 'Isarokitsok' (little wings), states that it is "raro ad insulas extremas visa, et quidem tempore brumali," adding "veteres rarissimi." During the present century, one, which is now in the University Museum, at Copenhagen, is said to have been killed on Diskö, in 1821, but it is possible that it may have been captured some years earlier, at Fiskernæs, and, says Professor Reinhardt (Ibis, 1861, p. 15), "the accounts of other instances, in which the bird is said to have been obtained in Greenland, are hardly to be confided in."

But one more locality for *Alca impennis* remains to be mentioned. It is, however, one of the most important for our consideration; not only because we have numerous notices of it in the very words of the ancient mariners who visited it, but also because we can gather from these notices a very good idea of what was probably the state of things as regards the Gare-fowl in parts of our own and neighbouring countries in the pre-historic ages. Professor Steenstrup has the merit of being the first naturalist who has collated these early and interesting accounts of the wonderful abundance of the 'Penguin' (as this bird seems always to have been called on the western side of the Atlantic) in the sea about Newfoundland. We have only room here to cite a few of the most important of these notices. Sebastian Cabot, who is usually considered to have been the first discoverer of North America, sighted land, which he called 'Prima-vista,' on S. John's day, 1497. This land, it seems, was part of Newfoundland, but we find no mention of the particular object of our inquiries for the next forty years. Then as we learn from the account given by Hakluyt (vol. iii. p. 168) of "The Voyage of M. Hore and diuers other gentlemen, to Newfoundland, and Cape Briton, in the yeere 1536," it is stated that:—

"From the time of their setting out from Grauesend, they were very long at sea, to witte, aboue two moneths, and neuer touched any land vntill they came to part of the West Indies about Cape Briton, shaping their course thence Northeastwardes, vntil they came to the Island of Penguin, which is very full of rockes and stones, whereon they went and found it full of great foules white and gray, as big as geese, and they saw infinite numbers of their egges. They draue a great number of the foules into their boates vpon their sayles, and tooke up many of their egges, the foules they flead and their skinnes were very like hony combes full of holes being flead off: they dressed and eate them and found them to be very good and nourishing meat."

About another forty years, and the same authority (vol. iii. pp. 172, 173) furnishes us with "A letter written to M. Richard Hakluyt of the middle Temple, containing a report of the true state and commodities of Newfoundland, by M. Anthonie Parkhurst Gentleman," dated "From Bristow, the 13th of Nouember, 1578," in which is this passage:—

"There are Sea Guls, Murres, Duckes, wild Geese, and many other kind of birdes store, too long to write, especially at one Island named Penguin, where wee may driue them on a planke into our ship as many as shall lade her. These birds are also called Penguins, and cannot flie, there is more meate in one of these then in a goose: the Frenchmen that fish neere the grand baie, doe bring small store of flesh with them, but victuall themselues alwayes with these birdes."

Again, from Hakluyt (vol. iii. p. 191) we have in "A report of the voyage and successe thereof, attempted in the yeere of our Lord

1583 by Sir Humfrey Gilbert knight, &c., written by M. Edward Haies gentleman, &c."—

"We had sight of an Iland named Penguin, of a foule there breeding in abundance, almost incredible, which cannot flie, their wings not being able to carry their body, being very large (not much lesse then a goose) and exceeding fat: which the French men vse to take without difficulty vpon that Iland, and to barrell them vp with salt. But for lingering of time we had made vs there the like prouision."

This report of the French practice just mentioned, is confirmed in a singular manner by many other records which Professor Steenstrup cites, among others by the narrative of Jacques Cartier's Third Voyage, in 1540. The account is also printed in Ternaux-Compans' 'Archives' (vol. i. pp. 125, 126), but it does not seem to us quite certain that the "Apponath"* may not have been some other species of *Alcidæ*. After speaking of the incredible abundance of birds at the so-called "Isle des Oyseaux," near Cape Bonavista, the writer goes on to observe, "neantmoins il y en a cent fois plus à l'entour d'icelle, et en l'air que dedans, desquels les vns sont grands comme pies, noirs & blancs, ayans le bec de corbeau: ilz sont tousiours en mer, et ne peuvent voler haut, d'autant que leurs ailes sont petites, point plus grandes que la moitié de la main, avec lesquelles toutefois ilz volent auec telle vistesse à fleur d'eau, que les autres oyseaux en l'air. Ilz sont excessiuement gras, et estoient appellez par c'eux du païs *Apponath*, desquelz noz deux barques se chargerent en moins de demiheure, comme l'on auroit peu faire de cailloux, de sorte qu'en chasque nauire nous en fismes saler quatre ou cinq tonneaux, sans ceux que nous mangeasmes frais."

It would be easy to continue the series of similar accounts, which as we have said Professor Steenstrup has collected and reprinted with singular industry. One of them speaking of the birds says, it "n'estoit question que d'entrer en terre, et les toucher deuant soy aux basteaux, ainsi que moutons à la boucherie, pour les faire entrer;" another, "il y en a de certaines especes qui ne peuuent presque voler, et qu'on peut aisement assommer à coups de bastons, comme auoient faict les Mattelots d'un autre nauire, quis auant nous en auaient emply leur chalouppe, plusieurs tonneaux des œufs, qu'ils trouuerent

* This word is also spelled "Aponars," and Professor Steenstrup suggests that it is a French corruption of "Harpooner."

aux nids." We think we have brought forward enough to show that no species could long withstand the continuance of so murderous a persecution, carried on too at the very season of reproduction. It is therefore far from being surprising that Anspach, writing in 1819 (Hist. Newfoundland, p. 393), should speak, as do all the authors who have succeeded him on the same subject, of the "Penguin" as extirpated in this quarter. Sir Richard Bonnycastle (Newfoundland in 1842, vol. i. p. 232, *note*) quotes a singular passage from the "English Pilot," for 1794—a work we ourselves have not been able to examine. Our readers will, of course, smile at the asserted an-homochroism of the bird's eye-spots.—

"There is also another thing to be taken notice of in treating of this coast, that you may know this [bank] by the great quantities of fowls upon the bank—namely, shearwaters, willocks, noddies, gulls, penguins, &c, without making any exceptions; which is a mistake, for I have seen all these fowls a hundred leagues off this bank, the penguins excepted." [This peculiarity of *Alca impennis* is constantly mentioned by writers of the last century; witness Macaulay in a paper we have already quoted, Edwards, and Pennant.] "It is true that all these fowls are seen there in great quantities, but none are so much to be minded as the penguins, for these never go without the bank, as others do, for they are always on it or within it, several of them together; sometimes more, sometimes less, but never less than two together; they are large fowls, about the bigness of a goose, a coal-black head and back, with a white belly, and a milk white spot under one of their eyes, which nature has ordered to be under the right eye—an extraordinary mark. For my part, I never saw any with such a spot under their left eye. These birds never fly, for their wings are very short and most like the fins of fish, having nothing upon them but a sort of down and short feathers."

It is worthy of remark that Sir Richard ascribes the extermination of the Newfoundland "Penguin" to "the ruthless trade in its eggs and skin."*

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* We imagine it was from this quarter that the matchless series of *ten* eggs, recognized a few years ago, by Mr. A. Newton, in the Museum of the Royal College of Surgeons, must have come. All that is known of them is that they were found, a short time prior to their recognition, by the late curator, Mr. Stewart, in a box bearing the words, "Penguins' eggs—Dr. Dick." When or how they came into the possession of the establishment there is no record. The fact, however, of the

Singular testimony to the truth of the extracts above given respecting the former annual massacres of this bird in the Newfoundland seas has been afforded. In 1841, a young Norwegian naturalist, Peter Stuvitz by name, was commissioned by his Government to inquire into the state of the cod-fisheries in that part of the world, with the view of obtaining information that might be beneficial to the same important branch of industry carried on off the coast of Norway. In the course of his investigations he heard frequent mention made by those he questioned of the former existence in immense multitudes of a bird which they termed a "Penguin," and in his report he alluded to this fact. The authorities at home were puzzled by the statement, believing that Penguins were only limited to the southern hemisphere, and expressed themselves to that effect. Stuvitz feeling his credit for the assertion at stake, made a point of visiting the Funk Islands, a small cluster of rocks lying off the entrance of Bonavista Bay, and there found, as he had been led to expect he should find, the remains of rude stone enclosures—'pounds,' as the fishermen called them—into which the hapless victims had of old time been driven by their persecutors, and heaps of the so-called "Penguins'" bones. Some of the latter he sent to Christiania, where they were speedily recognized as belonging to *Alca impennis*, and a solution of the mystery was thus arrived at. In 1863, a Yankee speculator obtained from the Colonial Government leave to deport the soil from these rocks, which he sent to Boston to be used as manure for agricultural purposes, and we read (P. Z. S., 1863, p. 437) that this has now been effectually done. In the process of removing the half-frozen mould, not only many bones of the species were disinterred, but at some depth beneath the surface, were several natural mummies of the bird, preserved, partly by the antiseptic property of the peat, and partly by the icy sub-soil. Two of these mummies were fortunately obtained by the Bishop of Newfoundland, who had been made aware by a gentleman in this country of the interest

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name "Penguin" being applied to them is sufficient to suggest their transatlantic origin, for on this side of the water the term never seems to have been used to designate the *Alca impennis*. Perhaps some of our readers may be able to throw light on the subject by informing us who this Dr. Dick could have been, and at what period he flourished. We cannot refrain in this place from expressing our regret that the authorities of the Royal College, have lately thought fit to disperse this unrivalled collection of specimens without having previously had models or photographs taken of them.

such specimens possessed, and they have been transmitted to England. The first which arrived formed the subject of Prof. Owen's memoir, the title of which we quote at the head of this article; the second, mounted as a skeleton, is now deposited in the national collection, and except an example in the Osteological gallery of the Jardin des Plantes, is the only one to be seen in any public Museum in Europe.

We have no space to enter into details respecting the bony structure of this bird. Our readers will find it admirably described in Prof. Owen's paper, and it is only when that distinguished osteologist comes to take a comparative view of the skeletons of *Alca impennis* and its real or reputed allies, that we feel called upon to protest against the necessity (as it has seemed to the author) for his showing at length that the *Alcidæ* have no intimate connection at all with the *Spheniscidæ*. Such a notion, if we are not mistaken, has for some years been given up by all ornithologists, except a few who are wedded to obsolete ideas of classification, and whose opinions will certainly gain no new supporters. It seems to us, indeed, that the resemblance between the Auks and the true Penguins is merely one of analogy, just such as obtains between the Swallows and the Swifts, the two groups having little in common except certain habits, and their structure, both internal and external, being as widely different. Nevertheless, it is, we acknowledge, extremely satisfactory to find this view of the case supported by an authority so high as that of Prof. Owen. We must also complain that the plates which illustrate this valuable memoir, are extremely meagre and inartistic, if we may use the term to mean that the art displayed fails to give an accurate idea of the originals. They make us long for the time when Mr. Ford's services will be again at the disposal of osteologists, or for a worthy rival of that unsurpassed delineator of bones to spring up. An outline conveying such a mistaken impression as that of fig. 3, in Plate 52, is worse than no figure at all, and we trust the draughtsman may never again have the opportunity of marring the deservedly great reputation which the plates in the 'Transactions' of the Zoological Society have ever enjoyed. Further, without being considered captious, we hope we may be allowed to express our inability to comprehend the principle on which the various subjects pourtrayed have been selected. We cannot imagine (and Prof. Owen's letterpress conveys to us no friendly hint on this point) why the osteology of so very abnormal an *Alcine* form as *Uria grylle* should alone have been chosen to illustrate that of *Alca impennis.* Moreover considering that the most remarkable feature of the latter is its want of the power of flight, we surely might have expected to find detailed figures of the wing-extremities, for a knowledge of which we are left to the general and confused view of the entire skeleton, represented in an attitude that could never have been assumed by the bird when alive.

And now as to the possibility of the bird's present existence. We have already stated our opinion that the Geirfugladrángr off the coast of Iceland, may still shelter the descendants of part of the old stock from the Geirfuglaskér, and if we are not misinformed there are rumours, which are more than vague, of the Gare-fowl having been seen in those seas since 1844, when the last two known with certainty to have been killed met their death on Eldey. There is also, the supposed Irish apparition of the bird in 1845, in which Mr. Thompson of Belfast certainly had much confidence, and another recorded observation in 1852 on the banks of Newfoundland, (Ibis, 1861, p. 397,) by Col. Drummond-Hay, assuredly not an inexperienced and imaginative, but a practical and veteran ornithologist, besides a more definite report that a dead specimen was picked up the following year in Trinity Bay. This evidence would point to a *locus* for the species (independently of the presumptive Icelandic colony) existing in more western waters, and to such a spot we are also led by a remark of Audubon's :—

"When I was in Labrador, many of the fishermen assured me that the 'Penguin,' as they name this bird, builds on a low rocky island to the south-east of Newfoundland, where they destroy great numbers of the young for bait; but as this intelligence came to me when the season was too far advanced, I had no opportunity of ascertaining its accuracy. In Newfoundland, however, I received similar information from several individuals." (Orn. Biogr. vol. iv. p. 316.)

Audubon, we admit, is a very untrustworthy authority, but we are assured by a friend who has lately visited Newfoundland, that the belief still exists as in 1833, when Audubon was there, and there can be little doubt that it refers to the Virgin Rocks, which lie near the edge of, and about midway on, the north-west side of the Great Bank. These rocks are carefully shunned by all the transatlantic-plying steamers, which usually make Cape Race for the express purpose, if we are not misinformed, of avoiding them. But it would be easy to test the truth of the story, and we hope before long some one may have the enterprise to do so. We must remark that the fact of the bird not being met with oftener is really no valid objection to our theory that it does still exist, when we reflect that, of the millions of the allied species which every summer resort to the "bird-cliffs" of the north to breed, an almost infinitesimally small proportion is ever seen at any other period of the year, even by those who occupy their business among the great waters. We do not attempt to explain the why and the wherefore of this—perhaps as our knowledge of the peculiarities of the Mid-Atlantic increases, we may be better able to give a satisfactory account of the fact—but so it is. In former days, when "Penguins" were abundant about Newfoundland, they seem to have passed southward along the coast in winter, and thus we find Catesby, in the early part of last century (*Hist. Carol.* App. p. xxxvi.) including the species as an occasional visitor at that season to the shores of Carolina, but we can well imagine a settlement of, at most, some few hundreds existing for years on such spots as the Geirfugladrangr or the Virgin Rocks, without even a straggler coming across the path of the few seafaring men who would appreciate the value of the meeting. This belief we confess to fondly cherishing—we cannot yet bring ourselves to address our old friend the Great Auk, in the tender words of Milton:—

> "Aye me! whilst thee the shores and sounding seas
> Wash far away, where'er thy bones are hurl'd,
> Whether beyond the stormy Hebrides,
> Where thou perhaps, under the whelming tide,
> Visit'st the bottom of the monstrous world."

Whether however the species be extinct or not, the fate of the Gare-fowl has still much interest. If it still exists, its doom will probably be sealed by its re-discovery. For all practical purposes, therefore, we may speak of it as a thing of the past, and regarded in this light the subject becomes even more than interesting, because owing to the recent date of the bird's extirpation (whether completed or not), we possess much more information respecting the exterminating process, than we do in the case of any other extinct species. Without drawing any overstrained inferences, we see how the merciless hand of man, armed perhaps, only with the rudest of weapons, has driven the Gare-fowl, first from the shores of Denmark, and then from those of Scotland. At a later period it has been successively banished from the Orkneys, the Færoes and S. Kilda.

Then too, a casual but natural event has accelerated its fate. The eruption of a submarine volcano on the coast of Iceland by laying low one of its chief abodes has contributed effectually to its destruction. But worse than all this has been the blow which on the discovery of America came upon the portion of the race inhabiting the Newfoundland islets, when it was brought suddenly face to face with a powerful and hitherto unknown enemy, and where the result has been what invariably happens, when a simple tribe of savages used only to the primeval customs of its forefathers is all at once confronted with invaders of the highest type of civilization—"The place thereof knoweth it no more."*

In conclusion, we have to say, that we have left several collateral branches of our subject—'The Gare-fowl and its Historians'—quite untouched. Some of them are very interesting—especially that of the etymology of the various names applied to *Alca impennis*, which has perhaps more bearing on biology, than our readers might at first be inclined to think—but we feel that enough has been said for the present. Let us only submit that we are far from having exhausted our theme.

XL.—Zoological Museums.

(1.) Return to an Order of the Hon. the House of Commons for Accounts of the Income and Expenditure of the British Museum for the Financial Year ended the 31st day of March, 1865, &c. together with a Statement of the Progress made in the Arrangement of the Collections, and an Account of the Objects added to them in the Year 1864.

(2.) A Letter to the Trustees of the British Museum on the Condition of the National Collection of Invertebrata. By Philocosmos. London, Hardwicke, 1865.

(3.) Rapport Adressé a son Exc. le Ministre de l'Instruction Publique, par la Commission Instituée en Execution du decret du

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* The number of existing specimens of *Alca impennis*, has by some writers been greatly underrated. Of stuffed skins it is stated there are 63 or 64, of eggs at least 59, (Ann. Nat. Hist. 3d. ser., vol. xiv. p. 393). Of osteological specimens in addition to those mentioned in the text, there are only a few bones in the Royal College of Surgeons.

29th Dec. 1863, pour l'Inspection du materiel du Museum d' Histoire Naturelle. Paris, 1865.

(4.) Annual Report of the Trustees of the Museum of Comparative Zoology at Harvard College, in Cambridge, together with the Report of the Director, 1864. Boston, U. S. A. 1865.

(5.) Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution for the Year 1863. Washington, 1864.

(6.) Museum d'Histoire Naturelle des Pays-Bas. Revue Méthodique et Critique des Collections deposées dans cet etablissement. Leyde, 1862-4. Parts 1—6.

As regards the progress of Zoological Science nothing can be of greater importance than the welfare of the great public Museums which every civilized nation in some form or other maintains within its dominions. It is to these institutions, and to those that are employed in them, that we must chiefly look for aid in extending our present imperfect acquaintance with the numerous and varied forms of the Animal Kingdom. Great as the benefits are which have been conferred on Zoology by amateurs and private collections, there can be no doubt that it is of far greater importance to the advance of science to keep our great public Museums and their staffs in an efficient state, than to give any amount of encouragement to the exertions of individual Naturalists. There can be no question therefore of the interest which attaches itself to the publications, of which the titles are given above. They supply us with information as to the present state of some of the most important public collections of Europe and America, and as such are eminently worthy of our readers' attention.

We begin then by taking up the document annually presented to Parliament by the Trustees of the "British Museum," which, besides the accounts of the income and expenditure of that establishment for the past year, with which we will not now trouble ourselves, contains reports from the officers of the different departments as to the "progress made in the cataloguing and arrangement, and an account of objects added, in the year 1864." Before noticing them severally, we may remark that a person unacquainted with the peculiar *regime* prevailing in the British Museum, would be rather puzzled at finding, first of all, a general Report headed "Departments of Natural History," signed by Professor Owen, and following it four other reports on the different "Departments" of "Zoology," "Geology," "Mineralogy," and "Botany," signed by Dr. Gray, Mr. Waterhouse, Mr. Story-Maskelyne, and Mr. Bennett respectively. Some indication, we think, should be given that these four "departments" together make up the general "Department of Natural History," of which Professor Owen has the superintendence.* As has been the case in former years, Professor Owen's chief theme all through his present Report is want of space. This, as most of our readers well know, has been the standing complaint in Bloomsbury for a long period. As we have pointed out in our last year's volume,† the Government will do nothing to remedy it, so long as the collections remain in their present situation. And, although the shortness of the last Parliamentary Session, together with the incompleteness of the negotiations with the Trustees, have again prevented the removal to Kensington from being carried out during the present year, there can be no doubt that the scheme will be brought before Parliament again upon their next assembly. So that we may now fairly look forward to a nearly approaching period when this long continued evil will be obviated by the transfer of the Natural History collections to a new locality, where ample space is available for their reception, and where they will form the nucleus of a new institution, freed, we trust, from many of the disadvantages to which they are at present subject.

Referring to Professor Owen's Report, we find that the total number of additions to the Departments of Natural History during the year 1864 was 12,973, and that the whole of the series under his superintendence was generally in a good state of preservation. The most noticeable acquisition of the Zoological Department during the year is stated to have been the collection made by Mr. Tristram's expedition to Palestine, concerning which the following remarks are given :—

'The "*arnereth*, which cheweth the cud and divideth not the hoof," rendered "hare" in our version of Deuteronomy xiv. 7, and Leviticus xi. 6, is represented in this collection by the *Lepus Syriacus*.

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* This is, we suppose, the case. But Professor Owen's General Report does not contain a word about "Botany," and the paragraph on the number of additions (p. 23), would seem to indicate that "Botany" is *not* part of "Natural History!"

† Nat. Hist. Rev. 1864, p. 343.

The "*shāphān*, which make their houses in rocks," rendered "coney" in Proverbs xxx. 26, Psalm civ. 18, and elsewhere, is exemplified by the *Hyrax Syriacus*. The "*Achbâr*," rendered "mouse" in Leviticus xi. 29, may refer to the species of *Arvicola*, or *Gerbillus*, or *Acomys*, as well as *Mus*, in Mr. Tristram's collection. The specimens of *Ibex* and *Gazella* are probably the species alluded to under the names "*tzaphir*," Daniel viii. 21, *Yehel*, Job xxxix. 1, and "*ez*," Genesis xv. 9, and rendered "*chamois*" in Deuteronomy xvi. 5, and elsewhere. Of the *hâtalleph*, rendered "bats" in Deuteronomy xiv. 18, and Isaiah ii. 20, the collection includes species of *Rhinopoma*, *Rhinolophus*, *Noctulinia*, *Vespertilio*, and *Plecotus*. It contains also a specimen of Syrian badger, although it is doubtful whether the "*tachash*" is rightly so rendered in Exodus and Numbers. The "*dugong*" (*Halichore Hemprichii* of the Red Sea), which more probably supplied the covering of the Tabernacle, is still a desideratum. The species of *Genetta*, *Herpestes*, and other small Carnivores brought from Palestine by Mr. Tristram, are indicated by the term "*Hholed*," or *Chôled*, in the Hebrew Scriptures, usually rendered "weasel" in the authorised version, Leviticus xi. 29. The "*tanshemeth*," or "mole," may have referred to the species of *Spalax* in the present collection, in which there is no true *Talpa*. The specimens of *Testude Græca*, and of *Emys Caspica*, which Mr. Tristram has shown to range to the Holy Land, exemplify the forms to which reference is made by the Hebrew "*tzav*," or "*tsab*," rendered "tortoise after his kind," in Leviticus xi. 29. The brief notices of the serpents in the Old Testament preclude a determination of their species; but the number of these, including three or more poisonous kinds, collected in Palestine by Mr. Tristram, accords with the references to such by diverse names, as *e.g.* "*nahash*" and "*shephiphon*," respectively rendered "serpent" and "adder," in Genesis xlix. 17; the poison of the "*nâchâsh*" and "*pethen*," rendered "serpent" and "adder," in Psalm lviii. 4; the species "which stingeth like an adder," "*ephah*" and "*tzepha*," Proverbs xxiii. 32; the serpent whose bite inflames, "*saraph*," rendered "fiery serpent" in Numbers xxi. 5.'

In the Geological Department Professor Owen calls especial attention to the collection of fossil remains and implements from the cave of Bruniquel, in Southern France, which were acquired by the Trustees in the spring of last year, as a "special purchase" for the sum of £1000., after having been visited and reported upon by Professor Owen. This collection is spoken of as follows:—

"Amongst the additions to the Department of Geology, the most interesting in relation to questions as to the antiquity of man, and the cranial and dental characters of primitive races, are the partly petrified remains of the men who inhabited the Limestone caverns of the South of France, at the period when chamois, bouquetin, wild horse, reindeer, the great extinct ox, &c. existed, and especially the reindeer abounded in that part of Europe; and at a period when, the use of metals being unknown, the primitive implements were chipped flints, by means of which divers weapons, and instruments, including needles, were manufactured from the bones and antlers of the beasts captured and killed for food. On some of these bone-instruments the reindeer and horse had been delineated in outline, with much truth and spirit, and these are probably among the earliest examples of the graphic art.

"The value of this series of human remains, discovered at Bruniquel by the Vicomte de Lastic in 1863, depends upon the care and accuracy with which every material fact as to 'matrix,' 'position,' 'chemical condition,' &c., of the crania was ascertained, on which a conclusion as to their contemporaneity with the remains of the extinct animals could be satisfactorily arrived at.

"To this end the cavern was visited by the reporter in January and February 1864, the human remains were inspected, and others were then exposed *in situ*, and one almost entire cranium was removed, and transferred to the British Museum, with the large mass of breccia, detached at a depth of four feet from the stalagmitic floor of the cavern, and exhibiting with other human remains and numerous implements, conditions of imbedding, identical with those of the bones and teeth of the *Cervus tarandus* and *Bos primigenius*."

Dr. Gray, whose special report on the Zoological Department stands next on the list, tells us that no less than 7628 specimens of animals of different classes, have been added to the Museum during the year 1864, each of which has been duly registered, and either arranged for exhibition, or stowed away, so that it may be referred to if required.

The following Catalogues of parts of the Zoological series have been published during the year:—

Catalogue of the Coleopterous Insects of the Canaries, by T. V. Wollaston, F.L.S.

Catalogue of Lepidoptera, Heterocera. Parts 29 and 30, by Francis Walker, F.L.S.

Catalogue of Fishes, Vol. V., by Dr. Günther.

Whilst on the subject of these very acceptable additions to the well-known series of Catalogues of our National Zoological collection, which have rendered such assistance to the students of Nature all over the world, we cannot avoid alluding to the great difficulty which is constantly met with by persons abroad, and even in this country, in obtaining these publications through the ordinary channels of trade. Several persons have assured us, that after again and again ordering them through their booksellers, they have failed in obtaining them. These complaints might be very easily remedied by constituting some London bookselling firm agents and publishers for the Trustees of the British Museum, and putting their names on the title pages. This is the method pursued by all the leading Scientific Societies of London, and the Trustees would do well to adopt it. The difficulties and delays to be encountered in obtaining the Catalogues in the only way now possible, from the Secretary's Office in the British Museum, are such as to be very likely to deter any enterprising book-vendor who may make the trial from repeating the experiment. The sale of all the Museum publications during the past year, appears to have produced only the small sum of £154. 1*s* 2*d*. If proper measures were taken to advertise* them, and a bookselling agent were appointed, we have no doubt that a much larger return might be realized.

From Dr. Gray's list of special acquisitions in the classes of Mammals and Birds during the year 1864, we pick out the following items as of general interest.

(1.) A male, a female, with rudimentary pouch, and a very young *Echidna* in spirits, presented by Dr. Müller of Melbourne. (These, we believe, have been described by Professor Owen, in a memoir recently read before the Royal Society, which will be published in the Philosophical Transactions.)

(2.) A "mummy" specimen of the Great Auk *(Alca impennis)* which was found pressed flat with the flesh converted into adipocine, on an island to the northward of Newfoundland, several feet below

* It is certainly a great error not to advertise the new Catalogues. A gentleman especially interested in British Ornithology informs us, that he has only within these few days, and then, by a mere accident, discovered that a "Catalogue of British Birds" had been issued in 1862!

the surface, in a deposit of "frozen guano." With the exception of the extremities of the toes, this example is perfect in every respect, even to the pen feathers of the wing; the beak is as perfect as the day the bird died. It was sent to Mr. Matthew Jones, and presented to the Museum by the Bishop of Newfoundland, who also procured the specimen that was previously sent to Mr. Alfred Newton, the skeleton of which has been described in the "Transactions of the Zoological Society."

The collection of Reptiles and Fishes in spirits, now under the care of Dr. Günther, to whose energetic labours in these classes of animals, we have on several occasions called our readers' attention, seems to have received many valuable additions during the year 1864. The additions to the first of these class are 847 in number, amongst which are many rare and valuable specimens from Borneo, Angola, Palestine, India, and Australia. The Fishes have been increased by the receipt of no less than 1706 examples, amongst which particular attention is called to a "large collection from the Essequibo river," in Guiana, a series of fishes from the Bosphorus, made by Dr. Millingen of Constantinople, a collection of fishes from Zanzibar presented by Lieut.-Colonel Playfair, and the "typical specimens of some new genera of deep-sea fishes from Madeira, discovered and presented by J. Y. Johnson, Esq."

As regards the Invertebrate classes, there does not appear to have been quite so much activity during the past year, and we shall perhaps understand the reason of this when we come to Philocosmos' letter on this subject by and bye.

Mr. Waterhouse's special report on the work in the "Department of Geology" during the past year, tells us that 4651 individual specimens have been "submitted to examination, labelled and entered in the inventory" during that period. Besides the collection of remains from Bruniquel, already spoken of, Mr. Waterhouse gives a list of numerous specialties, amongst which we may note "a nearly perfect skull, with the tusks about nine feet long, of *Elephas primigenius*, from Ilford, in Essex"—a "fine series of Marsupial remains, including a portion of the upper jaw, entire pelvis, tibia, and other bones of *Diprotodon australis*, from Queensland, and some very rare and valuable reptilian remains, (including a probably unique specimen of *Teratosaurus Suevicus*, from the Upper Keuper Sandstone of Stuttgardt."

The special Reports on the Departments of Botany and Mineralogy we will not now enter upon, as the present article is intended to treat only of the Zoological collections of different parts of the world.

We must now say a few words about the letter to the Trustees of the British Museum from "Philocosmos," of which the title stands second in our list given above. Philocosmos addresses the fifty lords and gentlemen who form the governing body of this National Institution, thus publicly, in order to bring under their notice a section of the collections, which, "as generally admitted, "urgently demands amendment." "The defect," he alleges, "may be "stated in a few words." It consists of "an almost entire absence in "the British Museum of those aids to the study of this vast portion "of zoology, to which naturalists think themselves entitled, and "which is certainly provided in every other important national "collection in Europe.* In other national collections," continues

* We believe the following to be a correct list of the scientific staff of the Zoological Museums of London, Paris, Berlin, Vienna, and Copenhagen :—

(1.) Zoological Department, British Museum, London:—
Dr. J. E. Gray, Keeper.
Mr. G. R. Gray
Dr. Baird
Mr. F. Smith
Dr. Günther
Assistants.

(2.) Museum d'Histoire Naturelle, Paris:—
Prof. Milne Edwards (Mamm. and Birds).
Prof. Duméril (Reptiles and Fishes).
Prof. Blanchard (Annulosa).
Prof. Lacaze-Duthiers (Mollusca and Zoophyta).
M. Florent-Prevost
M. Jules Verreaux
Aide-Naturalistes.

(3.) Zoological Museum, University, Berlin.—
Dr. W. Peters, Director.
Dr. Cabanis
H. Hopffer
Dr. Gerstaeker
Dr. von Martens
Custodes.
Dr. Stein (Extraordinary Assistant).

(4.) Imperial Zoological Cabinet, Vienna:—
Dr. Redtenbucher, Director (Insecta).
H. Zelebor (Mammals).
H. von Pelzeln (Birds).
H. Ritter von Frauenfeld (Mollusca).
H. Steindachner (Rept. and Fishes).
H. Rogenhofer (Insecta).
Graf Ferrari (Insecta).

(5.) Zoological Museum, University, Copenhagen:—
Prof. J. Steenstrup
Prof. Kroyer
Prof. J. C. Schiodte
Prof. J. F. Reinhardt
Inspectors.
Dr. C. F. Lutken, Assistant.
H. O. Mörch, Special Assistant for Conchology.

Philocosmos, "the many objects composing them are so classified, "named, and arranged, that the student can profitably examine "them," and there is likewise, "a staff of officers eminent in "science, ready and able to assist students in their researches." In the British Museum, as regards the Invertebrate collections, Philocosmos urges that this is not the case. As to the *amount* of materials, he allows that "thanks to the untiring and well-directed "zeal of Dr. Gray," our National Collection far exceeds any other, but as to the arrangement of these materials he pronounces it to be the most "chaotic." "If we except a few chosen groups of insects "which have received special attention, this priceless material is "stored away unstudied, unarranged, unknown; drawer after "drawer, full of rare forms—forms that in private collections some-"times are entirely unrepresented—exhibit nothing but a crude "disorganization. Here is material sufficient to form two, three, or "four really good national collections, and yet, by reason of its "condition, without the scientific value of many a second-class "private collection."

The reason of this distressing state of things is simply that there are not enough hands to work on the very extensive series of Invertebrata in the British Museum. Our continental friends will indeed be astonished when they learn that the duty of cataloguing, arranging, naming, and describing the whole of these enormous collections,* containing in round numbers about a million and a half of specimens, is now committed to two naturalists, Dr. Baird and Mr. F. Smith. A few years ago, it is true, these gentlemen were assisted by a third Naturalist, Mr. Adam White, a well-known authority in the classes Insecta and Crustacea. Since that gentleman's retirement from ill health, no competent person has been appointed to succeed him,† so that there are now only two left to do

* Philocosmos gives us the following estimate of the extent of these collections—"The collections of Insects in the Museum consist of 904,605 specimens, contained in 3775 cabinet drawers and 121 store boxes. The late Rev. W. Hope, a distinguished naturalist, and the founder of the Hope Museum and the Entomological Professorship at Oxford, used to say that, in superintending his own collections, he was able to take charge of a cabinet drawer a day; if this rate of progress is applied to the British Museum collection, twelve years must expire before the whole can be brought under the care of Mr. Smith. It is probable that the rest of the Invertebrata (under the charge of Dr. Baird) may consist of half a million of examples, the grand total of the Invertebrata in the Museum being, in round numbers, a million and a half."

† We have no space here to go again into the history of the appointment of Mr. White's successor, which has been so repeatedly canvassed by the ordinary press

the work hitherto performed by three. It is hardly necessary to say that even this number was wholly insufficient. "Philocosmos," who, as we have good reason to believe, is a very reliable authority in such matters, tells us that the collection of Insecta—to which favourite class he principally devotes his remarks, "absolutely requires four or five, instead of one Naturalist, to keep it in proper order." He states that every year the confusion is becoming worse by reason of accumulations, large additions being continually received, which it is impossible for a single person to attend to properly. The cost of resetting and cleaning the whole collection of Invertebrata he estimates at about £500, and that of re-arrangement at £2000. If the collections are worth accumulating and having, he urges, they are worthy of being preserved—"if they are worth having they are worth utilizing—if they are to be retained, they should exist to the national credit." Few of our readers, we fancy, will disagree with "Philocosmos" in this matter, or will be ill disposed to join in the prayer of two of his petitions to the Trustees.

1. That a special grant of £2500 should be asked of the Chancellor of the Exchequer with the object of overtaking arrears, for the purpose of arranging, without delay, the collections of Invertebrata.

2. That the permanent staff of the assistant keepers of the Insecta should be very materially increased.

With regard to Philocosmos' further petition, that the civil-service rules, as to vacant appointments in the Natural History Departments of the British Museum, should be entirely abandoned, we are not sure that it is necessary to go quite so far as this. As regards the appointments now to be made, in order to bring up the staff of this department of the Museum to its full requirements, we are

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as well as by the special organs of science, without any explanation of it having been vouchsafed by the Trustees, but shall content ourselves by reprinting, for the benefit of those who may not have heard of it, the following resolution, unanimously passed by the Entomological Society of London on the subject, on the 5th of July, 1863 :—

"Considering the state of the Entomological collection in the British Museum, and the vast accessions, still unarranged, which it has recently received, and which render it the most valuable collection in the world : considering also, that the proper classification of that collection requires the services of more than one person skilled in the science of Entomology—

"Resolved, That the nomination, in the place of Mr. Adam White, of a gentleman previously employed as a transcriber in the Printed Book Department of the Museum and entirely unknown as an Entomologist, cannot but prove a great detriment to the progress of the classification of the collection, and is virtually a waste of the public money. Such nomination is the more objectionable as several competent entomologists were candidates for the post."

quite of Philocosmos' opinion. Let us have the best men we can get, without restriction as to age or anything else, for at the present moment what we want is experienced Naturalists, sufficiently advanced in their profession to be able to describe and systematize, qualities not very often developed under the prescribed limits of thirty-five years. But for the future we must confess that it would be better, as a rule, to appoint younger men to inferior posts. Fresh blood is a very good thing occasionally, but when an efficient staff has once been secured, there can be no better or fairer method of filling the higher appointments than by the promotion of those who have earned their experience by occupying the junior posts creditably. And for the junior posts we think the age of thirty-five years an ample margin.

Having said so much about our own National Museum of Zoology, let us now look across the water and see what our continental neighbours are about. In France, as we must all allow, the Jardin des Plantes is theoretically at least the most perfect institution of the kind in existence. Not only does it contain living and dead collections of both animal and vegetable kingdoms side by side, but libraries, workshops, lecture-rooms, and every other appendage requisite for the due working of such an establishment. A *collège*, or body of seventeen professors, comprehending the most eminent naturalists in the country, is attached to the Musée d'Histoire Naturelle, the members of which are engaged in giving perpetual free lectures on the different branches of Natural Science. Assistant naturalists are employed to arrange and name the collections; travellers are engaged in collecting novelties in foreign countries; and artists are especially attached to the establishment for the purpose of figuring the new or rare animals and plants belonging to the Museum, Gardens or Menagerie. Yet those who are practically acquainted with the working of the Jardin des Plantes are well aware that it is not at the present moment the perfect institution which it ought to be. In the time of the illustrious Cuvier the Museum of Zoology, of which alone we are now speaking, was unquestionably the best in existence. Whether at the present time it can be said to excel its sister institutions in any one point is doubtful, in many parts of the series it is undoubtedly inferior to them. One reason of this falling off is, we believe, partly traceable to the fact that (until recently, when a wholesome change was made) there was no organised head of the establishment—the Professors having taken that office each in rotation. A second reason is, that under the Imperial government the institution has been always notoriously under the "cold shade," and has been stinted for means. Messieurs les Professeurs had certain ideas of independence about them which did not suit the established regime, and they were consequently left to get on pretty much as they could. Within the last year or two we rejoice to learn that matters have mended considerably, and that there is now every prospect of this celebrated establishment resuming its former vigour. Besides other reforms lately introduced by a decree of the 29th Dec. 1863 it was ordered that a report on the state of the Museum should be made every year to the Minister of Public Instruction, the report to be drawn up by five nominees of the Minister, and two of the Professors, assisted by the Director and the Accountant. It is the first of these Reports of which the title is given above, which furnishes us with some account of the present state of the establishment. As regards the zoological collections, one great defect spoken of is the want of space to arrange them in a natural series. On the ground-floor of the Museum, it is remarked, the larger mammals are placed side by side with the zoophytes; on the first floor the crustaceans are arranged between the collections of reptiles and monkeys, and the shells and insects are located in the middle of the bird-galleries. Other parts of the collection are altogether excluded from public view from want of space to exhibit them. Even in the public galleries, the objects are much too crowded together, and can often neither be properly seen by the public nor examined by the student. The remedies for this evil state of things recommended by the Commission are an immediate construction of new buildings for the zoological collections on an extended scale, and the more liberal endowment of the establishment. There is no doubt, we believe, that their reasonable requests will meet with immediate attention. Already we hear of designs for a very large addition to the *Galerie de Zoologie*, which will more than double the space at present available. When this has been accomplished, perhaps our own rulers will cease their miserable squabbles about the locality of our own Museum, and condescend in this, as in so many former cases, to follow the good example set to them by our Imperial ally.

Next to the Jardin des Plantes, one of the most important zoological museums in Europe is that of Leyden, now under the direction of the distinguished naturalist Professor Herman Schlegel. On the death of the late M. Temminck, some years since, Professor

Schlegel was placed in this post conjointly with Professor Van der Hoeven, but succeeded to the full command shortly afterwards on the resignation of the latter. Professor Schlegel has been very busily engaged in rearranging the treasures of this noble establishment ever since his accession, and as regards the mammals and birds, has already made important progress with his arduous undertaking. The work, of which the title is given above, is intended to form a sort of Catalogue raisonné of the collections under his charge. The parts hitherto issued all relate to the series of birds, which is here particularly full and complete, especially as regards the ornithology of the Indian Archipelago, in which indeed (even though our national collection has been enriched by the labours of Mr. Wallace in the same countries) it is unrivalled. The plan of the catalogue is very good, consisting as it does of a series of monographic essays of different groups in the form of a list of the different specimens of each species, and giving the exact habitat of each individual specimen, together with the name of the collector. So that we see good work, as regards Zoology, is likewise in progress at Leyden.

As regards three other first-class Zoological Museums of Central Europe, those of Berlin, Vienna, and Copenhagen, although we have no special product of their establishments to introduce to our readers' notice at the present moment, we are well aware that much activity in the good cause is now being manifested in each of these quarters. Dr. William Peters, Director of the Royal Zoological Museum of the University of Berlin, is too well known as one of the most active and most accomplished of living zoologists to require anything to be said in his praise in these pages. His frequent contributions to science in the Denkschriften and Monatsberichte of the Prussian Academy of Sciences have been constantly referred to in this Journal, and are well known to every naturalist. Dr. Peters has in preparation at the present moment, we believe, a Hand-book of the Mammalia, to the publication of which we look forward with lively satisfaction. He is likewise engaged on a special illustrated work on the Chiroptera, which, as access has been obtained to the typical specimens of this difficult group in nearly all the museums of Europe, promises to be a standard work of very great importance. At the same time Dr. Peters is continually adding to our knowledge of various other classes of Vertebrata and Invertebrata. As regards the latter section of the animated kingdom, we may remark that Dr. Peters has the assistance of four other naturalists, all of well known and acknowledged merit, to aid him in his labours, while here, in London, Dr. Gray is obliged to be contented with two! In the Imperial Zoological Cabinet of Vienna also we believe that four Naturalists are engaged in working out and naming the entomological collections, while in this country, as has been already stated, the whole of the series of Insects is committed to the charge of one unassisted individual. Even in Copenhagen, as will be seen by the list given above, the scientific staff is stronger than in our own much more extensive collection. Here also, we are informed, a new building destined to contain the several collections hitherto kept apart in different buildings, is now in rapid process of construction, and when completed will serve, no doubt, to extend still more the well-deserved reputation of the learned Zoologists of Denmark.

We must now devote our remaining space to a few words concerning what is going on on the other side of the Atlantic, where the exhausting war lately brought to a termination, seems by no means to have stopped the progress of Zoological Science. There are three Zoological Museums in the United States, which claim notice as contributing, or likely to contribute, materially towards the general advance of Zoology—the Smithsonian Institution, Washington, the Academy of Natural Science at Philadelphia, and the Museum of Comparative Zoology recently established by Professor Agassiz in Harvard College, Cambridge. As regards the Academy of Natural Sciences, Philadelphia, we have lately adverted to the loss sustained by this Institution (which is the property of a private Society), by the death of its munificent patron and former President, Dr. T. B. Wilson.* We trust, however, that the well-known liberality of the citizens of Philadelphia will quickly set at rest any apprehensions that this event may have raised of any cessation in the good work that the Academy has for so many years carried on for the benefit of science—and that a sum will be raised sufficient to ensure the preservation and proper arrangement of the noble collection belonging to that Society.

The Smithsonian Institution has, as is well known, a special department devoted to Natural History, which, under the care of the energetic Assistant-Secretary Professor S. F. Baird, has of late years played a most important part in Zoological Science. Professor

* Nat. Hist. Rev. 1864, p. 452.

Baird's report for the year 1863, which is contained in the volume now before us, gives us the gratifying intelligence that the "interest in the subject of Natural History, which received so material a check in 1861, and showed symptoms of revival in 1862, has continued to manifest itself still more strongly during the year 1863." Amongst other explorations, wholly or partially carried on by the Smithsonian Institution, with the main object of working out the Zoology and Botany of the North America continent, Professor Baird speaks of Mr. Kennicott's expedition to Arctic America, which has resulted in the acquisition of a very large quantity of valuable material. "The collection received in 1863, filled forty boxes and packages, and weighed in the aggregate, about 3000 pounds."

Another well known Smithsonian collector, Mr. John Xantus, had left for the West Coast of Mexico, and was making extensive collections in that quarter. Large series of natural objects had also been received from Dr. Van Frantzius in Costa Rica, Dr. Sartorius and Professor Sumicrast in Mexico, Captain J. M. Dow in Panama, Mr. W. T. March in Jamaica, and the Hon. C. R. Buckalew in Ecuador—not to mention numerous other collections of more or less importance. These materials are worked out by different Naturalists to whom they are submitted for that purpose, and the results published in the Smithsonian "Contributions to Knowledge," and "Miscellaneous Collections"—to different papers in which we have already on several occasions called our readers' attention. We must all acknowledge that the Smithsonian Institution is worthily carrying out the views of its founder, "to increase and diffuse knowledge among men."

Lastly, we have Professor Agassiz's Annual Report on the Museum of Comparative Zoology, at Cambridge, of which we have before spoken in this journal,* and which is a third institution, young as yet, but also likely, as it progresses, to do good service in the cause of science. Here again we hear of large accessions of specimens from every quarter, and of improvements in internal arrangements likely to conduce to the future welfare of the Museum. "The publications of the Museum" have, it is allowed, "proceeded very slowly," and Professor Agassiz acknowledges some disappointment with certain of his collaborateurs, whose investigations, made under his direction, have been "without his knowledge published

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* Nat. Hist. Rev. 1863, p. 524.

elsewhere." We have not space left to discuss the special reports on Mammals and Birds by Mr. J. A. Allen, on the Reptiles and Fishes by Mr. Alexander Agassiz, who appears to be following worthily in his father's footsteps; on the Insecta, Crustacea, and Annulata by Mr. P. R. Uhler, on the Mollusks by Mr. J. G. Anthony, and on the Brachiopoda by Mr. N. S. Shayler. Suffice it to say, that great activity seems to be manifested by all these gentlemen. And though we believe their eminent leader Professor Agassiz himself is now recruiting his health (and at the same time adding to the riches of his collection) in the wilds of South America, we have no fear that his temporary absence will seriously affect the labours of this energetic corps. Unless we are much mistaken, the Museum of Comparative Zoology of Cambridge, is destined hereafter to play no mean part in the Annals of Science.

XLI.—The Structure of the Medulla Oblongata.

The Grey Substance of the Medulla Oblongata and Trapezium. By John Dean, M.D. (Smithsonian Contributions to Knowledge.) Washington, 1864.

In the 'Elementa Physiologiae' of the learned Haller, a few paragraphs suffice for the description of the Medulla oblongata. At the present day, an account of the same organ, comprehensive enough to include the recent microscopic researches of Stilling, Schroeder van der Kolk, Lockhart Clarke, Koelliker, and others, would fill at least as many chapters. Nor can the increase be considered as a mere increase of words, or even as a mere increase of pedantic knowledge lacking wisdom. Every page of a faithful description of the minute anatomy of the nervous centres represents a large amount of very hard work, and every page is full of facts which give a promise of being some day rich in meaning. There is hardly any field in Biology in which labour is more praiseworthy or more fruitful. We may gladly welcome, therefore, any fresh careful study like that embodied in the memoir now before us.

In it Dr. Dean, of Boston, U.S., well known for his contributions to the minute anatomy of the spinal cord, attempts to give a descriptive account of the grey substance of the medulla oblongata in man and mammalia, and of the organ in mammalia known as the trapezium. The gradual development of the various parts of the grey matter of the spinal cord as they pass upwards towards the brain is carefully worked out; the rise and fall of the nuclei of the special nerves,—arranged as they are in two series, the hypoglossal abduces, facial and molar part of trigeminus in one line, and the spinal accessory, vagal glossopharyngeal, auditory and sensor part of trigeminus in another,—are fully described; the accessory ganglia, viz. the upper and lower olivary, the restiform, and postpyramidal bodies, &c., are investigated; and the relations of all these parts to each other and to the nerve roots are discussed at length. The author has naturally found that a large part of his work ended in a corroboration of the results arrived at by other observers. Particularly striking is the coincidence of his descriptions and views with those of our own Lockhart Clarke. In several instances he omits a detailed account, because, as he candidly and modestly states, the facts had been previously so well and accurately described by the English anatomist, that his own words would read like a mere quotation. We are not so fertile in original observers as not to feel gratified by such praise as this, coming as it does, too, from the other side of the Atlantic; and may well be proud of a man of whom it may almost be said that he described nothing which he has not seen, and seen nothing that was not visible.

In speaking of Dr. Dean's work as being in great measure corroborative rather than new, we do not in any way intend to depreciate it. On the contrary, seeing what a host of discordant and conflicting opinions almost always rise up round every fresh point in biological science, we may perhaps feel inclined to attribute very great importance indeed to faithful and clenching work of corroboration. For the establishment of a scientific verdict there should be at least two witnesses, and the second should share, in large measure, the credit of the first.

But, besides corroborative work, there is in this memoir, a great deal of new matter, consisting mainly of elaboration of points previously determined and of correction of erroneous ideas. Labour of this kind can only be properly appreciated by going over the same ground with the scalpel and the microscope; but we may call attention to one or two points which are of especial importance, since they have been made the basis for some physiological reasoning, and have been brought prominently before the English medical public in the translation of the work of the late Schroeder van der Kolk, published by the New Sydenham Society. If Dr. Dean is right, the views of the celebrated Utrecht Professor are wrong; and in that case it were well that they should be recalled or arrested before they have sunk too far into medical practice. Schroeder van der Kolk, as is well known, having satisfied himself that there was little or no direct decussation between the two hypoglossal nuclei, that, on the other hand, the two olivary bodies not only were largely united with each other, but likewise possessed special fascicules (also observed by Lenhossek), connecting each with the hypoglossal nucleus of the same side, and having observed that in the animal series the development of the olivary bodies corresponded with the amount of movement possessed by the tongue, drew up a theory that these structures were intimately concerned in or presided over the processes of deglutition and, more especially, of speech. And he supported this opinion with facts gathered from pathological researches. Dr. Dean, however, states, that there is, at least, some decussation between the two hypoglossal roots, which, therefore, may be presumed to be competent of bilateral action without the intervention of any third body. In the cat he finds this decussation very marked. He denies, moreover, the existence of any peculiar communication between the olivary bodies and the hypoglossal nuclei, and hence rejects Schroeder van der Kolk's theory of the special function of the former. At the same time he admits that some fibres from the hypoglossal nuclei, as well as from all the other nuclei of the medulla, 'pass among the cells of the olivary bodies, and, in many cases, are doubtless continuous with their processes.' And dwelling on the fact that those bodies are also largely connected with the system of arciform fibres, with the system of longitudinal fibres and with the antero lateral nucleus and caput cornu, he is led to agree with Clarke in attributing to them a 'co-ordinating influence.'

The remarkable nuclei, which were first pointed out by Clarke, and which have received the name of 'upper olivary bodies,' were thought by Schroeder van der Kolk to be especially connected with the facial nerve. And their great development in carnivora and feeble conformation in herbivora led that observer to regard them as organs for the expression of passion by facial movements. Dr. Dean has traced the upward development of these bodies from two nuclei existing on the outside of the lower olivary bodies, which he has especially described and named the 'antero-lateral nuclei,' from their position in the antero-lateral columns. He considers them as being, like the lower pair, far more intimately united with the arciform fibres than with any special nucleus, such as that of the facial, and consequently attributes to them too 'a co-ordinary influence.'

Dr. Dean, again, is unwilling to admit the existence of any special connection between the trigeminus (which he always, unwisely as it appears to us, calls the trificial) and auditory nerves, such as Schroeder van der Kolk contended for; although he regards the caput cornu, out of which the sensor root of the trigeminus is developed, as a kind of centre of communications for all the nuclei of the posterior columns, spinal accessory, vagal auditory, &c. So, also, with regard to a distinct connection between the auditory and facial nerves, in which Schroeder van der Kolk saw an explanation of certain reflex movements, such as those of the ear, &c., caused by sounds. Dean, while tracing fibres from the auditory nerve into the facial nucleus, cannot find any direct transition into the cells of the latter, and sees no just ground for Schroeder van der Kolk's theory. In fact, the American anatomist seems to have set his face against most physiological deductions from anatomical data. And there is no doubt that such deductions should always be made with the very greatest caution, especially when one is dealing with the minute anatomy of the nervous centres. In no field of observation are there stronger temptations to make a theory, in none less chance of making the right one. The tables indeed might be turned against Dr. Dean, who shares with most of his fellow-labourers a tendency to see every where the instrument of a 'co-ordinating' power. The 'co-ordinating' theory, however, can never prove very dangerous, for no one can see very clearly what it means. On the contrary, it may often be of great temporary use in pre-occupying the ground against usurpers, until, in due time, the rightful owner comes to claim his own.

Our author has a very interesting chapter on the development of the bodies pointed out by Clarke, and named by him the 'Tractus intermedio-lateralis' and the 'Columnae posteriores vesiculosae.' The spinal accessory and vagus are shown to be connected, as Clarke described, with the extension upwards of both these columns. The relations of the vagus and spinal accessory nuclei to certain longitudinal columns, which are continued above into the roots of the trigeminus and below into longitudinal fasciculi intimately connected with the tractus intermedio-lateralis, are also carefully traced out. By this means the homology of the sensory, or posterior nerves of the medulla with those of the spinal cord is illustrated, and the path is suggested (theory again) by which impressions received by the trigeminus and vagus may find their way through the longitudinal fasciculi and tractus intermedio-lateralis to the motor roots, especially of those nerves concerned in respiration.

We may also call particular attention to the chapters on the vagus, and on the auditory nucleus.

Among mammalia, the observations were for the most part confined to the sheep and the cat. A gap in comparative anatomy is therefore rather indicated than filled up.

In conclusion, we may state that the method of preparation employed in the investigation was essentially the one recommended by Clarke, and that the memoir has an especial feature in being illustrated by photo-lithographs. The author has also sent us specimens of the original photographs, some of which are excellent, but they have all suffered somewhat in the process of transference to the stone.

XLII.—British Annelids.

A Catalogue of the British Non-parasitical Worms, in the Collection of the British Museum. By George Johnston, M.D., Edinb. London: printed by order of the Trustees, 1865. pp. 365, 23 plates and 50 woodcuts.

Some thirteen or fourteen years ago, it was known to many British Naturalists that the late Dr. Johnston was engaged on the compilation of a Catalogue of British Annelids, for the Trustees of the British Museum. For many years previously, Dr. Johnston had paid great attention to this subject, and the volumes of the "Magazine of Zoology and Botany," and the earlier ones of the "Annals and Magazine of Natural History," contain many valuable papers by him, giving descriptions of new, or little-known, genera and species, while a special supplement to the later Journal, published in January, 1846, was devoted to a list of the then known British Annelids, a list that, until within the last few years, when the General Dredging Committee of the British Association published a fuller one, was the only guide the English student had to this very puzzling group. It would appear that previous to Dr. Johnston's decease, the greater part of the Catalogue which we proceed to notice was not only compiled, but printed. Why it should not have been published twelve years ago is a mystery to us. We perceive, however, from the preface, that "A Supplement, prepared by Dr. Baird, containing addenda, corrigenda, and a notice of additional species found since Dr. Johnston's death, with a complete index, have been added, to render the work more complete."

At the time when Dr. Johnston drew up this catalogue, there were few, besides himself, in this country who made any very special study of the Annelids. Nor although Savigny, Oersted, Grube, Audouin and Milne-Edwards had, to a considerable extent, reduced a chaotic mass of genera and species to something like order, was this to be wondered at; for at this present moment, although much additional work has been accomplished, the difficulties in the way of investigating these animals are nearly as great as ever. We purpose to consider by-and-bye why this is the case, but in the first instance, will give a brief analysis of the contents of the book before us. At the outset, we take especial objection to the title of this volume. The division of the Annuloida (even supposing that we exclude from this group the Echinodermata) into parasitical and non-parasitical worms is such a clumsy and unnatural one, that it cannot for a moment be justified; bringing together, as it does, families in no way related to one another, and separating those which have undoubted affinities.

The first Order alluded to is that of Turbellaria. The enumeration of the British species, accompanied as it is by very brief and uncertain diagnoses, will be of little assistance to the collector. Indeed, even with the late researches of M. de Quatrefages, this order is shrouded in almost Egyptian darkness. A large number of the species here given are Dalyellian, and those who have had occasion to try to identify the new species in Sir Charles Dalyell's works well know how hopeless is the task, in spite of the beauty of many of the illustrations. The genus *Stylus*, which dates but from February in this year, is formed for the reception of four species described by Dalyell, in all of which the posterior end terminates in a cartilaginous style.

The second Order receives the name Bdellomorpha; but it is not that order as characterized by E. Blanchard, who formed it for the reception of the genus *Malacobdella*. It contains the genera, *Octobothrium*, *Udonella*, *Capsala*, and *Nitzschia*,* which would appear to

* Dr. Johnston was generally most accurate in his spelling, and yet we find in one page the following varieties of spelling for this word:—*Nitchia*, *Nitzchia*, and *Nitschia*, none of them being correct. The latter is the spelling in the Index. Nitzsch lived until 1837.

be synonyms of *Tristoma* (and all of which belong to the Trematodes) and *Malacobdella ;* which latter, while showing certain affinities in its development to the Trematodes, is, perhaps, better placed at the end of the Discophora. The third Order is that of the Bdellidea, which is synonymous with the Discophora of Grube. This, and the next order, that of the Oligochæta, are now almost universally regarded as sub-orders of the Annulata. Here we have the various species of *Pontobdella*, *Hirudo*, and *Glossiphonia*, and in the appendix there are more copious details, and, in some cases, better descriptions than in the text. In the list of the British genera we notice the following instances of incorrect spelling: *Trocheta* for *Trochetia*, *Hæmopsis* for *Hæmopis*, *Glossophonia* for *Glossiphonia.* Doubtless, further investigations will not only add many species to the genus *Glossiphonia*, but will also assign many of the present species as varieties of others. In the account of the Oligochæta, there are many interesting details as to the habits and economy of the earth worms. The old controversy, as to the power of the common worm to reproduce lost parts is here renewed, and one can now look at the subject from a more impartial point of view than it was possible to do some fourteen years ago. *Villa* is the name of a new genus made for the reception of the *Lumbricus ciliatus* of Müller, which would appear to differ from *Lumbricus* in having the segments armed with setaceous bristles in four fascicles. According to Dalyell, it is constantly found lurking in the sand of the shore at about half-tide, from whence the head is protruded, waving to and fro. Grube is followed in placing *Tomopteris* in an order by itself, Gymnocopa. We are inclined to think *Tomopteris* founded on immature forms; but this question cannot be settled until something is known about its modes and forms of reproduction. No reference is made in the addenda to the various papers by Carpenter, Claparede, Pagenstecher, and others, on this genus.

We now come to the larger and more important portion of this work; the section which treats of the Annelida, the "Annulata appendiculata polychæta" of Grube. An introduction of five pages treats of the various terms used in describing the genera and species. But these terms are, for the most part, very loose and inexact, whence one of the difficulties of this portion of descriptive Zoology has, we think, arisen. For example, what is an Antenna? what a Palpus? what a Tentaculum? how do these all differ from Cirri? and what are the so-called foot and its bristles, branches, and cirri?

How can one be sure, in comparing one description with another, how far they differ, and how far they agree, unless there be a fixed and definite nomenclature. Some years ago, in 1856, Professor Huxley attempted to introduce, among the Annelida, a modification of the system of nomenclature, proposed with so much success by Milne-Edwards, among the Crustacea. But this system has not been adopted as it ought to have been, and even in the latest works on the Annelids, and in the very last papers descriptive of new species, we find the same old, we wish we could say antiquated, terms introduced. Every Annelid is composed of a certain number of somites; one or more of these may also form a segment; the cephalic segment may consist of several somites, and is conveniently called by Professor Huxley the peristomium, the terminal segments, the pygidium; but each somite, as a general rule, has a certain number of appendages: these, Professor Huxley calls parapodia—each parapodium divides into two portions, a notopodium and neuropodium. Now, it strikes us, if this nomenclature had been attended to, and enlarged as occasion required, our knowledge of the external anatomy of the Annelids would have been much more clear and exact. We call attention to this subject here, in the hope that future writers on this group of animals may be induced to abandon the old style and adopt the new.

Following Grube, Dr. Johnston divides the Annelida into the Rapacia and Limivora, corresponding to the Errantia and Sedentaria of Milne-Edwards. As a Zoological convenience this division may be accepted for a short time longer; but there is no very sharp line of distinction to be drawn between the animals of either group. In the arrangement of the families and genera, Grube is not followed very explicitly. Taking Carus's arrangement of the families as a recent guide, we will see what genera and species are met with in this country. Of the Aphroditea, we have the genera *Aphrodita* (3 species), *Lepidonotus* (8 species), *Polynöe* (1 species), *Pholöe* (2 species), and *Sigalion* (1 species); of the Aphinomea, *Euphrosyne* (2 species), *Spinther* (1 species). There is no diagnosis of this latter genus given in the text, nor is the omission alluded to in the appendix. This is the more to be regretted as the original description in the Annals and Magazine of Natural History was, necessarily, very incomplete.

Of the Eunicea, we have *Eunice* (7 species), *Onuphis* (2 species). Dr. Johnston divides Audouin and Milne-Edwards' genus *Onuphis* into two genera. *Onuphis* has pectinate branchiæ; the other, *Northia*, is distinguished by the absence of these organs. This latter genus, which was first published in this catalogue, is, we believe, badly defined, as one of the diagnostic marks of *Onuphis* is "branchiæ single or combshaped." We entertain serious doubts as to the correctness of the synonymic list. Of the two species of *Onuphis* (*Northia*), we may remark that the description of the first species, as given in the text, is by no means so elaborate as that given originally by Dr. Johnston, in the 16th volume of the Annals of Natural History; but on comparing both with the description given by O. F. Müller, we find many points of discrepancy. Unfortunately, the want of uniformity in the nomenclature prevents us from being positive on several points. Dr. Johnston's *Onuphis*, in his description given in the text, is convex on both dorsal and ventral surfaces. Müller's is "supra convexum subtus planiusculum;" Dr. Johnston says, "occipital segment, without any appendage." If this mean the peristomium, it is a mistake; if it refer to the second somite, counting the head, for the moment, as one, it does not hold good so far as the drawing is concerned, for in fig. 2 we see the second somite with appendages. In Müller's species the "collum" is "angustum et muticum," and the fig. tab. xviii. fig. 4 shows this. In Dr. Johnston's, the second somite (the neck) is broader than the head. In the specimen first described by Dr. Johnston the posterior somites were wanting, so that the character "anal segment with two styles," is simply borrowed from Müller. To the synonomy of the second species, *O. conchilega*, we may add, even after reading the foot note, the *O. Eschrichtii* of Oersted. Of *Lysidiæ* (not *Lycidiæ*) we have 2 species, of *Lumbrineris* 1.

Of the Nereida we have *Nereis*, with eight species, and we doubt not many more; of *Nereilepas* one species, of *Heteronereis* five. Of the Nephthyaceae, reduced to a subgenus of Nereida by Carus, we have *Nepthys* with three species. Of the Glycerea we have *Glycera* with six species; and *Goniada* with one. Of the Phyllodocea, *Phyllodoce* with seven species. Of the Hesionea, *Psamathe*, which Carus reduces to a synonym of *Cirrosyllis* of Schmarda. We think it will be found on examination that *C. fusca* of Johnston is not the *C. punctata* of Müller, unless indeed, as hinted by A. Agassiz, it turns out that the curious difference in the first fifteen somites is owing to the one being a 'parent stock' of the other. It is strange that this difference, though well figured on Plate xvi., is not alluded to in the text.

We have frequently met with fine large specimens of *C. punctata*, in which there was no such marked difference in the somites. Of the Syllidea, we have the genus *Syllis*, a new genus *Gattiola*, *Myrianida* and *Joida*. This important family has lately been reduced into order by Ehlers,* and we feel some surprise that his researches are not alluded to in the Appendix, the more especially as the position of the new genus *Gattiola* could have been easily decided. We give the divisions of this family according to Ehlers, adding the species at present known as British.

A. Syllidea with Palpi.

I. First segment, without tufts of bristles.

1. First segment always with more than two tentacular cirri. Procome, *Ehlers*.

2. First segment always with two tentacular cirri.

Gnathosyllis, *Schmarda*.

Odontosyllis, *Clprd.*

Pterosyllis, *Clprd.*

At the entrance of the tubular œsophagus, only soft papillæ, the armature at most a single tooth.

a Palpi quite or partially divided, central cirri present.

Syllis, *Savigny*. S. armillaris, *Oersted.*

S. cornuta, *Rathke.*

S. ? monoceros, *Dalyell.*

It is impossible, from the wretched description of this species, to assign it to its proper place.

S. tubifex, *Gosse.* This species was described in Annals and Magazine of Natural History, 2nd Series, Vol. 16. Habitat, Ilfracombe. It is not alluded to in the present work.

β. Palpi coadnate. Central cirri wanting.

Sylline, *Grube.*

3. First segment, with but one tentacular cirrus, ventral cirri absent.

a Microsyllis, *Clprd.*

b Exotocas, *Ehlers.*

4. First segment without tentacular cirri, ventral cirri present.

Exogone, *Oersted.* E. longiseta, *Gosse.* This spe-

* Die Börstenwürmer. Von E. Ehlers, M.D. Leipzig, 1864.

cies was described in the same volume of the Annals as above referred to. It is not mentioned in the text or appendix.

II. First segment, with tufts of bristles. In this section there are four genera—distinguished by the number of their antennæ—which number from three to four. None are native.

B. Syllidea without Palpi.

I. Elongated cirri from all the segments.

1. Cirri filiform.

Amblyosyllis, *Grube.*

2. Cirri club-shaped.

a with three antennæ.

Myrianida, *M. Edwards.* M. ? pinnigera.

b with four antennæ.

Eucerastes, *Ehlers.*

II. Only the first segment has elongated cirri.

1. The first, second and third segments with long cirri.

Proceræa, *Ehlers.*

2. The first and second segments with long cirri.

Autolytus, *Grube.* A. prolifer. This species is included under the genus *Syllis.* We should have expected to have had its synonymy corrected in the Appendix, from the researches of A. Agassiz. The following amended list of synonyms we take from Ehlers, abridging the references.

Autolytus prolifer, *Grube.*
Nereis prolifera, *O. F. Müller.*
Syllis prolifera, *Johnston.*
♂ Nereis corniculata, *O. F. Müller.*
Diproceræa corniculata, *Grube.*
Crithidia thalassina, *Gosse.*
Polybostrichus Müllerii, *Keferstein.*
♀ Sacconereis helgolandica, *M. Müller.*

Mr. Gosse's new genus and species which, through the researches of Mr. A. Agassiz noticed in our last number, has proved to be but a stage of *Autolytus prolifer*, should have been noticed in a supplement which purports to give the additional species found since Dr. Johnston's death. But we content ourselves once for all by saying that this has not been done, and while we in this review record all the additional species that for the moment occur to us, yet it is pretty certain that several will escape our notice. This will be of the less consequence, as the newly projected "Record of Zoological Literature" promises year by year to supply this want; nevertheless, it would have been well had the Supplement been a more faithful record, not only of the present existing British species, but also of their classification and synonymy. Among the Syllideæ described in Johnston, of the place of which we are uncertain, is the now first of all described genus, *Gattiola*, for an undescribed species of Gosse. The diagnosis of this genus does not say a word as to the presence or absence of palpi, but from the drawing we should refer it as a synonym to *Cirrosyllis*, Schmarda.

Joida macrophthalma, is described from a single specimen. If the figure is to be trusted, we cannot agree with Ehlers in referring this genus to *Syllis*, but we rather think it has affinities to the *Syllis maculosa* of Cuvier, and should along with the latter be placed under *Isosyllis*. Johnston's figure, Plate xiv*a*. fig. 5, shows that it belongs to the section which have their "erstes Segment mit Börsten." The next family is that of the Spiodea—of this we have the genus *Nerine* (2 species), *Spio* (2 species), *Leucodore* (1 species). Here comes in the family Chaetopterida, according to Carus' arrangement, and from a perusal of the views of Dr. Baird, who describes the only native species of this interesting family, we should have thought that this would have been his arrangement too. But in the Appendix we are desired to place it at the end of the Ariciea. *Chaetopterus insignis*, *Baird*, is at present the only British species, but we suspect it will be found pretty generally around the coasts. Of the Ariciea, we have *Aonis* (1 sp.). [This genus, added in the Appendix, we are desired to insert after the genus *Cirratulus*, in the family of the Cirratulida; surely it has much more affinities here]; *Ephesia* (1 sp.); *Sphærodorum* (1 sp.); this genus we believe to be identical with the previous one, but we are unable to say which name has the priority. Rathke's was published the same year as Oersted's (1843), but the month of publication of No. XX. of the "Nova Acta Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum," is unknown to us.

The family Cirratulida has as native genera, *Cirratulus* (2 sp.), and *Dodecaceræa* (1 sp.): Opheliacea has *Ophelina*, with one species, *O. acuminata*. [The synonym of this is given as *Ammotrypane aulogastra*, *Rathke*; but *A. aulogastra*, *Rathke*, is *Ophelia aulogaster* of Grube, a very different thing from *Ophelina acuminata*. Very probably there may be among the specimens marked *a*, *b*, *c*, in the British Museum, specimens of the former; otherwise it is not as yet recorded as native] *Ammotrypane* (1 sp.); *Travisia* (1 sp.): Arenicolida has *Eumenia* (1 sp.), *Arenicola* (3 sp.).

The second section of the Sedentaria contains the families Pherusea with the genera *Siphonostomum* (2 sp.): Maldania with *Crymene* (2 sp.): Terebellacea with *Terebella* (10 sp.), a new genus *Venusia*, for the reception of the *Terebella conchilega* of *Dalyell* [it would appear to differ from *Terebella*, in having all its segments provided with setigerous and uncinated feet, and the tube adherent throughout, horizontal. The branchiæ are in tufts of simple filaments] and *Terebellides* (1 sp.): Amphictenea with Pectinaria (2 sp.), [here we would add the *Amphicteis midas*, *Gosse*, described in the Annals of Natural History, 2nd Series, Vol. XVI., under the name of *Crossostoma midas*]; Hermellacea with *Sabellaria* (3 sp.), Serpulacea with *Sabella* (6 sp.) [A new genus, *Arippasa*, is made for the reception of the *Amphitrite infundibulum* of Montagu, but this must subside into a synonym of *Myxicola* of *H. Koch.*] *Protula* (2 sp.), *Serpula*. Of this genus following Phillipi we have as subdivisions *Serpula* (2 sp.), *Eupomatus* (2 sp.), *Placostegus* (2 sp.), *Vermilia* (1 sp.), *Pomatoceros* (2 sp.), and *Spirorbis* (17 sp.).

The last two genera of this family are *Filograna* (1 sp.), and *Fabricia* (=*Othonia*, Johnston). This genus was thoroughly revised by Mr. Gosse, who added to it two species. When we recollect their names (*Bairdii* and *Johnstonii*), we wonder how they could have been overlooked. Here, too, for want of knowing where else to place them, must be assigned the two species *hippocrepia* and *cralis*, of the very anomalous genus *Phoronis* of Strethill Wright. The last family given by Dr. Johnston, is called Campontiadæ, and contains *Campontia eruciformis*. This larval form we believe not to be annelidan, but it is hardly within the province of a review to enter into details on such a subject, and besides we are mindful of the rather hard words with which this work closes, "Mr. MacLeay thinks this to be a dipterous larva. Mr. Green thinks he has proved this, but in truth his remarks are very irrelevant, and deserve no consideration"!

There is a genus called *Mæa*, described for the first time, and an allusion made to details on the 22nd Plate, but our copy has but 21 Plates, so we can make no guess as to its probable affinities.

We have thus endeavoured, somewhat briefly, to give an account of the leading features of this the last, though by no means the best, of the British Museum Catalogues. Posthumous works are always more or less unfortunate. This one is peculiarly so, for it relates to a portion of Zoology which has lately made, and is now making, great progress, and though published but yesterday, dates some twelve years back. We have before suggested that the Appendix might have partly made up for this defect, but, at best, this could only have been partly done. It is not "addenda and corrigenda" that were needed so much as a thorough revision of the whole subject. To do this, all the specimens in the British Museum must be once more examined in detail, more especially the types. Good descriptions are better, inasmuch as they are cheaper, than illustrations, but bad descriptions are a torment and a worry to the working naturalist.

One good we predict from the publication of this volume, that the students of this branch of Natural History will be now somewhat better able to make out the species, and that we shall very probably have an increase in the number of those studying the Annelida. Let us hope that the result may not be merely a great increase in the list of British species, and a more exact description thereof, but that it may lead to the publication of an illustrated work on this subject, in which the pen of the Editor of this volume may, with due credit, record the labours of one who has made Berwick-on-Tweed classic ground to the Zoologist.

XLIII.—Lubbock's Prehistoric Times.

Prehistoric Times as Illustated by Ancient Remains and the Manners and Customs of Modern Savages. By John Lubbock, F.R.S., &c. London: Williams and Norgate. 1865.

As a large part of the series of essays which have been combined to form the present volume have already appeared in the pages of this Journal, and as, moreover, the author of them is one of our own editorial body, it will hardly be expected that anything like a critical review of the work can be given in these pages. Nevertheless, so much interest has been manifested, both at home and abroad, concerning Sir John Lubbock's labours, and his resumé of the several great questions of the day is of such importance as regards the future of ethnological science, that it will be neither just to ourselves, nor fair to our readers, to pass over the issue of the present work altogether in silence. We shall, therefore, devote a few paragraphs to a survey of the nature and contents of the present volume.

"Prehistoric Times," as we have already said, is founded on the basis of five articles which have appeared in different volumes of this Journal from 1861 to 1864. The author, as we are informed in the preface, was encouraged to reprint them in a separate form, mainly by the fact, that most of them had reappeared either in France or in America in the pages of other periodicals. At first, a simple reprint of the articles in question was only contemplated. It was, however, subsequently determined to add to them the substance of a course of lectures on the "Antiquity of Man," delivered at the Royal Institution, and to remodel the whole, so as to lay the principles of Prehistoric Archæology before the reader in a more complete and more connected form. In order to gain a more perfect knowledge of the subject, our author made personal visits to the gravel-pits of the Somme, the shell-mounds of Denmark, the lake-dwellings of Switzerland, and the bone-caves of Dordogne, besides minutely examining a host of public and private collections, in which the archæological objects disinterred from these different localities have been deposited. Finally, in order to point out the parallelism between ancient and modern barbarism, Sir John Lubbock has added to his work some valuable chapters on the manners and customs of modern savages. Nor has he hesitated in conclusion, as we shall see presently, to point out the necessary deductions concerning the past and future of mankind which follow from these premises, convinced, in the words of the Bishop of London, "that it would be treason to the majesty at once of science and of religion, if he sought to help either, by swerving ever so little from the straight rule of truth." But before more is said upon this part of the subject a few paragraphs must be devoted to the former portion of the work.

The study of the remains of the ancient peoples of Europe, so far as it has hitherto progressed, seems to indicate that four successive epochs preceded what is commonly called the historical period of mankind in this continent. These were,

(1.) The period of the "drift," when the Mammoth, the Cave-bear, the Woolly-haired Rhinoceros and other animals now extinct, were existing along with mankind. This our author proposes to call the "Palæolithic" period.

(2.) The "Neolithic" period, or "polished stone age," the implements of which are distinguished from those of the first period by their superior beauty and polish.

(3.) The "Bronze age," in which a compound of copper and tin was generally employed for arms and implements.

(4.) The "Iron age," when that metal had superseded bronze for cutting instruments.

Sir John Lubbock devotes his first chapters to the discussion of the remains of the "Bronze age," and endeavours to show how they may be distinguished from those of the Stone period on the one hand, and those of the more recent age of Iron on the other. The "commonest and perhaps most characteristic objects" belonging to the Bronze age, are the so-called "celts," found in the Irish and Danish tumuli. More than two thousand of these exist in the different Irish collections. Swords, daggers, spear-heads and javelins, are likewise common objects in series of bronze instruments. The personal ornaments most frequently met with of the same date, are bracelets, pins, and rings. The only remains of dwellings which can be *confidently* referred to the Bronze age, are some of the Lake-villages of Western and Central Switzerland, in several of which the number of implements of this metal found have been very large. But our author is of opinion that the great monuments of Abury and Stonehenge should also be referred to this period. Many of our readers will, no doubt, recollect the able article in the Quarterly of July, 1860, in which Mr. Ferguson has attempted to prove that both these monuments belong to post-Roman times. One of the chief arguments used in favour of this view was, that "the Roman road from Bath to Marlborough, either passes under Silbury hill" (which is on all sides admitted to be artificial, and most probably of the same date as Abury), "or makes a sudden bend to get round it, in a manner that no Roman road in Britain at least, was ever known to do." If the former supposition, which is maintained by Mr. Ferguson to be the "inevitable conclusion" from a careful examination of the circumstances be admitted, Silbury hill must have been erected subsequently to the time of the Romans leaving the country. But Sir John Lubbock stoutly maintains the contrary, and, as the point is one of some importance, we give his reply to Mr. Ferguson's arguments in his own words.

"Startled by this argument, and yet satisfied that there must be some error, I turned to the Ordnance map, and found to my surprise, that the Roman road was distinctly laid down as passing, not under, but at the side of Silbury hill. Not content with this, I persuaded Prof. Tyndall to visit the locality with me, and we convinced ourselves, that upon this point the map was quite correct. The impression on our minds was, that the Roman engineer, in constructing the road from Morgan's Hill had taken Silbury Hill as a point to steer for, swerving only just before reaching it. Moreover, the map will show that not only this Roman road, but some others in the same part of England, are less straight than is usually the case.

"Mr. Ferguson admits, in the passage just quoted, that the pieces of the road, on the two sides of Silbury Hill, are not in the same straight line, so that by his own showing, there must have been a bend somewhere. On the whole, therefore, I quite agree with old Stukeley, that the Roman road curved abruptly southwards to avoid Silbury Hill, and this shows Silbury Hill was ancienter than the Roman road."

The "Stone age" to which our author devotes his next chapters is that which preceded the invention of the use of metals. The immense number of stone-implements found in all parts of the world, sufficiently attest the extensive use of this material in former ages. The celebrated Museum of Northern Antiquities in Copenhagen, embraces some 10,000 specimens of this category; that of the Royal Irish Academy at Dublin 2000, whilst the Museum at Stockholm is estimated to contain between 15,000 and 16,000 similar objects. Our knowledge of this period is principally derived from the following sources—tumuli or burial-mounds, lake-habitations, such as those of Switzerland, heaps of refuse such as the kitchen-middings of Denmark, and bone-caves, as those of the Dordogne in France. After a general disquisition on the mode of manufacture, the different varieties and the conjectured uses of stone instruments, our author proceeds to describe the ancient burial-mounds from which so many of them have been disinterred. In many parts of the world these tumuli are extremely numerous. "In our own island they may "be seen on almost every down; in the Orkneys alone, it is esti- "mated that more than two thousand still remain; and in Denmark "they are even more abundant; they are found all over Europe "from the shores of the Atlantic to the Oural mountains; in Asia "they are scattered over the great steppes from the borders of "Russia to the Pacific Ocean, and from the plains of Siberia to "those of Hindostan; in America, we are told that they are to be "numbered by thousands and tens of thousands; nor are they "wanting in Africa, where the Pyramids themselves exhibit the most "magnificent development of the same idea; so that the whole "world is studded with these burial-places of the dead." These monuments of course, are not all referable to one period, nor to one race of men, but are mainly referable to the Neolithic and Bronze ages; "no known interment (with the exception, perhaps, of the Cave of Aurignac, &c.) being to be referred with any reasonable probability to the Palæolithic Age."

The "Pfahlbauten" or Lake-habitations of Switzerland, to which our author next turns his attention, are well known from the writings of Dr. Keller, M. Tryon, Dr. Rutimeyer, M. Morlot and others. They are mostly referable to the Stone age—those of the Bronze period being less generally distributed, and having been, as yet, only found on the western lakes.

In the Iron age they seem to have become almost deserted—pile dwellings referable to that period having been observed only on the Lakes of Bienne and Neufchatel. The Fauna of the Pile-dwellings, which has been so ably worked out by Professor Rutimeyer, occupies a middle position between that of the river-gravels on the one hand and the present Swiss Fauna on the other. Distinguished from the latter "by 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, and the Ibex, &c., it differs from that of the "gravel-drifts in the absence of the Mammoth, the Rhinoceros, the "Cave-bear, and the Cave-hyena."

The heaps of refuse cast out by the ancient inhabitants of Denmark, in the vicinity of their habitations, and often called by the Danish term "Kjökken-mödding," though the English form of the word, ("kitchen-midding") seems preferable for ordinary use, have been worked out by the savants of Denmark, no less energetically and successfully than the pile-dwellings of Switzerland by the Naturalists and Archæologists of the latter country. Sir John Lubbock gives us a careful resumé of the results thus arrived at, and, on the whole, comes to the conclusion that these shell-mounds represent a definite period in the history of that country, and are probably referable to the early part of the Neolithic age. Carrying our imagination back to this period, says our author, "we see before us on the low shores of the Danish "Archipelago a race of small men with heavy overhanging brows, "round heads, and faces probably much like those of the present "Laplanders. As they must evidently have had some protection "from the weather, it is most probable that they lived in tents "made of skins. The total absence of metal in the kjökken-"möddings proves that they had not yet any weapons except those "made of wood, stone, horn and bone. Their principal food must "have consisted of shell-fish, but they were able to catch fish, and "often varied their diet by game caught in hunting. It is, perhaps, "not uncharitable to conclude that, when their hunters were un-"usually successful, the whole community gorged itself with food, "as is the case with many savage races at the present time. It is "evident that marrow was considered a great delicacy, for every "single bone which contained any was split open in the manner best "adapted to extract the precious morsel."

The facts hitherto recorded by the Archæologists of North America, concerning the ancient monuments of that country, which form the subject of our author's next chapter, although of great interest, as proving that parts of the great valley of the Mississippi were formerly the seat of an earlier civilization and subsequent retrogression into barbarism, have not much value as regards the antiquity of the human race. Even if we attribute to these changes all the importance that has been claimed for them, Sir John Lubbock is of opinion that "they will not require an antiquity of more than three thousand years." He does not deny that the period *may* have been much greater, although he believes that that limit is sufficient to meet all the circumstances of the case. At the same time, there are other observations, which, if they shall eventually prove correct, would indicate a very much higher antiquity.

The ossiferous caves of Europe furnish us with much more important evidence on the subject. We shall not now attempt to go into the particulars of this part of Sir John Lubbock's work, as they have so short time ago been submitted to our readers in a former number of this Journal.* But we may be permitted to repeat the conclusion arrived at—that the bone-caves supply us with sufficient evidence that "man was coeval in Europe with the great group of quaternary Mammalia." In the like manner it will be unnecessary to say much about the great discoveries of M. Boucher de Perthes in the valley of the Somme, and other discoveries of flint instruments, to which we have so frequently called attention. After making careful allowance for all the objections started, and the difficulties urged in relation to this subject, Sir John Lubbock comes to the inevitable conclusion, that even, if "we get no definite date for the "arrival of man in these countries, we can at least form a vivid idea

* See "Cavemen." By J. Lubbock, F.R.S., &c. N.H.R., 1864, p. 407.

"of his antiquity. He must have seen the Somme running at a "height of about a hundred feet above its present level. It is indeed "probable that he dates back in Northern France, almost, if not quite, "as far as the rivers themselves. The fauna 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 rein deer, and the urus." Pursuing this branch of the subject, Sir John Lubbock remarks that the discoveries already described by no means exhaust the evidence now accumulated in favour of the great antiquity of the human race. The double change which is shown to have taken place in the prevalent vegetation of Denmark since the human period, the implements disinterred from the gravel-cone of the Tinière, and the calculations of M. Gilliéron as to the time requisite for the silting-up of the head of the Lake of Bienne since the building of the lake habitation of the Pont de Thiéle are among the points touched upon by our author in connection with this part of the subject. The Egyptian researches of Mr. Horner, the calculations of Sir Charles Lyell as to the age of the Mississippi Delta and as to the duration of the glacial epoch in this country are also commented upon. There can be no doubt, he observes, of the interest of these and such estimates, but we must always recollect that they are brought forward "not as *proofs* but as measures of antiquity." Our belief in the antiquity of man rests not on any isolated calculations, but on the changes that have taken place since his appearance, in the geography, the fauna and the climate of Europe. These, though they afford us no means of measurement, impress us with a vague and overpowering sense of antiquity. Sir Charles Lyell—himself the able advocate and populariser of these views—has fixed upon the pliocene strata as the earliest in which we may expect to find evidence of man's existence. But Sir John Lubbock alleges fairly enough that "if "man constitutes a separate family of Mammalia, as he does in "the opinion of the highest authorities, then, according to all palæ-"ontological analogies he must have had representatives in Miocene "times. We need not, however, expect to find the proofs in Europe. "Our nearest relatives in the animal kingdom are confined to hot, "almost to tropical, climates; and it is in such countries that we "must look for the earliest traces of the human race."

Having thus far devoted himself to the facts that have been hitherto collected concerning the primitive peoples of Europe, Sir John Lubbock now turns to the barbarous nations still existing in foreign countries in order to see how far their manners and customs will enable us to understand the habits and usages of the former inhabitants of this part of the world. Drawing a comparison between the labours of the Archæologist and Palæontologist our author remarks that the bone- and stone-implements are in some respects to the one what the remains of extinct animals are to the other. "Our fossil Pachyderms," he observes, "would be almost unintelligible, but for the living species of this group which inhabit Asia and Africa—and the extinct marsupials of the secondary formations are illustrated by reference to their living representatives in Australia and South America. In the same manner if we wish clearly to understand the antiquities of Europe, we must compare them with the rude implements and weapons still, or until lately, used by savage races in other parts of the world." This is rather a wide subject to enter upon, and Sir John Lubbock accordingly limits himself nearly entirely to describing what may be called the "non-metallic savages," amongst whom many weapons and other implements are still in use which curiously resemble those of the ancient inhabitants of Europe.

We will not follow our author into his discussion of the habits and customs of the Hottentots, Veddahs, Mincopies, Maories, Fuegians, and other primitive tribes. But the deductions drawn in the concluding chapter must not be passed over so hastily. As there is no evidence of "degradation,"—that is, of mankind giving up an improved practice and going back to a clumsier method, it is evident, assuming the common origin of the human race, that the lowest races of savages must be at least *as far* advanced as were our ancestors when they spread over the earth's surface. "What then," asks our author, "must have been their condition?"

"They were ignorant of pottery; for the Esquimaux, the Polynesians, the Australians, some North and South American tribes, and many other savage races, have none even now, or, at least, had none until quite lately. They had no bows and arrows, for these weapons were unknown to the Australians and New Zealanders; their boats, for the same reason, must have been of the rudest possible character; they were naked, and ignorant of the art of spinning; they had no knowledge of agriculture, and probably no domestic animal but the dog, though here the argument is weaker, inasmuch as experience is more portable than property. It is, however, in my opinion, most probable that the dog was long the only domesticated animal. Of the more unusual weapons, such as the boomerang, blowpipe, bolas, &c., they were certainly ignorant. The sling and the throwing stick were doubtless unknown, and even the shield probably had not been invented. The spear, which is but a development of the knife point, and the club, which is but a long hammer, are the only things left by this line of argument. They seem to be the only natural and universal weapons of man."

The same argument applies to the mental condition of savages. It is not probable that our earliest ancestors could count ten, for many races now in existence cannot get beyond four. But on the other hand, it is not likely that man can ever have been in a lower condition than is here indicated. Only under the tropics could he have existed without weapons, subsisting solely on fruit, like the monkeys. So soon as he spread into temperate regions, such a mode of life would be impossible, and nourishment, in part at least, must be sought for from the animal kingdom. "Then, if "not before, the knife and the hammer would develop into the spear "and the club."

These deductions, as we have observed, assume the original unity of the human race, which is vehemently opposed by Mr. Crawfurd, and other ethnologists. Sir John Lubbock acknowledges the weight of some of their arguments, but alleges, with good reason, that man was, in former ages, a more "plastic" animal, and more susceptible of change. In support of these views, he brings forward Mr. Wallace's remarkable application of the Darwinian theory to the origin of human races, of which an abstract was given in the last volume of this Journal.* Even, however, if we cannot altogether adopt the conclusions arrived at by Mr. Wallace, as to the future of the human race, we are justified, as our author believes, in considering "that the happiness of man is still greatly on the increase." An animal increases in numbers when conditions are more favourable to it, that is, when it is happier and more comfortable. As civilization increases population increases, and what is equally important, the means of subsistence increase in a still greater ratio, so that, contrary to what happens in a state of nature, "the most densely-peopled countries are those in which food is most abundant." It is all very well to talk of the "free and noble

* Nat. Hist. Rev. 1864, p. 328.

savage;" but those who, like our author, have troubled themselves more with facts than with fancies, will agree with him that, "the true savage is neither free nor noble; he is a slave to his own wants, and his own passions; imperfectly protected from the weather, he suffers from the cold by night and the heat of the sun by day; ignorant of agriculture, living by the chase, and improvident in success, hunger always stares him in the face, and often drives him to the terrible alternative of cannibalism or death."

In fine, the whole analogy of nature leads us to conclude that "the pleasures of civilized man are greater than those of the savage" —and there can be no doubt that, with the present rapid increase of civilization and of science, human happiness is also on the increase. The experience of the past gives us the most sanguine hopes of the future, for it is not reasonable to suppose that a process that has been going on for so many thousand years should now suddenly cease. "The unselfish mind," says our author in conclusion, "will find its highest gratification in the belief that, whatever may be the case with ourselves, our descendants will understand many things which are hidden from us now; will better appreciate the beautiful world in which we live, avoid much of that suffering to which we are subject, enjoy many blessings of which we are not yet worthy, and escape many of those temptations which we deplore, but cannot wholly resist."

XLIV.—Antediluvian History in Poitou.

Époques Antediluvienne et Celtique du Poitou. Par M. M. A. Brouillet et A. Meillet. Poitiers, 1865.

This work is divided into two parts: Topography, by M. Brouillet, and Technology, by M. Millet. The first part contains the description of several caverns, and their contents, as well as of numerous cromlechs and some Roman stations, examined by M. Brouillet. It is illustrated by numerous figures, which, though rude in execution, give a tolerable idea of the objects represented. A careful treatise on these subjects could not fail to possess much interest; but as regards the examination of cave-remains, much depends upon the correct determination of the animals to which they belonged. There is unfortunately much reason to doubt whether the species mentioned by M. M. Brouillet and Meillet are in all cases to be depended upon.

For instance, in describing one of the most important caverns, that of Chaffaud, M. Brouillet says that the remains comprised bones of the ox or aurochs, the horse, *ass*, hyæna, bear, wolf, dog, fox, hare, rabbit, and many small rodents. Now, without referring to the other species mentioned, it is well known that the ass was not introduced into Europe until a comparatively recent period. Again, in the Grotte aux Fadets, he mentions remains of the domestic fowl, which is also a species of recent introduction. M. Meillet does not appear to be much more conversant with Zoology than M. Brouillet, if at least we may judge from the fact that he ranges the weasel among the rodents. The worked implements found by M. Brouillet in the caverns, some of which would otherwise be extremely interesting, are unfortunately, as we shall presently see, open to doubt for another reason. Perhaps, therefore, the most interesting part of M. Brouillet's work is that in which he favours us with his views as to the Geological History of the quaternary period. He is a firm believer in cataclysms, but appears to be a little dissatisfied with the deluge of Noah. "Personne," he tells us, "ne nie le déluge de Noé, au contraire, tout le confirme, et les traditions et les faits Géologiques. Mais s'il nous dit à peu près l'âge des sociétés qui lui sont postérieures, il ne nous dit rien dé celui qu'avait le genre humain quand Dieu voulut le punir de ses désordres."

We do not deny Noah's deluge, but we do deny that there is any single *Geological* fact which confirms it. Those who believe in it must rely upon tradition. But if the Deluge does not tell us the age of the human race, "quand Dieu voulut le punir de ses désordres," this is of the less importance, inasmuch as M. Brouillet, with the assistance of M. Meillet, supplies the omission, and reveals to us some new deluges which give us, as we shall see, the most exact information upon the subject. The first European deluge "*paraît*," modestly observes M. Brouillet, "avoir été occasionné par le soulévement des montagnes de Norvège." It was not until after this deluge that man appeared in Europe. The second European deluge was caused by the elevation of the Alps. The Asiatic or Mosaic Deluge was subsequent, "aux deux cataclysmes Européennes," and was "partiel et non universel, comme le dit le livre de Moïse." Being, therefore, partial, and not having extended to our Continent, the inhabitants of Europe escaped the misfortunes which fell upon those of Asia. "Il me semble," adds M. Brouillet, and we are not disposed to deny it, "que ces suppositions sont tout aussi admis-

"sibles que l'idée de M. Boucher de Perthes, qui considère Adam et "sa posterité provenant d'une seconde création après l' anéantisse-"ment complet d'une première race qui n'aurait laissé aucun représen-"tant sur notre globe." We need not point out to our readers how widely these hypotheses, which account for the drift gravels by a succession of cataclysms and deluges, differ from those which are prevalent in this country, and for which we are in great measure indebted to the patient and life-long labours of Mr. Prestwich.

In the second portion of this work, M. Meillet also presents us with some remarkable speculations. He sketches out roughly the history of the human race, as follows:

"Première période . . . . La race Scythique, dite Japhéti-"que, habite déjà les 'monts Altaï;' race errante et voyageuse, elle "inonde le monde de ses hordes nomades: un rameau immense serait "descendu jusque vers les montagnes de l'Himalaya, et en aurait "occupé le versant nord: c'est la race Arya. Une autre branche se "serait dirigée vers le Turkestan actuel, par les régions nommées par "les anciens Margiane et Bactriane: une partie de la colonie paraît "s'être arrêtée dans ce pays, d'où nous la reverrons sortir plus tard; "l'autre partie serait passée au sud de la mer Caspienne, de là dans la "Turquie d'Asie, la Grèce, (deux pays qui n'en faisaient qu'un à cette "époque) puis en Italie, en Espagne, en Gaule et ne se serait arrêtée "qu'aux confins de l'univers connu, l'Angleterre, qui était alors jointe "au continent." "Passant," he proceeds, "à une autre date qui nous "intéresse, à l'an 13901," [this is certainly a very interesting date; we are not scandalized by the 13000 years, and an extra 900 makes certainly very little difference, but the last straw, we are told, broke the camel's back, and that last 1 is a little too much for us. However, we must let M. Meillet speak for himself. He supposes this first period to have occupied about 10,000 years] "pendant cette "longue période, les Aryas, fixés dans les plaines fertiles de "l'Inde, deviennent tout à fait sédentaires; de peuples chasseurs, "ils deviennent successivement pasteurs, agriculteurs, et enfin "artistes, cette phase ultime de la civilisation des peuples qui ont su "par leurs travaux agricoles se créer des loisirs qu'il faut occuper. "Les sciences et les arts sont alors portés à un haut degré de perfec-"tion sur les bords de l'Indus. Manon leur donne des institutions "civiles et religieuses; c'est un de leurs plus célèbres législateurs. Vers "14611, les Égyptiens inventent le zodiaque, qui ne tarde pas à passer "dans l'Inde."

The deluge of the year 13901, "dont nous venons de parler dut "être occasionné par la débâcle du pôle sud:" but about the year 2350, "arrivent de nouveaux déluges provenant de la débâcle de la glacière "du pôle nord." These are the deluges, some of which are mentioned in ancient traditions, but in addition to them various "petits cata-"clysmes locaux" are also mentioned by M. Meillet. Those who wish for more information as to M. Meillet's views must refer to the work itself. He does not, however, go at length into the considerations which have led him to such conclusions, although he refers us to certain authorities which are perfectly satisfactory to him; as, for instance, to "le Souria Syddantha, traité d'astronomie également en "Sanscrit, rédigé bien avant 13901." Some, indeed, might be disposed to doubt whether the astronomical treatise known under this name really belonged to a period so remote, but M. Pictet, we are told, has conclusively settled this question. "Je la consigne donc ici," says M. Meillet, "comme un fait." We cannot, however, avoid feeling a little doubt whether M. Pictet himself is prepared to accept the honourable responsibility thus conferred upon him. M. Meillet also refers to various other ancient works, belonging to the Hindu, Persian, and Egyptian literature, in which "cette date précise" is mentioned.

It will be seen that although M. Meillet is more definite as to his dates than M. Brouillet, still our two authors agree very well in their ideas as to the probable history of the quaternary period. They are, moreover, both members of the "Société des Antiquaires de l'Ouest:" and this Society is said to have been scandalized by the high antiquity which our authors had assigned to the human race. A resolution, therefore, appears to have been passed condemning the work of M.M. Brouillet and Meillet. In taking any such step as this, the Society no doubt placed itself in the wrong, and we are informed that M. Meillet, as well as several other members, accordingly sent in their resignation. But M. Brouillet—did not he stand by his friend? Did not he also protest against the condemnation by the Society? We should have thought that, united as he was with M. Meillet, by so many observations made in common, by the remarkable speculations in which they had together indulged, they would have been inseparable even in disgrace. But it was not so. M. Brouillet has not only continued in the bosom of the Society, but has had the fatted calf, in the shape of a medal, offered to him. Nay more, we regret to say that he and M. Meillet began to quarrel, and a not very creditable correspondence has passed between them with reference to the first discovery of certain caves described by them. Miss Austin, in one of her novels, describing a somewhat stupid young man, says, that "Jack knew a puddle when he saw one," and we suppose there is no one who does not know a cavern when he happens to see one. We remember once to have heard of a somewhat similar dispute between two entomologists, who were out collecting together. One of them showed to the other a beetle, which he had just found. "What is this?" he asked. "Oh," replied the second, "it is such and such a beetle, and I am very glad I have found it, as it has never yet been observed in this country." "*You* found it?" answered the first, "it was I. I have just swept it off that clematis." "Yes," replied the second, "but you didn't know what it was," and so on. The Entomologists however, were not so foolish as to rush into print, and we regret that M.M. Brouillet and Meillet could not keep their quarrels to themselves. It is a matter of small importance by whom the cavern of Chaffaud was discovered; the real merit consisted in examining it carefully. There is, however, one discovery which M. Meillet generously offered to share with M. Brouillet, and which the latter entirely repudiates. Many of the bones obtained from the caverns examined by these gentlemen, have upon them very curious engravings; but the most remarkable specimen of all, is a bone on which are engraved several Sanscrit letters. This extraordinary specimen was found in the stalagmite, "pêle-mêle avec des os "d'hyène, d'ours, d'aurochs, &c., dans une position bien définie. C'est "M. Brouillet et moi qui les avons trouvés nous-mêmes et dans un "terrain vierge de toute fouille." M. Brouillet, however, indignantly repudiates the soft impeachment. "I had nothing to do with it," he says, "and it was M. Meillet alone who found this specimen." Why should M. Brouillet indignantly repudiate that which is without doubt the most remarkable fact recorded in the volume? The answer is very curious. The engravings are a forgery—the work of some miscreant, who, knowing that the majority of Ethnologists believed that in very ancient times an Eastern nation, speaking a language belonging to the Sanscrit family had migrated into Europe, thought rightly, that to discover for the first time traces of the use of a Sanscrit alphabet, or indeed of any alphabet at all at so ancient a period, would be a fact of the greatest interest.

Fortunately, however, such a fraud was almost certain to be detected, and in this case the discovery has been immediate. The forger, whoever he may be, did not use the old Sanscrit characters, but those belonging to what is known as the Devanagari alphabet, which is not more than about 900 years old. It is perfectly evident, therefore, that a gross fraud has been perpetrated by some one, and it appears that M. Brouillet suspects his colleague of having himself engraved not only these Sanscrit characters, but also many of the other curious figures found on bones, and described in their joint volume.

All this is very much to be regretted. The "Société des Antiquaires de l'Ouest," M. Brouillet and M. Meillet have all succeeded better in their attacks upon one another than in their defence of themselves. We hope that M. Brouillet will continue his search for flint implements; we sincerely trust that M. Meillet will be able to clear himself from the insinuations of his colleague, and that the great abilities which he undoubtedly possesses will not be wasted on speculations such as those to which we have referred in this review, and for which he has not the necessary information.

The most satisfactory part of the business lies undoubtedly in the proof which it affords, that forged antiquities, however cleverly they may be contrived, and however skilfully they may be made, present some indication by which their true character may be detected.

XLV.—Recent Archæological Discoveries.

Two communications have lately been made to the French Academy of Sciences, which are of much interest as regards the recent Archæological discoveries in France and the adjoining countries. On the 14th of August, a letter was read from M. Simonin, addressed to M. Elie de Beaumout, in which the former announced that M. Foresi had discovered in the island of Elba certain objects, supposed to belong to the ages of stone and bronze. Of the objects referred to the age of stone nine-tenths are formed of flints, belonging to varieties which do not occur in the island itself. The principal types are:

1. Triangular arrow heads.
2. Knives resembling those discovered by M.M. Lartet and Christy, in the caves of Aurignac, Les Eyzies, La Madelaine, &c.
3. Scrapers.

4. Axes "de la forme bien connue, révélée par Boucher de "Perthes, mais plus petite."

5. Nuclei, "rappelant les fameux pains de beurre de Pres- "signy. L'un d'eux, trouvé à la Pianosa, îlot voisin de l' île d' Elbe, "est en belle obsidienne noire, portant sur tout son contour la trace "de longs éclats longitudinaux. Il a été divisé en deux : les bases "en sont polies, et de surface un peu gauche. La forme est con- "ique."

6. Objects of indeterminate form.

We do not perceive in the letter of M. Simonin any sufficient reason for referring these objects to the age of stone. Arrow-heads of stone were used throughout the age of bronze, and in the whole of Great Britain up to the present time, so far as we are aware, not a single bronze arrow head has been discovered. Scrapers also were used in the age of bronze.

Although M. Simonin does not describe the nuclei at length, still it is evident that they differ in one very remarkable respect from the "livres de beurre" of Pressigny. He says that they are in part polished, which is never the case in the "livres de beurre."

If the axes belong to the type which is characteristic of the drift gravels, the fact is no doubt extremely interesting. The objects belonging to the age of bronze are axes, "des formes les plus "anciennes, puis une faucille ;" also some objects of undetermined use and some moulds. We hope that we shall receive some more information with reference to these observations of M. Foresi.

At the sitting on the 21st of August, M. Milne-Edwards communicated to the Academy the following letter from M. Lartet, relating to a plate of fossil ivory found in an ossiferous bed at Périgord, and bearing marks which apparently are intended as the representation of a long-haired elephant.

"Since you think it may be useful to make public the palæontological specimen which has been shown to you, and on which may be recognized contours and linear details of an animal form, referable to an elephant, I send you a model of it executed by M. Stahl, the clever artist attached to the Museum of Natural History. Besides which, the original, after my return to Paris, will be at the disposal of any one who shall wish to make a more complete examination of it.

"The history of this specimen, which was discovered more than fifteen months ago is as follows:—In May, 1864, M. de Verneuil and our late friend Dr. Falconer, having expressed to me a desire to visit the caves and other localities in the Dordogne, which I had explored in common with my much regretted colleague, the late Mr. Henry Christy, I accompanied them in this excursion. The excavations at La Madelaine were then being continued, and had already furnished a number of those animal figures engraved on bone and reindeer horn, of which some were placed last year under the eyes of the Academy. At the time of our arrival, the workmen had just discovered five cracked fragments of a rather thick plate of ivory, which must have been formerly broken off from a tolerably large elephant's tusk. After joining these bits together by the marks furnished by the roughnesses of the fracture, I showed to Dr. Falconer several rather deep lines or engravings which, when brought together, seemed to indicate animal forms. The practised eye of the celebrated palæontologist who has best studied the Proboscidians, recognized directly the head of an elephant. He also identified several other parts of the body, particularly about the neck, a bundle of descending lines reminding us of the long-haired mane characteristic of the Mammoth, or elephant of the glacial epoch.* It is known that this specific peculiarity, referring to the sub-arctic habitat of an animal of this species, was verified in 1799 by Mr. Adams, of the Academy of St. Petersburg, by means of the body of one of these elephants (*E. primigenius*), which was embedded, flesh, bones, and all, in the ice near the mouth of the Lena. A tuft of the long hair of the Mammoth may be seen in the Gallery of Geology of the Museum.

"According to the rule which we have laid down, I did not wish to publish this discovery before it was confirmed by a second analogical observation, I therefore contented myself with exhibiting the specimen to some of the most competent judges. Among these I may mention MM. de Quatrefages, Desnoyers, de Longpérier, all of whom have, like yourself, examined it with the most scrupulous attention; also Mr. A. W. Franks, Director of the London Society of Antiquaries, who was good enough to take the trouble of following out upon the model, and tracing with a black pencil the most pronounced engravings, and those most characteristic of the forms to be distinguished. It is, therefore, the opinion of these eminent savants and that of Mr. Falconer, together with your own, which I shall lay with mine, before the Academy. For the rest, this new fact adds

* In the model, there is in the lines descending from the top of the head, a gap or interruption corresponding to a transverse breakage, filled up in the original by cement.

nothing to the already formed convictions on the co-existence of man with the fossil elephant (*E. primigenius*), and the other great Herbivora or Carnivora considered by geologists as having lived during the first phases of the quaternary period. The truth of this retrospective evidence is now deducible from so great a number of corresponding observations, and from material facts of so manifest a signification, that even minds the least prepared to admit it, no longer hesitate to accept it in all its reality, from the moment that they will take the trouble to see for themselves and afterwards to judge conscientiously.

"Permit me, Sir, to profit by this occasion, in order to beg you to announce to the Academy two discoveries of a more actual bearing upon my studies on the geographical distribution of the quaternary Mammifers. First, the observation of a Marmot, of a species new, or at any rate different from that of the Alps, the remains of which have been found in a Dordogne cave anciently inhabited by man.

"The other, and more important fact, consists in the finding in Périgord, at another place of human abode of great antiquity, a certain number of bones of the *Ovibos moschatus*, or Musk Ox, in a fragmentary condition analogous to that of other bones of the animals upon which the primitive inhabitants lived. These bones of the musk ox were found associated with the remains of the great bear, the cave lion (*Felis spelæa*), the reindeer, the aurochs, the horse, &c., and in the midst of the relics of human industry; thus showing the persistence of a glacial epoch up to the time when man established himself in this European region of which the climate is now so temperate. We know in fact that the musk ox, now banished to North America, never comes lower than 60 deg.; during the first part of the quaternary period, then, this animal existed 15 deg. further south. It is worthy of remark that M. Alphonse Milne-Edwards arrives at similar conclusions, from the studies he has made of fossil birds from the caves and other human stations in Périgord."*

M. le Marquis de Vibraye has since recorded a similar discovery made at l'Augerie in the Dordogne.

* See proceedings of the Société Philomathique, meeting of the 8th July reported in "L'Institut", number 3, August, 1856.

XLVI.—The Trees and Shrubs of the Ancients.

Essay on the Trees and Shrubs of the Ancients, being the Substance of four Lectures delivered before the University of Oxford, intended to be supplementary to those on Roman Husbandry, already published by C. Daubeny, M.D. F.R.S., Professor of Botany and Rural Economy in the University of Oxford. Oxford and London. 1865. 8vo.

This is a most valuable contribution to botanical Archeology, not so much perhaps from any number of new facts which it establishes, as from the bringing together in a concise methodical form, all that is known on the subject, and by the sifting the evidences upon which we have formed our conclusions, thus showing how meagre these evidences are, and how very few of the ancient Greek and Roman names of trees and shrubs have been, or can be identified with the species they represent. Linnæus, and other botanists of the last and previous centuries, followed by the majority of lexicographers, had unhesitatingly applied the ancient names to particular species, upon grounds which rarely exceeded vague conjecture, and these identifications, like the common ones of Biblical floras, had been the more generally accepted by writers of Central and Northern Europe, in consequence of the very little knowledge we had of the actual vegetation of the countries where the ancient authors lived and wrote. When, however, the pacification of Europe in the early part of the present century, had opened the classical soil of the Mediterranean regions to the exploration of naturalists, the glaring misapplications of ancient names, did not fail to come to light, and several elaborate works, both German and French enumerated by Dr. Daubeny, besides some Italian ones, were devoted to the correction of these errors, and to the inquiry as to what were really the plants known to, and named by the ancients. At an earlier period also, the late Dr. Sibthorp had laid up a rich store of information on the subject, the more valuable as much of it had been collected on the spot, during his celebrated travels in Greece. Of all these materials Dr. Daubeny has made very good use, and he has also availed himself of the old commentaries on Theophrastus and Dioscorides, and of some curious illustrations appended to old MSS. in the Vienna library. Applying to the whole his own critical acumen and knowledge, both of classical literature and natural science, he has produced a compilation, which, as we perfectly agree with him, "will be found to embrace an identification of a greater number of Greek and Roman plants than is contained in any former English publication," and we may add, as far as they go, much more to be relied upon. We believe, at the same time, that every other inquirer pursuing the subject with the same means at his disposal, and the same anxiety to get at the truth, must inevitably come to the same conclusion, that, "in consequence of the vagueness of the descriptions of classical writers, and the loose manner in which they noted the characters of the plants that came under their observation," it is scarcely possible, "except in the case of a few conspicuous and important species, to do more than point out with some degree of probability, the natural family, or at most, the genus to which the classical designation appeared intended to apply." The result of Dr. Daubeny's critical notes is summed up in a catalogue of about 140 genera, and nearly 100 species, of Greek and Italian trees and shrubs, referred with more or less probability to their classical appellations.

We join with Dr. Daubeny in deploring the servile manner in which ancient writers were in the habit of copying from each other the facts they gave, mixed up with old fables, instead of observing for themselves, but as some excuse we may allude to the difficulty of avoiding it, even in modern days, in all general works which must include more or less of compilation. A striking instance may be pointed out even in the work before us, where pp. 34 and 35, Dr. Daubeny has inadvertently given further currency to some of the many absurd fables put forth in a recent article on Conifers, in the "Edinburgh Review," and exposed by Dr. A. Gray, in "Silliman's Journal." Bernard de Jussieu did not bring a seedling of the Cedar from the Holy Land, nor did he stint himself of water to keep his plant alive. The Cedar which he brought without any romantic difficulties from England in his hat, a very common receptacle for a travelling botanist's plants, and planted in 1734, still stands in its original site, in the Jardin des Plantes, and no railway comes near it.

XLVII.—The Physiology of the Sphæriaceæ.

Beitrage zur Anatomie und Physiologie der Sphæriaceen, von August Sollmann. Botanische Zeitung, August 26, 1864. Vol. XXII. p. 265 and 271.

Ueber die Entwickelung der Fructificationsorgane von *Nectria*, von Alexis Janowitsch. Bot. Zeit. May 12, 1865. Vol. XXIII. p. 149.

In a report contained in a former number of this Review, (Jan. 1865), on the sexuality of the lower Cryptogamia, we noticed shortly the conclusions drawn by M. Sollmann, from the observations detailed by him in the paper cited above. The subject has since been treated by Professor Janowitsch, in the Journal above mentioned, and as his opinions are directly at variance with those of M. Sollmann, we have thought it worth while to state the contents of M. Sollmann's paper more in detail, and to give the contradictory views of M. Janowitsch, by way of supplement to our former report.

M. Sollmann states, that he has observed the process of fructification in four species of *Nectria*; viz. *N. Lamyi* De Not., *N. cucurbitula* Tod, *N. coccinea* P., and *N. cylindrospora* Sollm, and perhaps in a fifth, *N. inaurata* B. and Br. The phenomena being the same in all, he considers it necessary only to go into details with regard to the first species.

In this the stroma is formed by the growing together of the terminal threads of the mycelium, and the perithecia are produced at the surface of the stroma. The walls of the perithecia consist of three different layers, called by the author the outermost layer (*äusserste Schicht*), the transition layer (*Uebergang's-schicht*), and the fertile layer (*Fruktifications-schicht*). In observing the process of fructification, it is necessary, in order to avoid deception, to select for examination, only those perithecia which have not opened. Perithecia of different ages, although agreeing externally in appearance, exhibit essential differences in the fructifying layer, and three forms are particularly noticeable.

A. The form with asci. This (which is the form of the oldest perithecia), exhibits numerous asci attached to the wall of the perithecium, from its base to some distance upwards. The upper part of the perithecium produces pendant threads, and similar threads are visible as paraphyses in the lower portion. The youngest asci are small, almost cylindrical, and filled with a transparent fluid plasma. More advanced asci are club-shaped, and contain a vast number of reddish bodies, which render the ascus opaque, and prevent the observation of any new formation in its interior. These bodies disappear by degrees, and eight spores make their appearance in the now colourless ascus. Although at first sight, and having regard to their chemical reaction, these bodies might be taken for protoplasmic granules, they exhibit the following differences—they are elongated, acuminate at each end, somewhat thinner in the middle, sharply defined in outline, and apparently divided transversely; they exhibit (even after having been kept a long time) a molecular motion backwards and forwards in the direction of their axis, which motion is only arrested by long digestion in caustic potash and nitric acid, but is not affected by iodine and sulphuric acid, or by sulphuric acid and potash. Moreover they are found in large numbers *outside* the ascus, *i.e.* free in the cavity of the perithecium.

These bodies do not germinate, and cannot therefore be the spores of any parasite, against which supposition their *constant* appearance in all young perithecia is an additional argument.

After observing that the organisms in question have been sometimes looked upon as a secondary form of spore, sometimes as impregnative bodies, M. Sollmann adopts the latter opinion, stating that in the young form of the perithecium the mode of their development is conclusively shown.

This leads to the consideration of the form B. or spermatiferous perithecium. These perithecia produce neither asci nor paraphyses upon their fructifying layer, but contain threads which are torulose at the apex, and from which by constriction* (*Abschnürung*) small cells are given off, agreeing in every respect (chemical nature, incapacity for germination, &c.) with the so-called spermatia in the perithecia of form A. Therefore, M. Sollmann concludes, that these similar bodies in the two forms of perithecia are identical, and he proceeds to consider what relation subsists between the "spermatia" of the two forms of perithecia. Either, he says, the spermatia of the one form of perithecium penetrate into the other, or one of the perithecium-forms is developed from the other. There being in the early stage no opening through which the spermatia from one perithecium could enter the other, M. Sollmann is of opinion that it must necessarily be admitted

* We have no word in English equivalent to "Abschnürung." Constriction is perhaps the nearest, but is not quite satisfactory.

that the ascigerous form of perithecium is developed from the spermatiferous form.

The third form of perithecium to be considered, is C. *the transitional form.*

This sometimes resembles form A. and sometimes form B. It contains a number of paraphyses of all sizes, and a crowd of free spermatia. The paraphyses are shorter at the upper part of the perithecium, and at the apex of it resemble the spermatiferous threads. M. Sollmann is of opinion that these threads become by a terminal and peripheral increase in growth, transformed into paraphyses.

The asci are situated between the more advanced paraphyses. The largest asci are more or less filled with spermatia, the younger ones hardly project above the fructifying layer. The cavity of the young ascus is continuous with that of the mother-cell. The parts of the fructifying layer upon which the asci are formed, are full of spermatia, which lie partly *on*, and partly *in* the cells. The spermatia which are in the mother-cells pass upwards into the interior of the young ascus. Ultimately the ascus (which has become clavate) is quite stuffed with spermatia, and becomes opaque. The cavity of the ascus is now divided from that of the mother-cell, and no further entry of spermatia can take place.

M. Sollmann then proceeds to describe the process of fructification (*Befruchtungsact*). He says that eight membraneless bodies (cytoblasts) are developed in the ascus, either by free cell formation, or by division, but probably by the former. These bodies have a smooth surface, and become elongated in the direction of the longitudinal axis of the ascus. Thus they become first roundly elliptical, and at last elongate-elliptical. Up to this time they have no spiral membrane. At this stage the spermatia attach themselves by one end firmly to the surface of the cytoblasts. At the point where the spermatium attaches itself, the surface of the young spore gradually disappears, and the pole of the spermatium thus at lasts comes into contact with the contents of the spore. The spermatia come from all directions, and attach themselves firmly all over the surface of the young spore. The portion of the spermatium which penetrates the spore remains visible within it for a considerable time.

Ultimately the spermatia make their way *into* the spore, and the edges of the openings through which they have entered unite, leaving the surface of the spore with slight elevations at the points of entry. As the spermatia get deeper into the spore, these elevations disappear, and the surface becomes even. The spore is now for the first time surrounded by a double-outlined membrane. By degrees the spermatia become disintegrated, and are no longer visible in the contents of the spore.

During these processes the septa of the spore are formed.

M. Sollmann considers that the fact of the spermatia becoming dissolved in the substance of the spores, proves that they differ chemically from the latter, and he draws the following conclusion, which he gives in italics:—"As therefore (he says), the spermatia "are chemically, genetically, and physically, different from the true "spores, but unite with the contents of the latter to form a homo-"geneous mass and render them capable of reproducing the species, "we must look upon the spermatia as the vehicles of the fertilizing "matter, and we consequently have an impregnation in the proper "sense of the word."

At the conclusion of his paper, the author observes that in most *Sphæriæ*, the asci contain no spermatia, but only a granular mass, which lies upon the protoplasm, and asks whether the granules are not of the same nature as the spermatia. He says that he has clearly seen in many *Sphæriæ*, that the spermatia penetrate into the fructifying layer, and there change their form, and become divided into minute particles, endowed with molecular motion. This is seen clearly in *Sph. acuta* Hoffm., *Sph. obducens* Schm., and especially in *Nectria cinnabarina* Tode. The particles, he adds (as in *Nectria Lamyi*), make their way from the cells of the fructifying layer into the young asci, so long as the cavity of the latter is in continuous connection with that of the mother-cell. Before this stage, the asci are filled with a transparent, thickly-fluid mucilage. As the asci become older and larger, more and more of these granules make their way within them, and the asci become opaque. The granules are not distributed uniformly throughout the mucilage, but lie under the inner wall of the ascus, upon the protoplasmic mass. In the latter substance cytoblasts, at first membraneless, are now formed; these gradually enlarge, become surrounded by a membrane, and perfected internally. In the mean time the granular mass disappears by degrees, and when the spores are ripe, has vanished altogether. In what way the individual granules are got rid of cannot be directly observed, owing to their small size and vast numbers. As particles of the disintegrated spermatia, they certainly penetrate within the membraneless spores (like the spermatia of *N. Lamyi*), become rapidly amalgamated with the contents of the latter, and complete their impregnation.

We have now given the substance of M. Sollmann's paper. We do not propose to go at length into the contents of Professor Janowitsch's paper, as it does not profess to throw any light upon the process of fructification, and, indeed, concludes with the remark that the act of impregnation in the Sphæriacei is as much a mystery as ever. We must, however, notice those parts of it in which the author's conclusions are directly at variance with those of M. Sollmann. This latter paper relates to *Nectria inaurata*, B. and Br. *Nectria Lamyi* De Not. and *N. cinnabarina* Tode. The author describes the formation of the stroma, and the development of the pycnidia (preferring that term to spermogonia) or conidium-bearing organs, as also the mode of germination of the conidia of *N. cinnabarina*. He observes that the young perithecia contain in their interior a mass of transverse threads (*Faden-system*) growing from the inner wall, and converging radially, and which at first sight have the appearance of an irregular net-work. Those threads of this system which proceed from the roof of the perithecium, are much more developed than those from the base. The former grow until their ramifications reach the bottom of the perithecium, but the latter never reach the top. The asci are formed after the formation of the above threads. The author could not make out the earliest stages of spore-formation, but he says that as that which takes place in the asci, before and after the formation of the spores, agrees with what De Bary observed in certain *Pezizæ*,* there is no reason to doubt that the mode of origin of the spores in *Nectria* is analogous to that in the *Pezizæ*.

The thread-system disappears with the development of the asci, the remnants of it forming paraphyses.

After describing the spores of the three species, and the mode of germination in *N. cinnabarina* and *N. inauruta*, M. Janowistsch expresses a confident opinion that in *Nectria inaurata* and *N. Lamyi*, the bodies which Sollmann calls spermatia are nothing but the products of germination. He says that Sollmann has confounded the pycnidia of *N. Lamyi* with the young perithecia, whereas the two are always quite distinct organs, and spermatia are never borne on the parietal threads of the perithecia—that long before the ascus be-

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* In his treatise "ueber die Entwickelung der Ascomyceten".

comes filled with the so-called spermatia the eight spores are completely formed, and that it is easy to see that the spermatia sprout out from the spore. M. Janowitsch adds that in *N. inaurata* where (as in *N. Lamyi*) the ripe ascus is eventually completely filled with the bodies in question, the growth of the latter from the spores may by proper treatment of the spore be traced step by step under the microscope. Lastly, the author remarks that the occurrence of these bodies within the asci, in the neighbourhood of, and upon the spores of many species of *Nectria* (as observed by Berkeley and De Notaris) is easily explained by reference to the process of germination.

XLVIII. – Mr. Tristram's Explorations in Palestine.

(1.) The Land of Israel, a Journal of Travels in Palestine undertaken with special reference to its Physical character. By H. B. Tristram, M.A., F.L.S. London, 1865.

(2.) Descriptions of New Birds from Palestine. By H. B. Tristram, Proc. Zool. Soc. 1864, p. 169.

(3.) Report on the Birds of Palestine. By H. B. Tristram, Proc. Zool. Soc. 1864, p. 426.

(4.) Report on a Collection of Reptiles and Fishes from Palestine. By Dr. A. Günther, Proc. Zool. Soc. 1864, p. 488.

(5.) Report on the Terrestrial and Fluviatile Mollusca of Palestine. By H. B. Tristram, Proc. Zool. Soc. 1865, p. 529.

(6.) On the Ornithology of Palestine. By H. B. Tristram, Ibis, 1865, pp. 67 & 241.

The publications already issued concerning Mr. T[illegible] tion to Palestine show that its energetic leader [illegible] of making the fullest use of the [illegible] together for the purpose [illegible] and Flora, of which we [illegible] "Divines, antiquaries, and poets," it is [illegible] the very interesting narrative, the title [illegible] of our list, "have trodden the fields of Pa[illegible] familiar with its most striking features [illegible] of the Holy Land has been hitherto nearly altogether passed over, and taking up this branch of inquiry, Mr. Tristram has most undoubtedly succeeded in writing a "new book upon an old subject." We have no intention of following Mr. Tristram and his friends in their peregrinations over the Land of Israel, which extended over a period of nearly ten months, but can assure our readers that they will find the account of their wanderings in the present volume, not only written in a most attractive style, but replete with information in every branch of Natural History. With regard to the more strictly scientific papers relating to different parts of the Natural History of Palestine, we will, however, say a few words.

The total number of species of birds of Palestine recorded in Mr. Tristram's report given in the Zoological Society's "Proceedings" is 322—the list being confined to those which were obtained by or came under the personal observation of the members of the expedition. It is still imperfect, Mr. Tristram observes, especially in the great classes of Grallatores and Natatores, but the following will gives us some idea of its constituent parts.

"Of the whole 322 species noted in Palestine, 260 are included in the European lists, 31 are common to Eastern Africa, but are non-European species, or at most accidental stragglers, and are chiefly desert-species of Nubia and the Sahara; 7 are of Eastern Asia; 4 of Northern Asia, (*Serinus pusillus*, *Carpodacus erythrinus*, *Charadrius asiaticus*, and *Charadrius mongolicus*); 4 of the Gulls and Terns are characteristic of the Red Sea, and 27 species are, so far as our present knowledge extends, peculiar to Palestine and districts immediately adjacent, of which 9 species are now described for the first time, while several others, as *Cypselus galilæensis*, *Sitta krueperi*, *Bessonornis albigularis*, *Petronia brachydactyla*, *Nectarinia osea*, as well as most of Hemprich and Ehrenberg's new species, have not before been brought to England. Every species described by Hemprich and Ehrenberg has been obtained and identified during this expedition, excepting one doubtful species."

The Reptiles and Fishes collected by Mr. Tristram have been worked out for him by Dr. Günther, who gives us the results in another communication to the Zoological Society. Dr. Günther remarks, that very little was previously known of the Herpetology and Ichthyology of Palestine, and that the only specimens of this part of its Fauna in the vast stores of our National collection, consisted of a small collection made by Mr. T. W. Beddome, who visited Palestine in 1862. The Reptiles and Batrachians obtained by Mr.

Tristram's expedition are referable to forty species, most of which are either identical with, or nearly allied to those of the Fauna of the Mediterranean basin. Only one species (*Daboia xanthina*) is Indian. Two Lizards and one Snake (belonging to the family Calamariidæ) are described as new. The Fishes are referred to seventeen species, many of them Syrian forms, whilst species of the genera *Chromis* and *Hemichromis* show the affinity of the Jordan Ichthyological fauna, with that of the Nile and other rivers of Africa. The Fishes of the Lake of Galilee seem to be :—

Blennius lupulus,	Clarias macracanthus,
Chromis nilotica,	Barbus longiceps,
— simonis,	Labeobarbus canis,
— andreæ,	Scaphiodon capoeta,
Hemicromis sacer,	Cobitis galilœa.

Strange indeed it is that of the thousand travellers who have before visited its waters, not one should have taken the trouble to bring home specimens of the apostolic fishes !

The terrestrial and fluviatile Mollusks collected during the expedition belong to about 120 species, which have been worked out by Mr. Tristram himself. Mr. Tristram gives us the following remarks on the general character of the Molluscan fauna of this region.

" The character of the Molluscan fauna of Palestine partakes, as might have been expected, of the same variety which marks the other branches of its fauna and flora. There are, however, fewer exceptions to its general character as a part of the Mediterranean basin, and fewer traces of the admixture of African and Indian forms. Northern types, especially of the genus *Clausilia*, are frequent in the Lebanon and on its southern spurs in Galilee. The Molluscan fauna of the maritime plains and the coast possesses no features distinct from those of Lower Egypt and Asia Minor. The shells of the central region are scarce, and not generally interesting : while on the borders of the Jordan valley and in the southern wilderness we meet with very distinct groups of *Helix* and of *Bulimus*, chiefly of species peculiar, or common in some few cases to the Arabian desert.

" The fluvatile Mollusca are of a type very much more tropical in its character than that of the terrestrial shells. There are here but few species similar to those of the east of Europe. Most of the species are identical with, or similar to those of the Nile and of the Euphrates; and some of the genus *Melanopsis* are peculiar to the Jordan or its feeders. It seems probable that the inhabitants of the waters were better able to sustain the cold of the glacial epoch than the molluscs of the land; and from the post-tertiary remains found by the Dead Sea, we may infer that the species now existing have been transmitted from a period antecedent to the glacial; while the more boreal forms introduced at that epoch have maintained their existence in the colder districts of Northern Palestine to the exclusion of the southern species, which have not succeeded in re-establishing themselves. The beautiful group *Achatina*, requiring a degree of moisture not generally found in Palestine, is only represented by a few insignificant and almost microscopic species."

The remaining parts of the collection made by Mr. Tristram's expedition are, we are informed, in the hands of different Naturalists, who have undertaken to work them out in a similar manner. When this has been accomplished, Mr. Tristram proposes to combine the whole in a special publication to be issued by the Ray Society, under the title of "A Synopsis of the Fauna and Flora of Palestine."

Original Articles.

XLIX.—Upon the Episternal portions of the Skeleton, as they appear in Mammalia and in Man. By C. Gegenbauer.*

Under the name of Episternal bones those portions of the skeleton are indicated, which presenting well marked characters in Amphibia (Frogs), and in Reptiles (Lizards and Crocodiles), exist only in a fragmentary condition, and with modified relations in Mammals. In the Seals these bones are merely applied to the anterior extremity of the sternum; in the Armadilloes they constitute detached bones of more importance, lying in front of the manubrium sterni, and connected by a ligamentous bond of union with the sternal ends of the clavicles; and in the Monotremata they form a single T-shaped bone placed in front of the sternum, with the transverse or outrunning arms superimposed for a certain distance on the anterior clavicular bones.†

In all these instances then, there are portions of the skeleton which effect a connection between the sternum and the anterior clavicular bones: except of course in the Seals, in which no clavicles are developed. Now, in some instances these portions of the bony framework of the body are symmetrical in their arrangement, in others they are asymmetrical or azygous, and they consequently present many varieties of external form. Our knowledge of the existence of these and similar episternal structures in other divisions of the mammalia besides those abovementioned, has hitherto been extremely limited,‡ and though structures resembling those normally

* Translated from the original in the "Jenaische Zeitschrift für Medicin," &c. vol. I. (1864) p. 175, et seq.

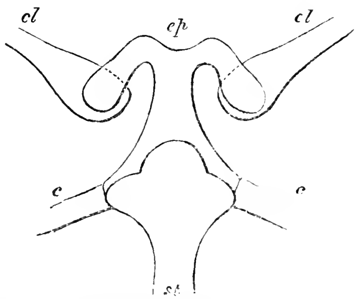
† Cuvier, Recherches sur les ossemens fossiles 4e Edit. T. viii. 1, p. 252; and Leçons sur l'anatomie comparée 2e Edit. T. 1, p. 238; Stannius, Lehrbuch der vergleich. Anatomie, S. 349; v. Rapp. Anatom. Untersuch. über die Edentaten. 2 Auflage, Tübingen, 1852, p. 39.

‡ In the *Chlamydophorus*, an animal which is closely allied to the Armadilloes, the clavicle, according to Hyrtl, is connected with the sternum by means of a ligament. Here, as Hyrtl remarks, the relations are the same as in *Dasypus*, except that a bony nucleus is absent. See Chlamydophori truncati cum Dasypode gymnuro comparatum examen anatomicum. Viennæ, 1855, S. 23 (Denkschrift. der Wiener Akad. Band. ix. der Mathemat phys. Classe.)

present in the Armadilloes have sometimes been met with in man, the analogies of the several parts have certainly not been accurately followed out. The results of my investigations show that episternal bones, or bones analogous to them, are much more commonly present than is usually admitted, and I am inclined to think that an examination of their arrangement in different animals may throw some light on their morphological significance. The degree of development attained by the episternal structures in different mammals undoubtedly varies to a considerable extent; and I shall therefore first describe the highly developed condition of these parts, presented by the Monotremata and Armadilloes, and leave to a subsequent period the discussion of the relatively smaller and therefore less easily recognized examples met with in other animals.

Amongst the Marsupials, I find in several species of *Didelphys* a T-shaped cartilaginous piece, the expanded base of which is seated on the anterior extremity of the sternum, and which in one case extended so far on either side as to assist in forming a *point d'appui* for the first rib. This structure (Ep. fig. I.) might indeed be

Fig. 1.



Episternal apparatus of *Didelphys* (Opossum.) :—*st*, sternum; *ep*, episternum: *cl*, clavicle; *c*, rib.

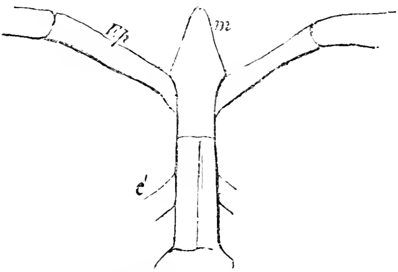
regarded as a persistently cartilaginous manubrium sterni; but the two transverse arms, proceeding from its anterior attenuated extremity, render this explanation doubtful. Moreover the connection of the lateral basal process with the first rib is by no means constant: indeed in various examples of three species of *Didelphys* that I examined, it was only met with in one instance, (shown in Fig. I.) The transverse anterior arms are club-shaped at their extremities, and are applied by their posterior or upper surfaces to the somewhat swollen extremities of the clavicles. On making transverse sections it may be clearly shown that there is an articular cavity between the clavicle and episternum, the connection between the two being however very firm and close. The transverse arms are usually directed backwards towards the expanded basis of the episternum, so that the clavicles appear to be attached much nearer to the first rib than is actually the case, whilst they possess a firm support in the anterior parts of the bony sternum. That position of the clavicles is most natural in which they abut upon the sternum, nor can this relation be materially altered, except by the yielding of some of the ligamentous bands retaining them in position, consequent upon which the transverse processes may readily be drawn forward, and their long axes made to fall in the same plane. Perhaps this mode of union of the clavicles in the Monotremata together with the backward direction of the transverse branches of the T-shaped cartilage, has been the cause of the neglect of these parts of the skeleton in animals whose anatomy has been otherwise so carefully studied. But it may readily be shown that the relations of these structures are precisely the same both in the marsupials and in the monotremes, though they are more highly developed in the latter. In the former they are both smaller and remain persistently cartilaginous, whence it follows that a less firm basis of support is offered for the clavicles, leading to the bending downwards of the transverse processes towards the sternum, by which means the firmer support of the side of the median portion of the episternum is obtained. Now as there is no joint nor marked line of differentiation between the osseous anterior portion of the proper sternum and the cartilaginous piece already mentioned, it would be possible to regard the whole structure as properly belonging to the sternum. But we must take into consideration that in other parts of the body, portions of the skeleton frequently become connate, or intimately connected with one another, and that the want of independency of the episternum may really proceed from defective ossification.* For in many cases the whole sternum is composed originally of undivided cartilage, the division

* I must here remark that I have only had the opportunity of examining young animals, so that it is quite possible that a point of ossification may subsequently appear in the azygous central portion of the cartilaginous episternum. Others will be able to decide this question, and will also determine the relations of the episternum in other genera of the marsupials, respecting which I can furnish no information. In a dry preparation of *Halmaturus* I found at the sternal end of each of the clavicles what appeared to be a cartilaginous mass, through which the connection with the sternum appeared to be effected. But I think it unsafe to draw any conclusions from such dry specimens, and only intend by thus mentioning them to excite the attention of other observers.

into a number of similar segments, subsequently appearing during the process of ossification; whilst in other instances, the segmentation already takes place in the cartilaginous condition before any ossification can be perceived. From the bare fact therefore of the continuity of the cartilage we can no more draw any conclusion respecting the unity of any portion of the skeleton, than we can respecting its multiple nature from the mere circumstance of the division of the cartilage. So long then as no proof is furnished that the ossification of the episternal bone proceeds from the true sternum, or that it is identical and continuous with it, it appears to be unsafe to consider it as belonging to the sternum merely on account of its adherence to it.

All doubts respecting the complete independency of the episternal structures disappear on examining those Rodentia and Insectivora, that are provided with clavicles. Thus in *Cœlogenys* (fig. 2.)

FIG. 2.



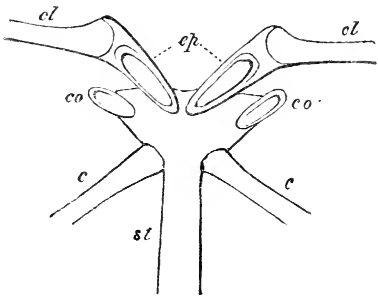
Episternal apparatus of *Cœlogenys paca*:—*Ep*, episternum; *m*, median episternal piece; c^1, first rib.

all three parts (central and two lateral) may be clearly recognized, though the two lateral portions have become detached from the middle azygous portion. Here the sternum is considerably prolonged in front of the attachment of the first rib (c^1), and terminates in a lancet-shaped cartilaginous piece (*m*) which presents upon its anterior surface a long keel extending from end to end, though somewhat flattened behind, near the sternum. On examining thin sections carried through the junction of the cartilage with the sternum, it is found that there is no direct continuity of tissue, but that a well-marked line of division exists between them, formed by fusiform cells arranged transversely, and lying in a softer fibrous matrix. In front of, as well as behind this line, the tissue passes into that of true hyaline cartilage. To the posterior extremity of the median portion of the cartilage are attached the broad flat ends of two outrunning cartilages (*ep*), which, after gradually assuming a cylindrical form, are applied to the clavicles in a manner that is precisely similar to that which has just been described as occurring between the median piece and the sternum. The histological differentiation is also here present: and the lateral cartilages, which are more intimately connected with the clavicles than with the median episternal piece, are at first composed of hyaline cartilage, and gradually become converted into fibro-cartilaginous structures.

On comparing this arrangement with that found in opossums and in monotremes, it is obvious that what in them is the azygous portion of bone or cartilage with two rami diverging from it anteriorly, is here split into three pieces: of which the median fragment is applied to the sternum, and has therefore identical relations in all; whilst the transverse branches having become detached (as indeed occurs to some extent in the Marsupials) are only brought into connection with the median fragment by an attenuated portion, and are still more intimately connected with the clavicle. The single episternum of the Monotremes and of the Saurians is consequently here broken up into three pieces, connected with one another by loose ligamentous bands only, but much more firmly bound to other parts with which originally they were simply in apposition. In *Cavia*, to which an "incomplete clavicle" has been ascribed, a very similar modification of the episternal apparatus is present. In point of fact the skeletons I have had the opportunity of examining, were altogether destitute of clavicles; but in front of the broad manubrium sterni, to the sides of which the first pair of ribs was attached—a peculiarly formed small and flat bony structure appeared, which, in the recent skeleton, would indubitably correspond to the ligamentous or cartilaginous lateral portions of the episternal apparatus of *Cœlogenys*. At any rate the median piece is completely homologous in both animals.

Hystrix (*H. cristata*) also certainly possesses an episternal apparatus. In one skeleton of this animal I found a cartilaginous mass at the anterior extremity of the sternum, behind which the long cartilaginous episternum was connected with the corresponding rudimentary clavicle. In the interior of the episternal piece I observed a point of ossification. In the mouse (*Mus musculus*, see Fig. 3). the rounded sternal extremities of the clavicles are continuous on each side with a portion of cartilage, of about $\frac{1}{50}$th of an inch in length. These fragments of cartilage converging towards one another become applied to the manubrium sterni, which is here broad and expanded anteriorly, and supports the first pair of ribs. The azygous median portion, which was present in the Rodentia (in *Cœlogenys* and *Cavia*), is altogether deficient, the two lateral parts alone appearing, which it is impossible from the evidence already adduced to admit as having a more intimate relation with the clavicle, however likely it might appear from an imperfect knowledge of these parts. These cartilaginous pieces are certainly *not* simply detached portions of the clavicles, or autogenously developed epiphysial cartilages, but are on the contrary portions of the skeleton, primarily separate and distinct from the clavicle. Each episternal cartilage presents a cup-like excavation for the reception of the sternal end of the clavicle, which

FIG. 3.



Episternal apparatus of *Mus musculus*:—*st*, sternum; *ep*, episternum; *cl*, clavicle; *co·*, coracoid; *c*, first rib.

is itself invested with cartilage, and constitutes a kind of articular cavity. The perichondrium of the episternal cartilages is directly continuous with the periosteum of the clavicles, and represents therefore the capsular ligament of the joints between them. The episternal cartilages are somewhat constricted about the middle of their length, and are applied to the sternum by thick rounded extremities. The investment of connective tissue is here only loosely attached to the sternum by the more superficial layers, whence a considerable amount of mobility is permitted both in the episternal pieces and in the clavicles. The distance between their points of attachment to the sternum is about one-half the length of the episternals themselves. The episternal pieces appear to retain their hyaline cartilaginous character for a considerable period, for even in apparently full-grown specimens I sometimes found them without any discoverable trace of ossification, and presenting the same appearances as in young individuals. In older animals, however, calcification of the cartilage takes place quite regularly at one or other of the two ends of each cartilage, as is represented in Fig. 3. In other species (*Mus sylvaticus, minutus*) the episternal structures present nearly the same general features. In *Mus sylvaticus* the two external ends of the episternals are in close approximation to one another. In *Mus minutus* the cartilaginous episternals appear at first sight to be directly continuous with the cartilaginous extremities of the clavicles. At the place of transition from one to the other, however, the cartilage alters in structure, and is found to contain long fusiform and transversely-arranged cells; and it is even possible in some instances, to detect a cavity in this tissue forming a true joint, though certainly one of the very lowest grade of development.

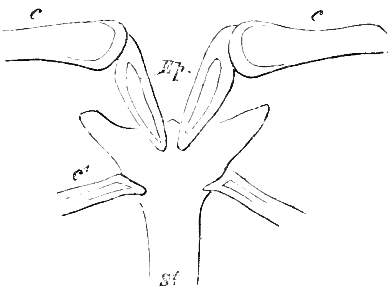
The two episternal pieces are club-shaped, the blunt end being directed towards the sternum, and the pointed end towards the clavicle. The latter extremity terminates in a cup-shaped expansion covered with hyaline cartilage which receives the clavicle. The variations presented by other species are insignificant. If the slight constriction, which is present in the *Mus musculus*, be conceived to be somewhat greater, the clavicular extremity of the episternum would exhibit the same cup-shaped process that is visible in *Mus minutus*. The sternal ends of the episternals are as far removed from one another as in the house-mouse. In their interior are two osseous nuclei—a posterior one of roundish form, and another immediately in front of it resembling a wedge.

The episternals of the Rat (*Mus decumanus*) are somewhat different from those of the smaller Muridæ. On a superficial examination they appear to be very solid and moveable pieces about $\frac{1}{50}$th to $\frac{1}{25}$th of an inch in length, lying between the clavicle and the sternum, and connected with both those bones by strong fibrous tissue. It is impossible to discover any articular cavity at either of their extremities. The dense episternals can be easily ascertained to be composed of bone; for on making a vertical section, the sternal end of the bony clavicle is seen to be invested with a layer of hyaline cartilage, and to contain numerous medullary cavities that are wide internally, and radiate towards the surface. Immediately continuous with this is a layer of fibrous tissue, which again passes into the hyaline cartilaginous investment of the cancellated bony mass, that constitutes the greater part of the episternal piece. Inferiorly the ligamentous bands do not pass on to the episternal bone itself, but are continued into a layer of hyaline cartilage, which is separated by a space from the cartilaginous investment of the episternal piece, and thus helps to form or surround a small articular cavity. The investing connective tissue of the episternals, on the other hand, passes on to the sternum without entering into the formation of any articular cavity.

In comparison with other species several peculiarities may here be noticed. In the first place, the elsewhere simple hyaline cartilage composing the episternals, is separated into two portions, one composed of areolar tissue, and connected with the clavicle; the other originally cartilaginous, and representing the solid episternals. In the second place the process of calcification of the cartilage has advanced to a considerably greater extent than in other species, the greater part of each episternal being converted into true bone, as is indicated by the presence of numerous medullary areolæ, yet even here the bones still constitute osseous nuclei only, since they are invested on each surface by a layer of cartilage.

The episternals of *Hypudæus* (*H. glareola*) are similarly formed to those of the Muridæ. The club-shaped clavicle on each side (Fig. 4.)

FIG. 4.

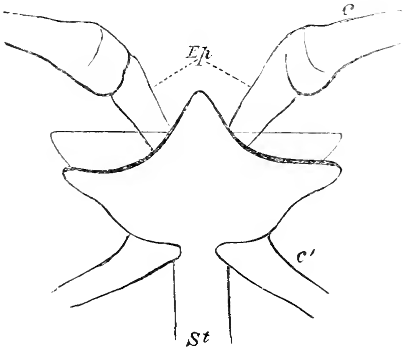


Episternal apparatus of *Hypudæus glareolus* seen from the inner side:—*ep*, episternum; *c*, clavicle; c¹, first rib; *st*, sternum.

becomes connected with the hollowed surface of the cartilaginous episternal piece, which contains an elongated bony nucleus, and is but loosely connected to the posterior surface of the very broad manubrium sterni. The division between the clavicle and episternum is very sharply defined throughout the greater part of their line of junction, but at the upper part the cartilage of the episternum is continuous through the intermediation of fibrous tissue with the clavicle, and thus an arrangement is exhibited which is betwixt that presented by the smaller Muridæ and the Rats.

The episternals of the Soricidæ attain nearly the same grade of development as those of Muridæ. In *Crocidura* (*leucodon*) each clavicle terminates in a peculiar rounded and ossified epiphysis, which is separated from the shaft of the bone by a thin layer of cartilage, and is joined by a conical elongated cartilaginous piece, which is firmly attached by connective tissue to the anterior border of the manubrium sterni, near the median line. In the interior of the cartilage I have found an osseous nucleus: I have not been able to determine the presence of an intervening joint, either here or in *Sorex* (*Sorex araneus*) where the episternals (Fig. 5) are still shorter than in other species, and, at least in the single specimen I examined, presented no ossification.

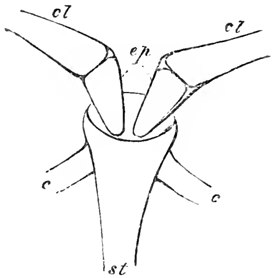
FIG. 5.



Episternal apparatus of *Sorex pygmæus* (Shrew) :—*ep*, episternum ; *c*, clavicle ; *c*[1], first rib ; *st*, sternum.

In *Arctomys* (*Arctomys Ludoviciana*) a short episternal exists on each side, externally cartilaginous, but containing a true bony nucleus in its interior, which, in my specimen, is perfectly distinct, even in the dry condition. There appears, however, to be a change here from the condition which has been already described as existing in the Rodentia and Insectivora, in that the episternum is applied, not to the posterior surface, but to the lateral and upper edge of the very broad manubrium sterni, a feature, however, that requires a closer investigation in moist specimens. These forms are associated with those met with in certain representatives of Rodentia and Insectivora as in the Hamster and Hedgehog, both of which in opposition to the above-mentioned animals, have well-marked clavicles, but only feebly developed episternals. As regards *Cricetus* the expanded extremity of the clavicle is connected with a cartilaginous piece of about three or four m.m. ($\frac{1}{6}$th of an inch) in length by a true joint (see Fig. 6).

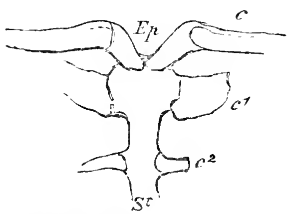
Fig. 6.



Episternal apparatus of *Cricetus* :—*ep*, episternum ; *cl*, clavicle ; *c*, first rib ; *st*, sternum.

This piece of cartilage terminates in a pointed extremity which is attached to a slight indentation on the posterior surface of the manubrium sterni, so that when looked at from before, only a very small portion of the episternals can be seen. I have been unable to find in this animal any joint at the back of the sternum, or any ossification or calcification of the cartilage, which I do not however consider to be a matter of much importance since its presence or absence is probably connected with the age of the animal. I have not been able to discern any striking peculiarities besides those I have already described, in the remaining Rodentia provided with fully-developed or rudimentary clavicles, and it seems more than probable, that in all of them one or other form of episternal apparatus is present. In the Hedgehog (Fig. 7, *ep*.) I find episternals similar in form to those of the Hamster ; but inasmuch as they are attached to the anterior border of the sternum, they are easily visible from before.

Fig. 7.

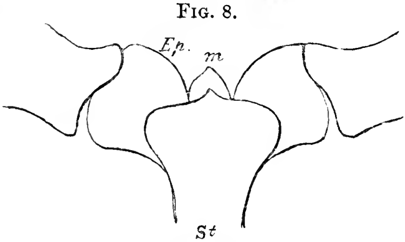


Episternal apparatus of *Erinaceus Europæus* (Hedgehog), as seen on vertical section :—*ep*, episternum ; *c*, clavicle ; c^1, first rib ; c^2, second rib ; *st*, sternum.

Like those of the Hamster they are composed of hyaline cartilage, which presents at some points a fibrous basis, and which also passes into the periosteum without any strong line of demarcation, whilst in the Hamster there is a highly developed joint between each episternal piece and the clavicle. I am unable to find any such structure in the Hedgehog; yet there is certainly no continuity of tissue between these parts, for the apparent investment of hyaline cartilage covering the sternal end of the clavicle presents elongated cells in its external layers, and ultimately passes by a slightly undulating surface into a tissue which more closely approximates connective tissue, and which is continued into the hyaline cartilage of the episternals, in the same gradual manner that it proceeds from that of the clavicle. Thus the episternal piece appears to constitute a glenoid cavity for the reception of the globular and articular-like end of the clavicle, and there is a slight amount of mobility between the two pieces, without however any true joint intervening between them. This structure corresponds exactly with that which is transitorily observed in the process of development of many joints, and in this particular presents a more complete differentiation of parts than is observed in the Insectivora above-mentioned. Amongst the Rodents, whose clavicles do not reach the sternum, and whose episternals appear only as elongated lateral pieces, without the median portion that occurs in *Cœlogenys*, *Cavia*, and *Hystrix*, I find, however, that occasionally, as in the rabbit, a very analogous conformation is present, the so-called ligament which connects the very distant end of the clavicle to the sternum agreeing completely with the above-mentioned anatomical arrangements. In the wild rabbit, I find the following histological and morphological construction. The rounded extremity of the clavicle, provided with a calcified cartilaginous investment, becomes continuous with a ligamentous cord that diminishes in thickness as it passes towards the sternum. All authors have regarded this as indifferent tissue in those animals which possess a clavicle that does not reach to the sternum. I find this cord however to be of compound character. Externally it consists of a sheath composed of longitudinally arranged connective tissue fibres, internal to which is a network of fine elastic fibres, that is itself obliquely crossed by another layer of fibres surrounding a central but much smaller cartilaginous rod. At its upper and thicker portion hyaline cartilage is clearly discernible, becoming modified as it passes towards the sternum, into a peculiar soft tissue that morphologically at least is not distinguishable from ordinary cartilage, though its physical properties are somewhat different. The elastic fibrous network found in the cord, confers upon it a high degree of elasticity—and it appears that it admits of and follows the extension of the cartilaginous nucleus, again enabling it to assume its original form. Tame rabbits present, in the construction of their episternals, essentially similar characters, only that the matrix of the internal cartilaginous core is fibrous, and the axial cartilage of the so-called clavicular ligament is composed of fibro-cartilage. If we now compare the construction we have already described in other mammals, with that found in rabbits, there can be little question that a fundamentally similar arrangements of parts exists, modified in the latter case no doubt to some extent, but still showing, that even with apparently rudimentary clavicles, episternal structures are to be found. It even appears that the lateral parts of the typical episternum diminish in length more gradually than the clavicles themselves. The conditions above described are such that the episternals, whether consisting of pure cartilage or partially ossified, present a structure rendering them immediately recognizable as integral portions of the skeleton. These conditions too, certainly include the more complete forms that stand in close connection with those well known to exist in the Armadilloes and Monotremes. If we now proceed from the consideration of those structural characters under which the episternals appear first in the Hamster, and then in the Hedgehog, and convince ourselves of the connection of these formations with the analogous ones found in the Mouse, *Didelphys* and *Dasypus*, it will not be difficult for us to recognize them, and to comprehend their morphological significance under less characteristic forms.

If we now examine other mammals provided with clavicles, some of the following peculiarities may be found in the episternal apparatus. In the Mole (fig. 8), the broad sternal extremity of the very

Fig. 8.

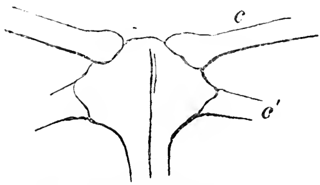


Sterno-clavicular articulation of the Mole, as seen on perpendicular section. *St*, sternum; *Ep*, episternum; *m*, median piece of episternum.

peculiarly formed clavicle is no more immediately connected with the manubrium sterni, than was the case in the above-mentioned animals. The terminal surface presents a saddle-shaped depression which, for the anterior third of its extent is invariably directly attached to a remarkable cartilaginous structure (*ep*), whilst in the posterior two-thirds, an articular cavity frequently intervenes. The cartilaginous piece is at least equal in length to one-third of the clavicle, and is applied to the anterior and lateral borders of the manubrium sterni. The extent of the joint between the clavicle and the cartilaginous piece varies to some extent according to my observations, and in a few examples appeared only as a small fissure extending from behind forwards. The whole sternal end of the clavicle is invested by a thin cartilaginous layer, which at the part corresponding to the joint forms an articular cartilage, covering the clavicle, whilst elsewhere it is directly continuous with the cartilaginous episternal piece, though the limits of the two in a histological point of view are sharply defined. The structural characters of the cartilaginous piece itself cause it to be just as strongly differentiated from the manubrium sterni as from the clavicle: and the surface of the former seems also to be invested by cartilage. As regards the intimate structure of the episternal cartilage, I found that with low microscopical powers, it presented a peculiar longitudinally striated appearance, just as though a fibrous investment was continued over it, from the clavicular to the sternal extremity. Closer investigation, however, showed that this apparent fibrillation was in reality due to the peculiar arrangement of the morphological elements of the cartilage. For immediately beneath the surface of the sternal extremity, roundish scattered cartilage cells appeared, which occasionally presented indications of division. At a short distance from this point, and towards the middle of the cartilage, the cells formed rows, at first of a somewhat oval form, and composed of three or four cells, but subsequently of a greater number, as from ten to fifteen, the group then presenting a fusiform shape. By comparing different rows, it was ascertained that each row proceeded from a single cell, multiplication by division in a longitudinal direction being exceedingly common amongst them. The intermediate substance (matrix of the cartilage) showed also some indications of longitudinal striation, though no doubt the impression to the eye was chiefly the result of the above-mentioned arrangement of the cells. The external investment of the cartilage, composed of connective tissue, was continued from the periosteum of the sternum into that of the clavicle, and consequently surrounded the fissure which existed between the clavicular surface of the cartilage and the clavicle, thus completing the articular cavity. The two cartilaginous episternal pieces, possessed a certain amount of elasticity. They were closely approximated to one another at the anterior border of the manubrium sterni, and the outer space was occupied by a short lancet-shaped cartilaginous prolongation (*m*), the minute structure of which was the same as that of the larger pieces of cartilage. From the above description, it follows that these cartilaginous pieces are not to be considered as detached portions either of the clavicle or of the sternum. From the clavicles they are separated by a well-defined line, and a well-marked histological difference; and at one part the separation is so perfect that a kind of joint is formed: whilst they are also differentiated from the sternum by their microscopical structure with equal clearness, so that they can neither be regarded as simple processes of the sternum, nor as sternal prolongations of the clavicles. They consequently exactly agree with the above-mentioned intermediary pieces between clavicle and sternum; and if they are in those instances to be termed episternals, the same nomenclature must also be applied to these cartilaginous structures of the mole. The smaller degree of independency resulting from their more intimate connection with the sternum, constitutes no serious objection to this view: for we have already seen that in the Hedgehog the episternal cartilage is very intimately connected with the clavicle; and that on the other hand, in *Didelphys* the T-formed cartilage is more closely connected with the sternum than with the clavicle.

At a much lower grade of development, yet still by the light of the structures just described in the mole, readily recognizable as belonging to the same series, are the homologous parts in the Squirrel. If in this animal, the sterno-clavicular articulation be examined from the anterior surface of the body (Fig. 9), the expanded sternal ex-

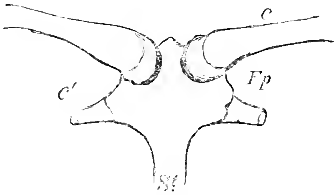
FIG. 9.



Episternal apparatus of *Sciurus vulgaris* (Squirrel), seen from the outer side:—*c*, clavicle; *c*[1], first rib.

tremities of the clavicles appear to be directly applied to the obliquely bevelled anterior edge of the manubrium sterni. But an examination of the inner surface of the manubrium shows, that even in this instance, intervening structures are present. (Fig. 10.)

FIG. 10.



Episternal apparatus of *Sciurus vulgaris* (Squirrel), seen from within:—*St*, sternum ; *Ep*, episternum ; *c*, clavicle ; c^1, first rib.

Only a few preparations of the sterno-clavicular articulation are required to show that a remarkable piece is introduced between the sternum and the bony clavicle. This piece is formed of a fibrous mass, which is but slightly developed anteriorly, is softer than cartilage, and when longitudinal sections are carefully examined, appears to be chiefly composed of connective tissue. The sternal end of the clavicle is here also invested by cartilage, and from the cartilage the fibrous band which can be followed to the sternum directly springs. This band, whilst possessing much firmness in the central part, is of loose texture at the two extremities. The morphological elements of cartilage are not distinguishable in it, so that on histological grounds the whole intermediate piece is of a different character from that which I have found in other mammals. *Tamias* presents arrangements that are essentially similar to those of *Sciurus*.

If the extreme shortness of the parts in the Mole be disregarded, very similar characters are found in the corresponding parts in various Carnivora (*Meles*, *Lutra*, *Mustela*, *Felis*, *Hyæna*). Amongst these animals the episternal on each side is represented by a band of considerable length, proceeding from the clavicle, which has been regarded either as properly belonging to the clavicle, partly from defective information, and partly from the similar mode of connection existing between the clavicle and scapula, or, as a structure developed to make up for the smaller size of the clavicle. Now, although the elongated form and purely ligamentous strcuture of the episternals here present may be considered as a sign of degradation, no objection need be raised to its homology with true episternal structures, any more than the small size of the piece of bone attached to the acromion only by a ligament, need be held to cast a doubt upon their representing the clavicle. It must be admitted also, that in other classes the clavicles and episternals alike present degradations of a similar character, as may be seen amongst the Edentata in *Myrmecophaga didactyla* and *Chlamydophorus truncatus*, where the episternal is still tense and of moderate length; but does not appear to contain any more solid parts in its interior.

In the flying mammals I have long sought in vain for the various parts of the bony girdle of the chest, so well known to me in other mammals; and I drew the conclusion from their absence that a more intimate connection of the episternals with the sternum occurred, and consequently that the broad manubrium sterni of these animals resulted from the fusion of these parts.* The recent discovery of a structure that indubitably belongs to the series of episternal structures in these creatures has, however, changed my opinion on this point.

If the sterno-clavicular articulation of a Cheiropterous animal is examined from before, the well-marked clavicle is seen to run to the side of the manubrium sterni, and covered with cartilage, to be inserted into a depression of the manubrium, which also possesses a cartilaginous investment. No intermediate piece of any description intervenes, and consequently the usual episternal fragment seems in this instance to vanish with the appearance of a more highly developed clavicle. On making an examination of the internal surface of the articulation, however, it may be seen that the whole of the terminal surface of the clavicle is not implicated in the formation of the joint, but that its posterior and inferior part gives attachment to a conical ligament which is connected with the sternum. The ligament lies imbedded to some extent in the capsular ligament, increasing its strength, but it is important to observe that it originates directly and immediately from the clavicle itself. Its position, therefore, quite independently of its magnitude, which is only a secondary consideration, clearly indicates that this fibrous band is to be placed in the category of the true episternals. In *Pteropus* a similar conformation of parts is present. The episternals of Quadrumana and Man are much less highly developed.

* The examination of the embryos of the Cat exhibit a division of the manubrium sterni from the body of the sternum exactly at the point of junction of the first rib. In adult *Rhinolophi* I have been unable to remark anything particular on this point. *Vespertilio Daubentoni* is, however, provided with an articulation at this part of the formation, of which the ribs on both sides participate.

From a consideration of the foregoing statements no reasonable doubt can be entertained that in the interarticular fibro-cartilage which separates the clavicle from the sternum, we have the equivalent of the symmetrical episternals. In *Cercopithecus* (*C. ruber*) I find a general agreement in the composition of the sternoclavicular articulation with that of man; the interarticular fibro-cartilage, however, being a good deal thicker behind, so that when viewed on that aspect it at once strikes the eye as being an independent structure. Here also, as in man, the presence of the cartilage causes the joint to be composed of two chambers or cavities. In order more easily to explain the structure of the sternoclavicular articulation, and at the same time to serve as a means of comparison, I have made a drawing of a somewhat oblique vertical section of it, and the interarticular fibro-cartilage may be seen to form a distinct portion of the skeleton, both in man and apes; whilst not only from its general relations, but also through its intimate connection with the sternal end of the clavicle and with the manubrium sterni, it is obviously to be regarded as a peculiar modification of the episternal piece, though certainly less developed than even in the Cheiroptera. The episternals are consequently portions of the shoulder girdle, which only vanish entirely when the clavicles are wholly absent, but which are always visible when the clavicles are present, and frequently form structures of very considerable magnitude. Now if we regard the interarticular fibro-cartilage of the sterno-clavicular articulation as the representative of the episternals, it follows that the occasionally present "*ossa supra-sternalia*" described by various authors, and recently in particular by Luschka,* as sometimes occurring in man, must be considered to hold an intimate relation to the typical episternals of armadillos, &c. But a comparison of these ossifications lying in front of the manubrium sterni with the episternals of the armadillos, &c., is by no means satisfactory when we know that certain constantly present portions of the skeleton, namely the interarticular fibro-cartilages have already been determined to be the equivalents of the symmetrical episternals. Nevertheless I am unable at once to explain away these *ossa supra-sternalia* by considering them as merely accidentally and rarely occurring structures; for it is possible they may stand in genetic connection, not indeed with the more commonly developed symmetrical wings, but with the pro-

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* Zeitschrift für wissenschaft. Zoologie. Bd. iv. p. 36.

jecting azygous portion of the primordial episternals—a process which is seldom developed in the Mammalian class. That a division may really take place in an originally simple piece leading to the formation of an episternal apparatus composed of a central and two lateral portions, is clearly shown in *Cœlogenys*. It is consequently highly probable that all symmetrical episternals correspond not to the whole, but only to the lateral portions of the primordial piece, so that we cannot regard them as resulting from the division of a common median piece, but rather as a degradation in point of development of the latter leading to its total disappearance, whilst the lateral portions still remain persistent. But remains of the median piece united with the sternum have been shown to occur in the Mole. (Fig. 8.) Such remains lying in front of the manubrium sterni, and consequently between the above-mentioned symmetrical pieces, may in some cases assume a cartilaginous or an osseous form, and naturally lead to the formation of the *ossa supra-sternalia*.*

From these considerations it appears to me that the latter are abnormally occurring rudiments of a median episternal piece, through which, as happens so frequently in other animals, we are reminded of lower grades of organisation. Having thus examined the relations of the episternals in what I must admit to be a very limited number of mammalian genera, it will be advantageous to review generally their points of agreement and difference, and thus to gain some insight into the relations of these several structures to one another in Mammals, and to compare them with the analogous structures that are found in the other vertebrated classes. It will be advisable to commence with those of the Reptiles.

In the Lizards the episternals appear as a T-shaped or cruciform bone, of which the median portion overlies the proper sternum to a considerable extent. In the Crocodiles the transverse branches are wanting, and hence the episternal corresponds, independently of its position in regard to the sternum, which is the same as in Lizards, rather to the most anterior segment of the sternum of Seals, or

* Though these are found to be arranged symmetrically, it by no means follows that they must correspond with parts that are originally symmetrical: for the history of the development of the sternum renders it evident that symmetrical osseous nuclei may occur in an asymmetrical portion of cartilage. Moreover, if we admit that the first appearance of the asymmetrical episternal piece and the mode of its ossification when it becomes bony are wholly unknown, it is clear that the symmetrical arrangement of the supra-sternal bones is by no means opposed to the belief that they may be homologous with a portion of the skeleton that is elsewhere asymmetrical.

perhaps to the median piece of *Cœlogenys* and *Cavia*, in which its relations are the same as in the Pinnipedia.

In the Monotremes, again, as in the Lizards, transverse processes reappear coincidently with the presence of clavicles. These structural arrangements recur in the Opossums, as has been formerly shown in detail, in a more rudimentary form, the parts long retaining their cartilaginous condition, and presenting in the other species provided with clavicles various grades of development. In the above-mentioned Marsupials the clavicles are no longer superimposed upon the transverse processes of the T-shaped piece, but are connected with their extremities only, and this constitutes the usual relation of these parts in all the remaining and higher species of Mammals. An asymmetrical median piece of the episternum no longer appears, as in *Cœlogenys* and *Cavia*, for the two connate pieces at the anterior extremity of the manubrium sterni in *Dasypus novem-cinctus* do not appear to me to be correctly referred to the azygous piece of the episternum, but to correspond rather to the symmetrical pieces. In other species, as in *Dasypus sexcinctus*, the separation or division of the symmetrical pieces is well marked, and here the bony pieces of the episternum annexed to the sternum are connected with the clavicle on each side by a long ligamentous band of union. To the same category belong the structures that have been above described in *Mus* and other animals in which there is a ligamentous union between the episternal and clavicular bones. The connection with the sternum is, however, of a much lower character, both in the Rodentia and in the Insectivora. In these orders two parallel series occur. In *Sorex*, as well as in *Mus minutus* and *M. musculus*, points of ossification appear in the cartilaginous episternals, whilst in the Hedgehog and the Hamster the episternals remain completely cartilaginous, articulating in both with the clavicle. Finally, a reduction in point of size occurs in *Sciurus*, together with absence of articulating cavities, and even in the Mole there is only a partial development of an articular cavity at the clavicular extremity of the episternals. The arrangement observed in Monkeys and in Man occupies an intermediate position between these several forms; for, on the one hand, on account of their small size the episternals are here allied to those of *Sciurus*, and on the other hand, by the development of articular cavities they acquire a resemblance to those of other Rodents.

From the foregoing considerations, then, it would appear that the episternals present themselves under three different forms in Mammals.

The first, which may be considered as the most complete form (because presenting but slight modification of the type observed in the lower Vertebrata) is that in which it consists of a median piece connected with the sternum, and carrying two lateral transverse portions. The two other forms are incomplete, modified, and in some respects degenerated. The former more complete arrangement serving as the type, is characteristic of the Lizards, but so far as I am aware does not occur in lower groups. In the Monotremes and Opossums (and whether also in the remaining Marsupials further investigation must disclose) the typical form is still preserved; though in the Opossums the whole structure remains persistently cartilaginous. It also still appears in certain Rodentia, as in *Cavia* and *Cœlogenys*, though the lateral pieces are now separate and distinct from the median portion.

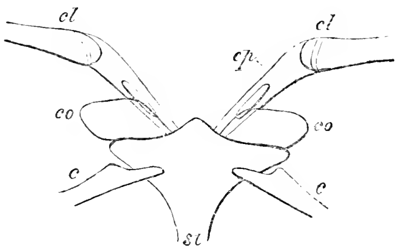
The second form is characterized by the presence of the median piece alone, and is seen in the Frog, in the Crocodile, and amongst Mammals in the Pinnipedia. It thus occurs even in animals destitute of clavicles.

The third form, lastly, is characterized by the absence of the median piece, whilst the two lateral portions are still visible. The whole structure seems here to be dependent upon the presence of a clavicle, and from its first appearance, with few modifications, it constitutes a connecting medium between the clavicle and the sternum. This connecting medium may either be represented by an ossifying piece of cartilage, as in *Mus* and *Sorex*, or by a bone which is connected to the clavicle by a ligament, as in the Armadilloes, or by a fragment of fine cartilage, or by fibrous tissue alone. The cartilaginous piece representing the episternal, or more correctly speaking the symmetrical lateral pieces of the episternum, is either included in a longer fibrous mass as in *Lepus*, or is continuous with the clavicle as in *Erinaceus*, or is separated from the clavicle by the intervention of a joint, as in *Cricetus;* in both the latter instances being but loosely connected with the sternum: or again, it may be directly continuous both with the clavicle and the sternum, as in *Talpa;* or it may be separated alike from the clavicle and from the sternum by an articulating cavity, as in Monkeys and in Man. If only ligamentous tissue be present, it proceeds either from the whole extent of the surface of the sternal extremity of the clavicle, sometimes appearing as a longer piece (as in the Carnivora provided with clavicles, and as in *Myrmecophaga didactyla*), and sometimes as a shorter piece as in *Sciurus;* or it proceeds from only a limited portion of the terminal surface, and thus permits the remaining greater portion of the clavicle to be directly articulated with the sternum, as in the Volitantia.

Thus from the varieties in the size, form, and intimate structure of the episternals in certain Mammalian classes, it follows that besides the proof of the general existence of these parts of the skeleton, there is evidence that there may be found within the limits of each class a series of modifications: yet however wide these deviations from the common type may be, there does not appear to be any difficulty in recognizing in the structures in question a something which is common to all the Unguiculata.

In the examination of the anterior sternal segment of some of the above-mentioned animals, I have observed another peculiar relation, which I shall here briefly mention. In Mice, and especially in *Mus musculus* (see Fig. 3) an oval-shaped cartilage is visible at the side of the expanded portion of the most anterior segment of the sternum. On examining it from the front, only one half of it is visible. This piece possesses a sharply defined contour in its whole circumference, up to the very point where it is applied to the sternum, and the point of application is always exactly intermediate on each side between the episternal cartilage and the attachment of the first rib. On superficial examination we might consider it to be a peculiar and independent portion of the skeleton, and when I first discovered it I thought that I had obtained in this little cartilaginous piece the rudiment of the second or posterior clavicle, which is developed as far as the sternum only in Monotremata amongst Mammalia, appearing elsewhere as a scapular appendage (processus coracoides). The investigation of the mode of connection of this cartilage with the sternum led me to doubt this view, for on making transverse sections I found there was not a mere application of the two surfaces at this point, but a connection of a much more intimate nature. Additional circumstances of some weight in determining the morphological significance of this sharply defined cartilaginous mass, which projects from the transverse branch of the manubrium sterni, but does not appear to be merely a prolongation of it, are, that it is of very constant occurrence, and that its ossification does not proceed continuously from the sternum, but commences from a perfectly independent nucleus; therefore, although it cannot be stated with certainty, none will doubt the probability of the interpretation that in it we see the sternal rudiment of a coracoid; and this view received further support from the fact that a similar structure is met with in *Crocidura*. In this animal I find that the very broad anterior extremity of the sternum presents a little projection or spine in the middle line, behind which the two episternals are attached. To the whole extent of the anterior border of the manubrium sterni external to this spine is attached a cartilaginous lozenge-shaped plate, the anterior and external angle of which is rounded off.

Fig. 11.



Episternal apparatus of *Crocidura*.—*st*, sternum—*c*, 1st rib—*co*, coracoid—*ep*, episternum—*cl*, clavicle.

The two cartilaginous plates project somewhat in front of the point of attachment of the episternal bones. Their transverse diameter is about twice as great as their antero-posterior. Their connection with the manubrium sterni is not so intimate as in the case of the cartilaginous pieces described above as existing in the Mouse; but there appears to be a limiting membrane between the two, composed of connective tissue, so that the cartilages may justly be considered as independent structures. Their ossification, which only consists in a partial calcification of the cartilage, is likewise independent of the sternum, and appears chiefly in the superficial layers both of the anterior and posterior surfaces, and in two or three different spots simultaneously. In *Sorex* also these plates are present, but much less distinctly defined (Fig. 5), so that for confirmation of my opinions regarding these structures I prefer to rest on *Crocidura*. Now since, as has been already explained, we cannot refer these structures to the sternum itself, since, moreover, they cannot be considered as episternal pieces, these parts being already present in connection with the anterior extremities of the clavicles, and lastly since they cannot be regarded as symmetrical and lateral appendages of the median portion of the episternal bone which is here absent, nothing remains but to acknowledge in them the rudimentary sternal extremities of a second pair of clavicles, that is to say, of the so-called coracoids. The part of the sternum to which they are attached is in complete accordance with this view. The structural arrangements which exist in *Crocidura* appear to me to be of importance in the determination of the several parts already described in the Mouse, and if these are somewhat different, it must be remembered that we are dealing with two very different classes of the animal kingdom.

It is perhaps reserved for later researches to acquire a better and more extended knowledge of those fragmentary portions of the skeleton which are homologous with similar parts in lower animals; and by the discovery of transitional forms, to acquire positive information upon the various points which are only rendered highly probable by the observations I have here recorded.

L.—Note on Hybridism in Vegetables. By C. Naudin, Member of the Institute of France.

[As coming from the most distinguished experimental fertilizer on the Continent, and one whose ever conscientious labours have been of very considerable service to science, and will be of greater value to future theorists, we gladly make room for the following communication.

It was transmitted, with the information, "that it forms a supplementary chapter to M. Naudin's 'New Memoir on Hybridism in Vegetables,' which obtained the prize offered by the French Academy for the best solution of certain questions respecting the important subject of hybridization. As, however, it was considered to have no very immediate bearing on the recent questions proposed, the Academy did not print it." Whatever may have been the motives which ruled the French Academy in rejecting this chapter, we need hardly point out to the readers of The Natural History Review, that its author is in error in supposing that his views would have presented any novelty to English Naturalists, even had they appeared before Mr. Darwin's work, or still less that they involve, as he imagines they do, the Darwinian hypothesis. The speculation that all species are derivative is a very old one, and was accepted by many in England and on the Continent before the appearance of Mr. Darwin's work, as being at least as philosophical and certainly more rational than the only other speculation hitherto advanced, viz., that species were created separately and independently. What Mr. Darwin has done is: 1. To show that the operation of natural selection must eventually result in the coordination of the derivative individuals, into more or less definable groups which we call species, genera, orders, &c. 2. To demonstrate that such a process actually takes place in minor groups, both of the animal and vegetable kingdom. 3. To show how the main facts of classification, development, and geographical distribution, are all consonant with and explicable upon the hypothesis that organised beings are all derivative, and have been ruled by natural selection in everything relating to their development, whether as to grade of perfection, numbers, magnitude, or diffusion over the earth's surface. It is the application of this demonstrably proved law of natural selection together with the fact that the struggle for existence must lead to the extinction of the weaker races to the speculation of the derivative origin of species, that is the novel point which Mr. Darwin has brought out, and which raises the said speculation to the rank of a legitimate hypothesis; and it is the fact of the derivative origin of species being no longer a speculation, but a hypothesis (or, as some say a theory,) that has necessitated its careful consideration by every scientific biologist and its acceptance by many at once, and by more as time advances.

There is nothing in M. Naudin's communication that indicates his having advanced in his conclusions as to the "origin of species by variation" beyond the state in which that speculation was left by Lamarck in his own country, and by the "Vestiges of the Natural History of the Creation," in this. M. Naudin, however, seems to have failed to perceive the points of Mr. Darwin's hypothesis, and hence supposes that he had forestalled its author. His communication is, however, an excellent exposition of his scientific creed, and coming from so justly distinguished a naturalist we are sure that it will be persued with interest by all, and with profit by many who may be opposed to his conclusions.—*Ed. N. H. R.*]

The experience of more than twenty centuries has established the fact, which is of immense importance as regards human economy, that vegetables submitted to culture are modified in various ways, and give rise to new forms, which acquire at length, either by artificial or natural selection, a certain degree of stability, and are even reproduced in many cases with the same fidelity as types originally specific. There is scarcely a single species, which has been cultivated from remote antiquity, which has remained perfectly uniform and which has not been divided into secondary forms sufficiently distinct from each other to be easily recognised by every common observer. Wheat, the vine, the olive tree, the date palm, cabbages, onions, kidney-beans, gourds, &c., offer examples which are known to every one. These secondary or derivative forms which render primitive species real groups analogous to our botanical genera, are properly speaking what are designated under the names of races and varieties, terms accepted by science, which applies them to forms slightly contrasted, but which have remained wild, and over which man has never exercised any modifying influence.

It may be objected indeed that these pretended derivative forms are merely true species occurring primitively in nature, exactly as we see them now, and that neither the processes of cultivation, nor the different circumstances of soil and climate through which man has caused them to pass, has modified them in the slightest degree. But this objection, in addition to its being extremely improbable, since none of these forms which may bė counted by thousands occur in a wild state, does not hold against that other fact, that we see new forms arise in modern times, and that species of recent introduction, as the potato, Indian corn, the dahlia, the China-aster, and hundreds of other plants but lately introduced, offer the same phenomenon of variation from the typical form. There can therefore be no doubt of the inherent capability of natural species to be sub-divided into secondary forms, into varieties, or to speak more philosophically into *species of an inferior dignity*, which with time, when they are preserved free from impregnation with other sub-species of the same origin, acquire all the stability of character presented by old species.

Is this phenomenon then limited to species submitted to cultivation, and does it necessarily require the intervention of man to produce them? I do not think so; it seems to me on the contrary infinitely more probable, that it has taken place in nature on a much wider scale than in the narrow domain of our industry, where even at the present day, natural agents, such as soil, light, heat, atmospheric conditions, &c., are the principal agents. I regard then, in accordance with most botanists, all those slight species classed under the names of *races* and *varieties* as forms derived from a primitive specific type, and having in consequence a common origin. I go further: the best characterised species themselves are, in my opinion, so many secondary forms relatively to some more ancient type which actually comprised them all, as they themselves comprise all the varieties to which they give birth under our eyes, when we submit them to cultivation.

Whether they allow it or not, all botanical describers feel instinctively that the question of *species* is connected with that of origin, and that in declaring that this form is a species, and that a simple variety, they declare implicitly for a system determined with relation to their origin. But, two systems only are possible. Either species were created in the first instance such as they are now, and in the same portions of the globe which they still occupy, and in consequence without any mutual dependence, and without any other than a metaphorical relationship; or else they are united by the bond of a common origin, are really related to each other, and descend from common ancestors. The former system is the most ancient; it comes to us directly from the middle ages and is supported by Bible texts which, in my opinion, are falsely interpreted; it is cotemporary with and the complement as it were of that geological system which made the globe proceed from the hands of the Creator in the form which we now behold it, with the same continents, the same seas, the same watersheds, the same mountains, the same topography in a word, and in consequence, the same animals and vegetables. In this system all is primordial, and appears as it were suddenly, by the sole act of the Divine Will without antecedent phenomena, and without any evolution. In a word it is the *system of the supernatural*, received by many Theologians, as well Protestant as Catholic, and, it must be confessed, even by a certain number of men of science.

I am assuredly far from denying the Divine intervention in the great act of creation, any more than I deny it in the phenomena of the present world, where I see it unceasingly present. God does not testify his power less in working by agents, than in operating directly; in proceeding by the way of revolution, by a logical series of phenomena, than in proceeding by sudden gushes and by miracles. The formation of an embryo in a fecundated ovule, the development of this embryo into a feeble plant which bursts its integuments, and finally its transformation into a great tree, which, in its turn, is adorned with flowers and reproduces its race, all these things are neither less marvellous, nor less incomprehensible, nor less divine than the creation of a world; they are, to speak truly, real creations since they give place to beings which had no previous existence. Nevertheless, since we see the phenomena succeeding each other, and following in a logical order it does not come into our mind that they are supernatural matters. What makes a miracle, is not its incomprehensibility, but its *exceptionality*, which places it apart from the regular chain of facts. Any fact which enters into any physical series, which has antecedents, I might almost say parents, in anterior phenomena, which, in a word, has a material cause and material consequences, is a *natural fact*—a *fact amenable to science*. But if the same logic, the same sequence of phenomena, the same evolution in things, has been the prelude of the appearance of organized beings on this globe, their creation enters purely and simply into the order of physical and natural phenomena, as certainly as the partial creations continued to the present day, which form the very life of these beings.

It does not follow from the circumstance that the creation of organized beings may be considered as a rigorously dependant series of phenomena, that the torch of life was lighted on this globe by the force of terrestrial nature. We would not willingly admit the spontaneous formation of the monad, and the observation of all time, which has never been seriously contradicted, shows that life, under whatever form it appears, is always and everywhere transmitted. This consideration forces me invincibly to think, that the first germ of all organization is *strange to our planet*, and that it has been imported, whence, when and how, it has pleased the Organizer of Worlds. If the extra-terrestrial influence of the sun is necessary for the mere maintenance of life upon the earth, how much more need was there for the concourse of some foreign agent to originate life.

One fact strikes me in the contemplation of the organized and living world which surrounds us, and of which we form a part; viz., that variable as are their forms, organized beings have strong analogies with each other. It is in virtue of these analogies, that their classification into kingdoms, classes, families, genera, and species becomes possible. Suppress these analogies, suppose as many moulds radically different as there are individualities in nature, and all possibility of classification will vanish. Is this grand phenomenon of analogies susceptible of explanation? Yes, if we adopt the system of common origin and of the evolution of forms; No, if we hold that of primordiality, and the independence of forms. There are seven or eight hundred kinds of *Solanum* disseminated over an immense extent of country in the Old and New World; all are specifically distinct, but all resemble each other in a certain sum of common characters, incomparably more important, in the eyes of the Classifier, than the completely external, and, so to speak, superficial differences by which they are distinguished, since these common characters assign to all their places in the same class, the same family, the same genus. I ask then, are these analogies a fact without any cause in physical order? Do they exist fortuitously or simply because it has pleased God that they should exist? If you hold to the system of the independent origin of the species, you will have to choose between chance, which is an absurdity, and a supernatural fact, that is to say, a miracle, two elements which do not pass current in science. Allow, on the contrary, a common ancestor to all these species; generalise in the vegetable kingdom this faculty, of which the present forms preserve the last relics, of gradual subdivision, according to the necessities of nature, into secondary forms which diverge from the common point of origin, in order to be presently themselves sub-divided into new forms, and you will arrive gradually, without any abruptness, and by the sole act of evolution, at species, races, and at the slightest varieties. The superficial traits will vary from one form to the other, but the common essential foundation will always subsist; you may have a thousand derivative forms, but each of them will have the impress of its origin, the sign of its relation to all the others, and it is this sign which will guide you in uniting them into the same family and the same genus.

These ideas of the general relationship between beings of the same genus, the same family, the same kingdom, are not new to me; it is ten years since I expressed them in the Revue Horticole, and I confess I have felt not a little flattered at seeing them professed by English *savants* of the highest distinction. This is the way in which I expressed myself in 1852. "We do not believe that nature has proceeded, in the formation of species, in any other manner than we ourselves proceed to form varieties, &c. (See Revue Horticole, 1852, p. 104, &c.* * *

"The vegetable kingdom regarded in this point of view would no longer present itself as a linear series of which the terms would proceed increasing or decreasing in complexity of organization, according as we examine them by commencing at one extremity or the other; it would no longer be a disorderly entanglement of intercrossing lines; not even a geographic map whose regions, differing in form and extent would touch each other at a larger or smaller number of points; but a *tree* whose roots, concealed in the depths of cosmogonical æras, had given birth to a limited number of successively divided and sub-divided stems. These first stems would represent the primordial types of the kingdom; their last ramifications would be the present species.

"The result would be that a perfect and rigorous classification of organised beings of the same kingdom, of the same family, would be nothing else than a *genealogical tree* of species, indicating the relative antiquity of each, its degree of *speciality* and the line of ancestors from which it had descended. The different degrees of relationship of species would thus be represented as it were in a palpable and material fashion, as also that of the groups of different degrees, going back to the primordial types themselves. Such a classification, drawn up in a graphic table, would be comprehended with as much ease by the mind as by the eyes, and would present the most beautiful application of that principle which is generally admitted by naturalists, that nature is sparing of causes but prodigal of effects."

Since these notions were put forth, I have been able to modify them in certain details, but their foundation has remained in my mind. I believe then in the unity of origin, and in the derivation of living beings from the same branch; and by consequence in a single focus of creation whence the stocks of these great branches have been elaborated, from a common nucleus. This first unity of bond does not exclude the secondary centres of the *multiplication of forms* in which I equally believe, and of which traces remain, notwithstanding so many dislocations of the surface of the globe. What I regard as no less certain, is that the forms, during the process of multiplication in the course of ages, have always followed divergent paths, and that, in consequence, it is contrary to nature to suppose that species can be changed the one into the other, or that two species can be melted into one by hybridisation.

LI.—Notices of Distinguished Naturalists recently Deceased.

During the last few weeks, we have to deplore the loss of three men distinguished in various branches of science, whose deaths will leave vacancies, that it will be by no means easy to supply. We extract the following notices of their active and laborious lives from the pages of some of our contemporaries.

Sir William Jackson Hooker, K.H., D.C.L., F.R.S. &c., Director of the Royal Botanic Gardens, Kew, died at his residence, in Kew, on the 12th of August last, having just completed his 80th year.

Sir William Hooker was born in 1785. His father, who was in business at Norwich, was a man who devoted all his leisure to reading, especially travels and German literature, and to the cultivation of curious plants; by which doubtless, was laid the foundation of that love of natural history for which his son became distinguished. Sir William's education was received at the High School of Norwich. Having at an early age inherited an ample competency from his godfather, William Jackson, Esq., he formed the design of devoting his life to travelling and natural history. Ornithology and entomology first attracted his attention; but, being happily the discoverer of a rare moss, which he took to Sir J. E. Smith, he received from that eminent botanist the bias which determined his future career. Henceforth, botany was his sole aim; and with the view of collecting plants, he made expeditions to Scotland and its islands, France, Switzerland, and Iceland and also extensive preparations for a prolonged exploration of Ceylon, which plan was, however, frustrated by the disturbances which broke out in that island.

During this period, 1806—14, he formed the acquaintance of all the principal scientific men in England and on the Continent, and commenced that intercourse and correspondence which never ceased till the day of his death. In 1815 he married the daughter of Dawson Turner, of Yarmouth, himself well known as a good botanist, and settled at Halesworth, in Suffolk. Here was laid the foundation of his now magnificent herbarium, and here commenced a long series of valuable botanical works, which followed each other at short intervals up to the present time. An increasing family and a decreasing income induced him, in 1820, to accept the Regius Professorship of Botany in Glasgow, at which place the next twenty years of his life were passed, and where his popularity as a lecturer, his admirable method of training his students, and his genial and attractive manners, soon made his house a rendezvous for all scientific men who visited Scotland—we might almost say England. Gradually his correspondence and his herbarium alike increased; the latter receiving large contributions from his numerous pupils, who, in foreign countries, remembered with gratitude the teacher who had placed science before them in so attractive a form.

In 1836 he received the honour of knighthood from William the Fourth, in acknowledgment of his distinguished botanical career, and of the services he had rendered to science; and in 1841 his connexion with Scotland terminated, and a new era of his life began with his appointment to Kew. To be Director of Kew Gardens had long been the ambition of Sir William Hooker's mind; and throughout his long residence in Glasgow he never abandoned the possibility of eventually being placed in that position. He was encouraged in these views by a nobleman well known for his distinguished patronage of literature and science, and himself a keen horticulturist, and no mean botanist. We allude to the late John, Duke of Bedford, who through the influence of his son, Lord John Russell, a statesman then rapidly rising into power, exerted a silent but most powerful influence with the Government and officers of the Queen's Household, in effecting the transference of the Gardens to the public. Sir William's appointment was indeed drawn up by Earl Russell; it gave him a salary of £300 a-year, with £200 to hire a dwelling-house for himself, which should be large enough to contain his library and herbarium, the latter requiring no fewer than twelve ordinary sized rooms for their accommodation. This was afterwards increased to £800 a-year, with an official house in the Gardens, and accommodation for his herbarium in the residence of the late King of Hanover, where it forms the principal part of the great Herbarium of Kew. The noble Earl is fond of stating that on taking Sir William's appointment for signature to a brother Lord of the Treasury, the latter remarked, " Well, we have done a job at last!"

The history of Sir William's career as Director of the Royal Gardens is so well and so widely known that it need not detain us long. From a garden of eleven acres, without herbarium, library, or museum, and characterized by the stinginess of its administration, under his sole management it has risen to an establishment comprising 270 acres, laid out with wonderful skill and judgment—including an arboretum of all such trees and shrubs as will stand the open air in this country, magnificent ranges of hot-houses and conservatories, such as no three establishments on the Continent put together can rival—three museums, each an original conception of itself, containing many thousand square feet of glass, and filled with objects of interest in the vegetable kingdom from all parts of the globe, a herbarium unrivalled for extent, arrangement, accuracy of nomenclature, and beauty of keep, and excellent botanical libraries, including small ones for the use of the gardeners and museums.

To the accumulation of these treasures he not only brought all the powers of his Glasgow correspondence, but by means of his friendly relations with the Admiralty, Colonial and Foreign Offices, Indian Office, and many private companies, enlarged the bounds of his intercourse in all directions, and at a comparative trifling cost procured specimens from countries the most distant and difficult of access.

To him is due the formation of many of our Colonial Gardens, and the resuscitation of the rest; his example has stimulated national gardens on the Continent, to a degree they never felt before; whilst the amount of information on all branches of economic botany which he has diffused among the labouring and manufacturing classes can hardly be over-estimated.

In conclusion, it is only right to state that though these more public duties have naturally attracted the most attention, his scientific labours not only did not cease on his coming to Kew, but were literally doubled. Rising early and going to bed late, and rarely going into society, the whole of his mornings and evenings were devoted to scientific botany. The "Species Filicum," prepared wholly at Kew, is of itself a sufficient monument of one man's industry; and when to this we add that he published from his own pen upwards of fifty volumes of descriptive botany, all of them of merit and standard authority, it must be confessed that his public career has in no way interfered with his scientific one. Indeed, up to the day of his death his publications were progressing as busily as ever, and the first part had appeared of a new work, the "Synopsis Filicum," for the continuation of which extensive preparations had been made.

Not content with publishing himself, he was always forward in obtaining for others remunerative botanical employment. Besides numberless appointments given to young and rising gardeners and botanists, he procured the publication of the results of many scientific expeditions and missions, and lately, after many years' strenuous exertion, induced almost all our Indian and Colonial Governments to employ botanists upon the publication of their Floras.

Mr. Hugh Cuming, the well-known Conchologist, died at his residence in Gower Street, on the 10th of August last, at the age of 74. Mr. Cuming was born at West Alvington, Kingsbridge, in the county of Devon, on the 14th of February, 1791. Even as a child his love of plants and of shells displayed itself in a remarkable manner; and under the friendly patronage and encouragement of Col. Montagu, the celebrated author of "Testacea Britannica," who resided in the neighbourhood, it was largely fostered and developed. Apprenticed to a sail-maker, he was brought into contact with seafaring men, and in the year 1819 made a voyage to South America, and settled in business at Valparaiso. Here his passion for collecting shells found an ample field for its development, and was greatly stimulated and assisted by the English Consul, Mr. Nugent, and by several officers of the British Navy; among others, by Lieut. Frembly and the officers of the surveying ships under the command of Capts. King and FitzRoy. In 1826 he gave up his business in order to devote himself wholly to his favourite pursuit. With this object he built a yacht, expressly fitted for the collection and stowage of objects of Natural History; and a cruise of upwards of twelve months among the islands of the South Pacific amply rewarded him for his toils in dredging and collecting by sea and shore. On his return to Valparaiso, he prepared for a voyage of more extended duration along the western coast of America; and his reputation being now widely extended, he started under peculiar advantages. The Chilian Government granted him the privilege of anchoring in its ports free of charges, and of purchasing stores free of duty, and he was furnished with letters to the authorities of all the States which he visited, who, in consequence, received him with marked attention, and gave him every possible facility.

After two years spent in exploring the coast from the Island of Chiloe, in lat. 44° S., to the Gulf of Conchagua, in lat. 13° N., dredging, while under sail and at anchor, in the bays and inlets, searching among the rocks, turning over the stones at low water, and rambling inland over the plains, river banks, and woods, Mr. Cuming returned with all his accumulated stores of plants and animals to his native land. The Zoological Society had just previously been established, and it was in 1831 that its evening scientific meetings began to be enlivened by the brilliant displays of new shells from his cabinet, which were described by the late Mr. Broderip and the late Mr. G. B. Sowerby; while the anatomy of some of the more interesting mollusks formed the subject of papers by Prof. Owen. For four-and-thirty years his unrivalled collection has continued to supply fresh novelties for these meetings, and the supply is still far from being exhausted. In 1835 he determined to undertake a new expedition, and fixed upon the Philippine Islands, rich in natural productions, little explored, and where his knowledge of Spanish would be of great advantage, as the scene of his labours. Letters of recommendation from the authorities at Madrid to the Governor-General at Manilla, to the governors of the various provinces into which the islands are divided, and to the Archbishop of Manilla, procured him a hospitable welcome among all ranks, but especially among the clergy, wherever he presented himself. Although his dredgings and wanderings by the sea-shore were by no means inconsiderable, his attention was now more particularly directed to the woods and forests of these luxuriant islands, and in them he reaped a most abundant harvest of plants, and filled his store-chests with innumerable specimens of such a magnificent series of land-shells as had never before rewarded the exertions of a collector. In every locality Mr. Cuming became the guest of the Padre or priest, always the chief personage of the district, in the interior of these islands. Their houses and equipages were placed at his disposal, and, what was of still greater importance, the services of the school-children, educated at the expense of the Spanish Government, and numbering in some places as many as four or five hundred, were secured to scour the woods for snails and plants. Small bribes of money were most effectual in directing the lynx-eyes of these youthful collectors to the detection of such as were especially pointed out to their notice, and shells which gladdened the collector's eyes by their exceeding novelty and beauty were brought to him day by day in quantities which seemed prodigious. After four years spent among the islands of the Philippine group, and short visits to Malacca, Singapore, and St. Helena, Mr. Cuming returned to England with the richest booty that had ever been collected by a single man. His dried plants, which numbered 130,000 specimens, were immediately distributed, as well as his living orchids, which were numerous and of great beauty. Large numbers of birds and reptiles, quadrupeds and insects, were also added to the museums at home and abroad. But his collection of shells formed by far the most important part of the spoils which he had secured. Before leaving England he had brought together, through his Pacific and South American collections, and by means of purchase and exchange, the largest and most valuable private collection then in existence. His vast Philippine collections enabled him to increase this to an enormous extent; and during the five-and-twenty years that have elapsed, he has been untiringly engaged in its arrangement and completion, in adding to it by purchase and exchange, and in getting the species described and figured by conchologists, both at home and abroad. It is stated by Mr. Reeve that it contains not fewer than 30,000 species and varieties, and in most cases several specimens of each.

Mr. Samuel P. Woodward, Ph.D., A.L.S., F.G.S., Assistant-Palæontologist in the British Museum, and Examiner in Natural Sciences to the Council of Military Education, died on the 8th of July last, at the early age of 44 years. Mr. Woodward was born September 17, 1821. He was the second son of the late Samuel Woodward of Norwich, well known to geologists and antiquaries as the author of 'Geology of Norfolk,' (1833); 'Synoptical Table of British Organic Remains,' (1830); a 'History of Norwich Castle,' (posthumous, 1847), and various papers in the 'Archæologia' of the Society of Antiquaries. Shortly after his father's death, he was temporarily employed (in 1838) in the library of the British Museum, and in 1839 succeeded Mr. Searles Wood, as Sub-curator of the Geological Society of London, and was elected a Member of the Botanical Society, and an Associate of the Linnean. In 1845 he was appointed Professor of Botany and Geology in the Royal Agricultural College, Cirencester, and became one of the Founders of the Cotteswold Naturalists' Field Club. In 1848 he was made first-class Assistant in the department of Geology and Mineralogy in the British Museum. He published but one independent work, a 'Manual of Recent and Fossil Shells,' of which the first part appeared in 1851, and the two following in 1853 and 1856. This has been used or recommended as a text-book by nearly every Professor of Natural History and of Geology in Great Britain; while in America it has obtained a very extensive circulation.

The small Geological Map of England, published by the Society for the Diffusion of Useful Knowledge, was prepared in 1843 by Mr. Woodward, under the superintendence of Sir R. I. Murchison;

and Professor Owen acknowledged his assistance in the Invertebrate portion of his 'Palæontology.' Dr. Woodward contributed several important papers to the 'Quarterly Journal of the Geological Society,' 'Proceedings of the Zoological Society,' 'Recreative Science,' 'Annals and Magazine of Natural History,' &c. The article 'Volcanoes' in the 'Encyclopædia Britannica,' the scientific reviews in the 'Critic' of 1860, and the 'Athenæum' reports of proceedings in the Geological Sections of the British Association, from 1841 to 1856, are amongst his minor contributions to Geological literature.

These Memoirs exhibit the vast acquaintance with the recent forms of Mollusca possessed by their author, and afford strong evidence of the philosophical cast of his mind, and his talent in determining the zoological relations of obscure organisms. One of his most remarkable achievements in this line of research was his determination of the true affinities of the extinct family of *Rudistes*, published in the XIth volume of the Quarterly Journal of the Geological Society; and the Society showed its appreciation of the merits and value of his memoir on that subject by awarding him the proceeds of the Wollaston donation fund in the year 1854; and again in 1857, on this account, and to assist him in his researches in the class Radiata.

He was a member of the Council of the Geological Society from 1859, and had recently been appointed one of the Examiners in Geology and Palæontology to the University of London.

Although his published works may, for a man of his acknowledged merit and position in the scientific world, appear to be small, they represent only a portion of the original work that he performed; many of the results he arrived at must unhappily have died with him, but others remain in the form of carefully prepared manuscripts, which his brothers entertain the hope of publishing. It may be a matter of surprise that he did so little in making known the results of his investigations; but for the last twenty years of his life, he suffered from chronic asthma, which eventually became so distressing as to awaken the sympathies of all, and caused many to marvel at the energy he displayed in research and conversation during intervals of release from pain.

An attack of acute bronchitis which occasioned the rupture of an artery in the lungs, was the immediate cause of his death, at Herne Bay, (whither he had gone in the hope of benefit to his health), on the 11th of July last.

LII.—Proceedings of the Scientific Societies of London.

1. Ethnological Society. (4, St. Martin's Place.)

May 9th, 1865.

The papers read were:—1. "On Language and Ethnology." By the Rev. F. W. Farrar. The views of the author were that the diversity of languages was primordial, and that they originated at different geographical centres. The search for the primitive language has come to be regarded as a vagary to be ranked with the attempts to discover the quadrature of the circle or the *primum mobile.* But obviously, if all languages were derived from one, that one must have been the primitive language, and ought, therefore, with our present philological knowledge, to be easily discoverable. Accordingly, whole volumes have been written on the subject, and among many languages, Low Dutch, Swedish, Basque, Irish, and Polynesian, have all been claimants for the honour of having been the language of Paradise, and it has even been supposed that the primitive language was restored at Pentecost. Hebrew, however, has been the most persistent candidate, and nothing was easier than the proof of its pretensions. It was simply this: all were descended from Adam and Eve. Adam and Eve spoke Hebrew, therefore Hebrew is the primitive language. But this syllogism lost sight of the fact that the Hebrews were among the very few nations who had considered the problem of the diversity of tongues, and that in the passage which deals with the subject, they attributed the fact to direct confusion miraculously introduced into all human speech.

Many eminent ethnologists have been jealous of the encroachment of philology on their domain, but the author thought philology and ethnology ought to be sister studies, and that though they worked separately, their conclusions should be combined. That there is one small family of languages united by the closest affinities, Hebrew, Phœnician, Chaldee, Samaritan, Syriac, and Arabic, has always been recognized; and to this family the faulty, but not inconvenient and conventional name of *Semitic* has been given. The discovery of Sanskrit brought to our notice a language coeval with, if not anterior to, the Hebrew, and utterly distinct from it—a language which bound together in one the dialects of Hindostan and of Persia with some European tongues, and thus was founded the Aryan families of languages. So far, then, we have two, and two only—the Semitic, consisting of some half-dozen Syro-Arabian dialects, and the Aryan, embracing eight important historical families—Celtic, Teutonic, Lithuanian, Slavonic, Hellenico-Italic, Thracian, Armenian, and Iranian. A third northern group, may perhaps, be added, whose affinities have been established by the labours of Klaproth, Scholt, and others. This group consists of five families—viz., Tungusic, Mongolian, Turkic, Finnic, and Samoiedic. And to it has been assigned what we cannot but regard as the unfortunate name *Turanian.* This name the author believed was first used by M. Omalius d'Halloy, and by him applied to the actual Tartars of Touran; but he has himself abandoned it, because of the wide extension of meaning it has received from other hands, and substituted for it the name *Alatian*—a name which the Tartars of Siberia apply to themselves.

We thus know of three linguistic families—Semitic, Aryan, and let us say *Alatian.* How small a distance, then, have we gone in classifying and in grouping the remaining innumerable tongues—of the languages of the Caucasus, Basque, Malay, Polynesian, North and South American, Chinese, African, Australian. They are all clearly non-Semitic and non-Aryan, and only the name Turanian remains. Now, if it were in any degree established that all non-Aryan and non-Semitic languages fall into one Turanian group, it would throw the great discovery of the Aryan unity completely into the shade. The author believed, however, that the name Turanian ought not to be so applied; for after admitting the unity of the Semitic, Aryan, and Alatian families, a third name was wanting to conceal our own ignorance of any true principle of unity pervading, or supposed to pervade, the remaining languages of the world. For this purpose we had much better adhere to the purely negative name *Allophyllian*, suggested by Dr. Prichard.

The author agreed with Professor Pott, that it was impossible to suppose a development from Chinese to Greek. The grammar of a language is its unutterable individuality; it may be cultivated and polished, but it can no more alter its organization than a gardener can change an onion into a potato. A people under stress of conquest may exchange its own language for another; but no nation could, or would, of its own accord, alter its own mother speech into one radically different. We are, therefore, led to conclude that every language at its creation received one ineffaceable stamp.

2. "On the Indians of South America." By Sir Woodbine Parish, K.C.H., F.R.S., &c.—D'Orbigny supposes the number of Indians now existing in that vast extent of country from the confines of Bolivia to the southern extremity of Patagonia, not to exceed 32,000. But this is a much lower number than is generally given to these Indians by the best-informed people at Buenos Ayres. Azara, who gives a very full account of these tribes, says he could count thirty-two languages amongst them, and this is vastly increased if we adopt the lists given by the Jesuits. May they not, the author asks, be generally classified under a very few heads or original stocks?—as, for example—1. The Araucanian and Pampas Indians, on the eastern side of the Andes, scattered over Patagonia—nomade tribes, but stopped from proceeding northward by heat of climate and rivers. They had no canoes, and subsisted by hunting wild animals, making cloaks of their skins. 2. The Tupis and Guaranis of Brazil and Paraguay, a docile people cultivating the fruits of intertropical climes. They were fishermen, and had canoes, in which they were carried by the rivers flowing northward to great distances. They grew cotton, and made clothing of it. 3. The Peruvians, the Asmaras, and Quichuas—more or less in an advanced state of civilization. They had llamas as beasts of burthen, and the wool of the alpacca and vicunas to clothe them, and had established a system of government under the Incas far superior to any other found in America by the first European discoverers.

Anniversary Meeting.

May 23rd, 1865.

Professor Busk, V.P. in the Chair. The Report of the Council was read and adopted. The Treasurer's accounts showed a balance of £170. in hand. The Officers and Council elected for the ensuing year, are :—*President :* J. Crawfurd, Esq.; *Vice-Presidents :* Prof. Busk; J. Lubbock, Esq.; Lord Talbot de Malahide; and R. Dunn, Esq.; *Honorary Treasurer :* F. Hindmarsh, Esq.; *Hon. Secretaries :* T. Wright, Esq.; and D. W. Nash, Esq.; *Hon. Librarian :* L. J. Beale, Esq.; *Council :* C. H. Bracebridge, Esq.; L. J. Burke, Esq.; T. F. D. Croker, Esq.; Sir A. W. Clavering, Bart.; F. Galton, Esq.; J. Dickinson, Esq.; J. Evans, Esq.; Rev. F. W. Farrer; A. W. Franks, Esq.; T. Hodgkin, Esq.; Prof. Huxley: D. King, Esq.; J. Heywood, Esq.; Sir R. I. Murchison; Sir C. Nicholson, Bart.; J. Thrupp, Esq.; C. R. Des Ruffières, Esq.; W. Spottiswoode, Esq.; and Dr. Thurnham.

2. Geological Society. (Somerset House.)

May 24th, 1865.

The following communications were read:—1. "Additional Observations on the Raised Beach of Sangatte, with reference to the date of the English Channel, and the presence of Loess in the Cliff-section." By Joseph Prestwich, Esq., F.R.S., Treas. G.S.—In his paper on the Loess and Quaternary Beds of the North of France and South-east of England, Mr. Prestwich expressed an opinion that the break in the land between France and England was not the result of the last geological change, but that the channel existed at the period of the formation of the Low-level gravels of the Somme and Thames Valleys, and probably at that of the High-level gravels. During a recent visit to the Sangatte Raised Beach, the author recognized fragments of chert in the shingle and associated sands, which he inferred were derived from the Lower Cretaceous strata; associated with them were fragments from the Oolitic series of the Boulonnais and two pebbles of red granite, probably from the Cotentin. These facts seemed to the author to add much probability to the existence of a channel open to the westward, and extending between France and England, anterior to the Low- and possibly to the High-level Valley-gravel period. Above the raised beach occurs a mass of chalk- and flint-rubble, with beds of loam, from 20 to 80 feet thick, and containing land-shells. Mr. Prestwich considered this accumulation analogous to the Loess, which it resembles in general character, while the shells found in it belong to species common in that deposit.

2. "On the Superficial Deposits of the Valley of the Medway, with Remarks on the Denudation of the Weald." By C. Le Neve Forster, Esq., B.A., B.Sc., F.G.S., and William Topley, Esq., F.G.S., of the Geological Survey of Great Britain.—In the first part of the paper the authors gave a description of the superficial deposits of the valley of the Medway. They showed that deposits of river-gravel and brick-earth (loess) occur at various heights up to 300 feet above the level of the river. A detailed account was given of the "pipes" at Maidstone, where brick-earth (loess), containing land and fresh-water shells and mammalian remains, has been let down into deep cavities in the Kentish Rag, probably by the gradual dissolving away

of the limestone by the action of rain-water containing carbonic acid. Several interesting cases of disturbed gravel were mentioned.

The second part of the paper was intended mainly to show what light is thrown upon the theory of the denudation of the Weald by a study of the superficial deposits. After a brief account of previous theories, with objections to the theory of fracture and the marine theory, the authors endeavoured to prove that the gravel and brick-earth (loess) occurring at a very great height above the level of the Medway are old alluvia of that river. If this point be granted, it follows that so large a denudation has been effected by atmospheric agencies, *i. e.*, rain and rivers, that, in the opinion of the authors, there will be little difficulty in supposing the present inequalities of surface in the Weald to have been produced by these agents acting on a comparatively plane surface of marine denudation. A discussion as to the origin of escarpments then follows. The authors considered that the escarpments of the Chalk and Lower Greensand which surround the Weald are not sea-cliffs, but are due to the difference of waste of the hard and soft formations under atmospheric denudation.

June 7th, 1865.

The following communications were read:—1. "Note on *Ovibos moschatus*, Blainville." By M. E. Lartêt, For. Mem. G.S. Translated by the late H. Christy, Esq., F.R.S., F.G.S.—A hoof-phalange found by Mr. Christy and the author at one of their stations in the Gorge d'Enfer was stated to be identical in form and dimensions with the corresponding bone of the existing *Ovibos moschatus*, to which species M. Lartêt therefore referred it. With it were found remains of *Ursus spelæus*, *Felis spelæa*, Wolf, Reindeer, and Aurochs, as well as worked flints differing from those found in any other of the Dordogne caves. The author remarked that the Gorge d'Enfer is the most southern locality at which remains of *Ovibos moschatus* have yet been found, and is 15° south of its most southern limit at the present day; but the Reindeer has been found by Mr. Christy and himself further south still—on the northern slope of the Pyrenees.

2. "On some Additional Fossils from the Lingula-flags." By J. W. Salter, Esq., F.G.S. With a Note on the Genus *Anopolenus*; by Henry Hicks, Esq., M.R.C.S.—In a recent paper Mr. Salter described the new genus *Anopolenus* as a blind Trilobite allied to *Paradoxides*, without facial sutures or head-spines, and with truncate body-

segments not produced into spinous appendages, as in most of its congeners. The remains of a new species, provided with extraordinary free cheeks, have proved that this conclusion was founded upon a part only of the head and of the body of the animal, which now appears to be more truly intermediate between *Paradoxides* and *Olenus* than was before supposed, while at the same time it presents characters opposed to those of either genus.

Mr. Hicks gave a full description of the genus as now known, and of the new species, which he called *Anopolenus Salteri*. From his description it appears that *Anopolenus* possessed minute eyes, a facial suture, and expanded pleura, but that their arrangement was abnormal.

In conclusion Mr. Salter compared the two species of *Anopolenus* now known, stating that the one first described, without the more anterior of the two segments which compose the head, was to all appearance a perfect Trilobite. He also gave a figure of a new species of *Olenus—O. pecten*.

3. "On the Discovery of a New Genus of *Cirripedia* in the 'Wenlock Shale of Dudley.'" By Henry Woodward, Esq., F.G.S. —The attention of the author having been called to two species of *Chiton* described by M. de Koninck from the Wenlock Shale, he found one of them (*Chiton Wrightianus*) to be a Cirripede. He stated that the distinctive characters of Chiton are: (1) The valves never exceed eight in number; (2) the series is always unilinear; (3) the valves are always symmetrical, and divided into three areas. The species mentioned does not, however, conform to any of these characters, as it had probably as many as four rows of unsymmetrical plates, having no apophyses, a uniformly sculptured surface, and not divided into three areas; each series exceeded eight in number. Mr. Woodward then endeavoured to show that *Chiton Wrightianus* was really a Cirripede, and formed the type of a new genus, to which he gave the name *Turrilepas*.

4. "On some New Species of *Eurypterida*." By Henry Woodward, Esq., F.G.S.—In his Advanced Text-book of Geology, Mr. Page figured and named the only known species (*S. Powriei*) of his new genus *Stylonurus*, but gave no description of it. Mr. Woodward now described this species in detail, from specimens found near Pitscandly, in the Turin Hill Range, Forfarshire; he also gave a description of a new species (*S. Scoticus*) found in an Old Red Sandstone quarry in Montroman Muir, near the Forfar and Montrose Pike.

Mr. Salter has expressed an opinion that *S. Powriei* is a full-grown male, and *S. Scoticus* a young female of the same species; but Mr. Woodward observed that if the sexes are not to be determined by the thoracic plates, but by more general characters, then the two forms of plates in *Slimonia* indicate two species of females, and the two forms in *Pterygotus minor* ought to indicate two species of males.

5. "On a new genus of *Eurypterida* from the Lower Ludlow Rocks of Leintwardine, Shropshire." By Henry Woodward, Esq., F.G.S.—In this paper Mr. Woodward described a Crustacean alluded to by Mr. Salter in the 'Annals and Magazine of Natural History;' for 1857, under the MS. name of *Limuloides*. It appears to form a connecting link between the *Xiphosura* and the *Eurypterida*, but it differs from the former in not having a cephalothorax; the cephalic, thoracic, and abdominal divisions being distinct, and apparently capable of separate flexure; and from the latter in having only three thoracic segments, &c. The name *Limuloides* not being allowable as a generic appellation, the author applied it to the species, using the generic term *Hemiaspis*.

June 21*st*, 1865.

The following communications were read:—

1. "On the Carboniferous Rocks of the Valley of Kashmere." By Capt. H. Godwin-Austen. With Notes on the Carboniferous Brachiopoda, by T. Davidson, Esq., F.R.S., F.G.S.; and an introduction and Résumé, by R. A. C. Godwin-Austen, F.R.S., F.G.S. Communicated by R. A. C. Godwin-Austen, Esq., F.R.S., F.G.S.

This paper was a continuation of one read before the Society last year, in which the Carboniferous, Jurassic, and Post-tertiary deposits and fossils were described by Capt. Godwin-Austen, Mr. Davidson, and Mr. Etheridge. In this communication Capt. Godwin-Austen confined himself to the Carboniferous formation which was shown by him to have, in the Valley of Kashmere, a thickness of more than 1500 feet. The upper portion of this mass contained but few fossils, except in one particular bed near the entrance of the ravine above the village of Khoonmoo; but the lowest portion, or Zèwan bed, is made up chiefly of the remains of Brachiopoda and Bryozoas and a higher stage, though still near the base of the formation, contains abundant remains of *Producta*. The position of a limestone containing *Goniatites* is not very clearly determined, but it is probably a member of the Zèwan series.

The sections in which the relative positions of the different beds were exhibited were described in detail, and plans and a map were given showing their geographical relation.

Mr. Davidson described the Brachiopoda forwarded with the paper, stating that they abound particularly at Barus and Khoonmoo, but are rarely in a very good state of preservation. Among them are several common and wide-spread European and American species, with a few that have not hitherto been noticed. They appear to be of Lower Carboniferous age.

In the introduction Mr. Godwin-Austen gave a synopsis of the more remarkable facts brought forward in the paper, and in a Résumé he gave lists of the fossils which had as yet been determined. These were forty-seven in number, forty-two of which had specific names, and twenty-two of which are well-known forms; eight are common to the Punjaub and Kashmere, seven of them being also found in British Carboniferous beds; and Mr. Godwin-Austen remarked on the support given to the notion of the approximate contemporaneity of distant formations containing the same fossils by the occurrence of these European Lower Carboniferous species near the base of the Carboniferous formation of Kashmere.

2. "On the Mammalian Remains found by E. Wood, Esq., near Richmond, Yorkshire." By W. Boyd Dawkins, Esq., B.A., F.G.S. With an introductory note on the deposit in which they were found. By E. Wood, Esq., F.G.S., and G. E. Roberts, Esq., F.G.S.

These mammalian remains were discovered last autumn on a terrace of blue clay, mixed with limestone débris, about 130 feet above the north bank of the River Swale, during excavations for a new sewer. The deposit was stated by Mr. Dawkins to be a heap of kitchen refuse, and the great majority of the bones, except the solid and marrowless, are consequently broken, while not one of the numerous skulls is perfect. The collection contained bones of the following species:—*Ursus arctos*, *Canis familiaris*, *Sus scrofa*, Horse, *Cervus elaphus*, *Cervus dana*, *Bos longifrons*, *Bos brachyceros*, *Ovis aries*, *Capra ægagrus*, and the horn-cores of a third form of goat, which appeared to be the *Ægoceros Caucasica*, which had also been found by Mr. Dawkins and Mr. Sanford in a bone-cavern explored by them in 1863. In a note to Mr. Dawkins, M. Lartêt expressed his opinion that these horn-cores belonged to some of the diversified forms that are the result of hybridity, and stated that they resembled some found in a bone-cave in the Pyrenees, which appeared to belong to a hybrid between the goat and the Bouquetin.

3. Linnean Society. (Burlington House.)

May 24th, 1865. (*Anniversary.*)

The following Fellows were elected members of the Council, in the room of others going out: The Rev. Hamlet Clark, Messrs. Robert Hogg, LL.D., A. Newton, J. T. B. Syme, and E. H. Vinen, M.D. Mr. G. Bentham, F.R.S., was re-elected President; Mr. W. W. Saunders, F.R.S., Treasurer; and Professor Busk, F.R.S., and Mr. Currey, F.R.S., Secretaries.

June 1st, 1865.

The President nominated Messrs. J. J. Bennett, J. D. Hooker, M.D., John Lubbock, and W. W. Saunders, Vice-Presidents for the year ensuing. The papers read were: 1. "Remarks on the Best Method of Displaying *Entozoa* in Museums," by T. S. Cobbold, M.D., F.R.S. 2. "On Animal Individuality, from an Entomological Point of View," by the same author. 3. "Contributions towards a Monograph of the Species of Annelides belonging to the *Aphroditacea*, containing a List of the Known Species and Descriptions of some New Species, from the Collection of the British Museum," by W. Baird, M.D., F.L.S. 4. "Synopsis of the *Diptera* of the Eastern Archipelago, discovered by Mr. Wallace, and noticed in the Journal of the Linnæan Society," by Mr F. Walker, F.L.S.

June 15th, 1865.

Mr. Syme exhibited a plant, in flower, of the rare *Cephalanthera rubra*, found by Mr. G. S. Wintle, in beech woods, in Gloucestershire. Mr. Redhead exhibited a living plant of *Cystopteris crenata*, from Gulbransdal, in Norway.

The following papers were read:—

1. "Descriptions of Fifty-two New Species of *Phasmidæ*, from the collection of Mr. W. W. Saunders, with remarks on the Family," by Mr. H. W. Bates, Secretary Royal Geographical Society. 2. "On Two New Tropical African Genera of *Anonaceæ*," by Professor Oliver, F.R.S. 3. "Notes on a Collection of *Algæ* procured in Cumberland Sound, by Mr. James Taylor; and Remarks on Arctic Species in General," by George Dickie, M.D. 4. "Supplementary

Observations on the *Sphæriæ* of the Hookerian Herbarium," by Mr. Frederick Curry, F.R.S. 5. "On the Asymmetry of the *Pleuronectidæ*, as elucidated by an Examination of the Skeleton in the Turbot, Halibut, and Plaice," by Ramsay H. Tranquaire, M.D., Demonstrator of Anatomy in the University of Edinburgh.

2. ZOOLOGICAL SOCIETY. (11, Hanover Square.)

May 9th, 1865.

Further communications were read from Mr. E. L. Layard, of Cape Town, Corr. Memb., on a supposed new species of Zebra discovered by Mr. Chapman in South Africa.—A communication was read from Dr. G. Hartlaub, For. Memb., describing two new species of African Birds, proposed to be called *Tchitrea spekii* and *Saxicola spectabilis.* The former species had been discovered by the late Captain Speke, during his last expedition, the latter by Captain Bulger, Corr. Memb. of the Society, at Windvögelberg, in the Cape Colony.—Mr. Sclater pointed out the characters of a new Accipitrine bird from Costa Rica, proposed to be called *Leucopternis princeps.*—A paper was read by Mr. J. Yate Johnson, Corr. Memb., describing a new form of Trichiuroid Fishes obtained at Madeira, proposed to be called *Nealotus tripes*, and giving remarks on the genus *Dicrotus.*—Dr. Gray read a paper on the development of the sternal callosities in *Cyclanosteus senegalensis*, and on the synonyma of *Cyclanosteus*, and the allied genera of Tortoises.—Dr. Corbold called the attention of the meeting to a new and remarkable discovery in helminthology recently made by Professor Leuckart.—A paper was read by Mr. A. G. Butler, describing six new species of Diurnal Lepidoptera, in the collection of the British Museum.

May 23rd, 1865.

The Secretary called the attention of the meeting to a specimen of a rare Parrot—*Chrysotis augusta*, Vigors—from the island of Dominica, which had been presented to the Society's Menagerie by P. N. Bernard, Esq.—The tenth of series of Memoirs, by Professor Owen, on the extinct Dinornithine Birds of New Zealand, was read. The present memoir contained the description of parts of the skeleton of a flightless bird, indicative of a new genus and species of the family, which Professor Owen proposed to call *Cnemiornis calcitrans.* The materials upon which the present paper was based had been gathered from the bottom of a fissure in a limestone rock at Timaru, in the middle island of New Zealand, by Dr. David S. Price. The *Cnemiornis* was supposed to have been of about the same stature as Bennett's Cassowary. The name chosen bore relation to the remarkable size of the processes of the tibia in this form.—A note was read by Professor Owen on the morbid appearances observed at the *post-mortem* examination of a King-Penguin, lately living in the Society's Gardens. Professor Owen attributed the death of the bird to inflammation of the stomach and of the abdominal membranes immediately external to it.—Dr. Gray communicated a revision of the genera and species of Amphisbænians, with the description of some new species in the collection of the British Museum.—Dr. Gray also gave a notice of a new species of Australian Sperm Whale, *Catodon Krefftii*, in the Sydney Museum, founded on drawings and notes communicated to him by Mr. G. Krefft, the curator of that establishment.—A paper was read by Mr. E. P. Ramsay, of Dobroyde, New South Wales, containing notes on the habits of several species of Cuckoos found in the vicinity of Sydney.—A description was read by Mr. G. French Angas, of a new species of shell from Port Jackson, proposed to be called *Gouldia australis*.—A paper was read by Mr. A. G. Butler, containing descriptions of six new species of Exotic Butterflies, in the collection of the British Museum.

June 13*th*, 1865.

The Secretary exhibited a photograph of a pair of Gayals (*Bos frontalis*), intended for transmission to the Society by Mr. W. Dunn, of Akyab, Corr. Memb., and made some remarks on several interesting living animals lately added to the Society's Menagerie. The Secretary also exhibited some specimens of a Humming bird (*Heliomaster angelæ*), transmitted to him by Dr. Burmeister, For. Memb., and read some notes by Dr. Burmeister on the changes of plumage exhibited by this bird.—A paper was read by Professor Allman, F.R.S., on the characters and affinities of *Potamogale*, a genus of insectivorous mammals recently discovered in Western Africa. Professor Allman came to the conclusion that this singular form was more closely allied to *Solenodon* than to any other known genus, but that it presented such striking peculiarities as would render it necessary to regard it as the type of a new family of Insectivora, to which the name of Potamogalidæ might be given.—Mr. W. H. Flower communicated a Note on the Australian Cetacean, lately described by him in the Society's Proceedings as *Orca meridionalis*; also a note on the Fin-Whale described by Dr. Gray in 1847, as *Physalus sibbaldii*, to which species he was now inclined to believe that the Whale lately described by himself as *Physalus latirostris* must be referred.—Mr. Sclater read a report on a small collection of animals transmitted from Madagascar to the Society by Mr. J. Caldwell, Corr. Memb., amongst which were a new species of Bat, described by Dr. Peters as *Nyctinomus* (*Mormopterus*) *jugularis*, and a new Crustacean, proposed by Mr. Spence Bate, to be called *Astacus Caldwelli*, after its discoverer.—Dr. J. E. Gray communicated a revision of the mammals of the order Insectivora, founded on the specimens in the collection of the British Museum.—Mr. Wallace exhibited and pointed out the characters of twenty-one new species of birds discovered by him during his explorations in the Malay Archipelago. Eight of these were from Celebes, and the rest of them from Sumatra, Borneo, the Moluccas, and the New Guinea group.—A paper was read by Mr. A. Butler, describing six new species of Diurnal Lepidoptera in the collection of the British Museum.—Mr. F. Moore communicated a list of the Diurnal Lepidoptera collected by Captain A. L. Lang in the North-Western Himalayas, together with Notes by Captain Lang of the habits and localities of each species. Captain Lang's series was stated to contain 119 species, thirty of which were new to science.

June 27th, 1865.

An extract was read from a letter addressed to the Secretary by Mr. R. Swinhoe respecting some Chinese Deer, destined for the Society's menagerie.—The Secretary announced the safe arrival in the Society's Gardens on the previous evening of a young male African Elephant, received in exchange from the Jardin des Plantes. —Mr. Busk communicated a memoir upon the fossil Elephants of Malta, based upon collections formed in that island by Captain Spratt, R.N., which had been originally placed in the hands of the late Dr. Falconer for examination. Upon Dr. Falconer's decease, Mr. Busk had undertaken the task of identifying these remains, which he was induced to refer to three species of the genus *Elephas*. One of these, not much inferior in bulk to the existing Indian Elephant, was, as Mr. Busk believed, probably *Elephas antiquus*. The two others were both of diminutive stature as compared with the existing species of Elephant, neither of them having exceeded five feet in height. To the first of these, slightly the larger of the two, Mr. Busk proposed to restrict Dr. Falconer's name *Elephas melitensis*, and to call the other and smaller one after the lamented naturalist who had done so much towards increasing our knowledge of these animals, *Elephas falconeri*. The two latter species were distinguished by very well marked dental and other characters.—Mr. St. George Mivart, read a paper on the axial skeleton of the Primates, in which the modifications presented by the vertebral column and the adjoining parts of the skeleton of this order of mammals were pointed out.—Dr. J. E. Gray pointed out the characters of a new genus of Delphinoid Whales from the Cape of Good Hope, proposed to be called *Petrorhynchus*, and gave particulars concerning other Cetaceans from the same seas, skulls of which had been submitted to his examination by Mr. E. L. Layard, Curator of the South African Museum, Cape Town.—A joint paper was read by Mr. Bartlett and Dr. J. Murie on the movement of the symphysis in the lower jaw of the Kangaroos.—Mr. N. L. Austin read some notes on the habits of the Water Shrew (*Crossopus fodiens*) as observed in a state of nature and in captivity.—A paper was read by Professor Owen containing descriptions of new species of Indian Cetaceans, which had been observed and collected on the eastern coast of the Indian peninsula by Walter Elliot, Esq. Of the seven species described as new, six belonged to the family Delphinidæ; the seventh was referred to the Sperm Whales (*Physeteridæ*), and proposed to be called *Physeter* (*Euphysetes*) *simus*.—A report was read by the Rev. H. B. Tristram on the Terrestrial and Fluviatile Mollusks, collected during his recent expedition in Palestine.—Mr. Sclater read a paper on the genera and species of the family of Swifts (*Cypselidæ*). Mr. Sclater was acquainted with about fifty well characterised species of this family, divisible into two subfamilies (proposed to be called *Cypselinæ* and *Chæturinæ*), which together contained six genera.—A paper was read by Dr. P. P. Carpenter, entitled: "Description of two species of Chitonidæ, from the collection of W. Harper Pease." Dr. Carpenter also communicated a paper by Mr. W. Harper Pease containing descriptions of new genera and species of Marine Shells from the islands of the central Pacific.—A paper was read by Ritter von Frauenfeld, on some new species of Mollusks of the genus *Vivipara*, in Mr. Cuming's collection.—Two papers were read by Mr. G. B. Sowerby entitled: "Descriptions of new *Scintillæ* and a new *Pythina*," and "Descriptions of new species of *Conus*."

LIII.—Miscellanea.

1. The transfer of the Marsupial Fœtus into the maternal pouch.

The mode in which the young Marsupial is transferred after birth into the pouch of its mother, has been often discussed by Naturalists, but, from the great difficulties encountered in attempting observations on this point, has hitherto remained, to say the least of it, obscure. From the following notes, communicated by Mr. James G. Shute to the Boston Society of Natural History, it would appear that that gentleman has succeeded in witnessing the operation as performed by the American Opossum (*Didelphys Virginiana*).

"During the delivery of the young, the parent lay upon the right side with the body curved in such a manner as to bring the vulva nearly opposite the mouth of the pouch, which was opened, or drawn down, by contraction of the muscles, so as to receive the young when delivered. The young were seven in number. The time occupied in the delivery was about four hours. The parent remained in the same position about thirty-six hours, and refused all sustenance.

"Immediately after the transfer of the young to the pouch, I removed one, by detaching it from the teat, in order to ascertain if the movement of the fœtus was instinctive. I found that it was at least partly voluntary, as it made an effort to regain its place in the pouch; and the same movement was made on the part of the parent to receive it as at first. I did not notice any use of the lips or limbs of the parent during the transfer."—Proc. Boston, Soc. N. H. ix. p. 332.

2. The cause of submergence during the Glacial Epoch.

Prof. Ramsay has recently sent to the "Reader" the following letter addressed to him by Mr. James Croll, observing that the suggested theory "not only throws a great deal of light on the mean-"ing of many well-known observations, but is fertile in future "results."

Glasgow, August 22, 1865.

I send you a few lines on a subject on which I know you feel very much interested. It has been found both in Europe and in America, or, in fact, wherever there have been any records left of the glacial epoch, that a general submergence of the land followed closely upon the appearance of the ice-sheet. This fact has led some geologists to suspect that there must have been some physical connexion between the appearance of the ice and the sinking of the land. In an able paper lately read before the Geological Society, Mr. Jamieson suggests that the submergence might have been caused by the earth's crust having yielded under the enormous weight of the ice.

While pondering over the subject, a few days ago, what I suppose to have been the true cause of the submergence suggested itself to my mind. The cause was a purely mechanical one, of extreme beauty and simplicity, The submergence was a necessary result of the influence of the weight of the ice-sheet on the earth's centre of gravity. The whole affair is so simple and obvious, that it is singular that the cause should have so long escaped observation.

The surface of the ocean always adjusts itself in relation to the earth's centre of gravity, no matter what the form of the solid mass of earth may happen to be. Now, if a large portion of the water of the ocean be converted into solid ice, and placed, for example, around the northern Polar regions, it will necessarily change the position of the earth's centre of gravity. The centre of gravity will be removed a little to the north of its former position. The water of the ocean will then forsake the old centre, and adjust itself in relation to the new. The surface of the ocean will, therefore, rise towards the North Pole, and fall towards the South; in other words, there will be, in relation to the sea-level, a depression of the land on the northern hemisphere, and an elevation on the southern. The surface of the land, it is true, will not sink nearer to the earth's centre of gravity, as is generally supposed, but the centre of gravity will rise nearer to the surface. The land will not sink under the sea; but, what is the same thing, the sea will, in consequence of the change in the earth's centre of gravity, rise upon the land. The extent of the rise of the ocean level, or, what is equally the same, the extent of the submergence, will be in proportion to the weight of the ice-sheet. The weight or the size of the ice-sheet being known, we can determine, with the utmost certainty, the extent of the submergence; or, conversely, the extent of the submergence being known, we can determine both the weight and size of the ice-sheet. It is singular why physicists should have not perceived the physical impossibility of an ice-sheet, several thousands of feet in thickness, being placed upon the northern hemisphere, and the ocean still retaining its former level in relation to this land; unless the ice-sheet be counter-balanced by one of equal weight placed upon the southern hemisphere. But this leads us to another result. The submergence of the land during the glacial epoch leads to the conclusion that the glaciation was not contemporaneous on both hemispheres. If the ice-sheet had covered both hemispheres, the earth's centre of gravity, and, consequently, the ocean-level, would have remained unaffected. The submergence of the land is, therefore, another confirmation of the truth of the theory, which attributes the glacial epoch to the excentricity of the earth's orbit; for, as you are aware, if the glacial epoch had been due to the excentricity, the glaciation could have extended to only one hemisphere at a time. One hemisphere would have been covered with snow and ice, while the other would have been enjoying a perpetual spring.

A glacial epoch resulting from the excentricity on the earth's orbit would extend over a period of upwards of 100,000 years. But owing to the precession of the equinoxes, and the revolution of the apsides, the glaciation would be transferred from one hemisphere to the other every 10,000 years or so. A glacial epoch extending over 100,000 years would, therefore, be broken up with five or six warm periods. A warm period on the one hemisphere would be contemporaneous with a cold period on the other. Under these circumstances we ought to have elevation of the land during the warm periods, and submergence during the cold. The land ought to have stood higher than at present during some periods of the glacial epoch as well as lower. This again, I presume, is in agreement with geological facts. That the cold of the glacial epoch was not continuous but was broken up by comparatively warm periods, when the ice, to a considerable extent at least, disappeared, I think, has been clearly proved by Morlot, Geikie, and others, from the stratified beds of sand, clay, and gravel, old water-courses and striated "pavements" which have been found in the true boulder clay. (See Geikie's Glacial Drift of Scotland, pp. 92—94. Morlot's paper in the *Edin. New Phil. Journal*, New series. Vol. II., 1855. Lyell's Antiquity of Man, second edition, p. 320.)

We shall now consider whether the relation between the actual extent of the submergence during the glacial epoch and the size of the ice-sheet be something like what it ought to be on the supposition that the submergence resulted from the cause which we have assigned. Unfortunately, however, the utmost uncertainty still prevails both in regard to the size of the ice-sheet and also in regard to the actual extent of the submergence. All that we can therefore do, is to make a rough estimate of what probably was the thickness and extent of the ice, and then to ascertain whether the amount of the submergence theoretically deduced from the supposed quantity of the ice, is anything like an approximation to the generally-received opinion among geologists regarding the probable extent of the submergence.

It has been proved by Mr. Jamieson that in some parts of Scotland the ice-sheet must have at least been 3000 feet thick. Agassiz thinks that in some parts of North America its thickness could not have been less than a mile. The thickness of the ice in Scandinavia and other parts of northern Europe must also have been enormous. What was the probable thickness of the ice in Greenland and other Arctic regions during the glacial period, we are, I presume, unable to form the least conjecture. But to simplify our calculations, let us assume that it was, say 7000 feet thick at the North Pole, and that it gradually diminished in thickness towards the Equator, according to a law, into the consideration of which we need not here enter, so that the upper surface of the sheet should curve exactly the same as the surface of the land underneath. The specific gravity of ice is 92, and the mean specific gravity of the earth, according to the determination of the Astronomer Royal, is 6·56. Hence the specific gravity of the ice-sheet would be to that of the earth as 1 to 7. Consequently, if a sheet of the same density as that of the earth, and 1000 feet thick at the Pole had been substituted in the room of the ice-sheet, it would have produced the same effect. But this would be simply adding 1000 feet to the polar diameter of the globe without increasing its equatorial diameter. But 1000 feet thus placed on one side of the globe which, in the present case, is on the north side, would, of course, shift the centre of gravity 500 feet to the north of its former position, and as the ocean would accompany the centre, there would consequently be a submergence at the North Pole equal to 500 feet. But this is not all; for at the time that the ice-sheet would be forming on the northern hemisphere, a sheet of equal size would be melting off the southern, and this of course would double the effect, and thus produce a total submergence of 1000 feet at the North Pole, and a total elevation of 1000 feet at the South Pole. A sheet 3500 feet thick at the Pole would produce one-half that effect.

The same results would, of course, follow, although the thickness of the ice-sheet at the Poles were far less than we have for convenience assumed, provided that an equal amount of ice be in some way or other placed on the northern hemisphere.

Although the general submergence and re-elevation of the land during the glacial epoch were, no doubt, due to the cause which we have been considering, still there would probably have been local depressions and elevations going on during the period, resulting from other causes, the same as there are at present, and have been in all ages.—I am, yours respectfully,

James Croll.

3. Birth of a Hippopotamus in Europe.

In a paper on this subject read before section D., at the recent meeting of the British Association, at Birmingham, by Mr. Sclater, it was remarked that three pairs of this huge animal were now living in different Zoological Gardens of Europe, viz., in those of London, Paris, and Amsterdam. Though the female in the gardens in London had often shown signs of breeding, and attempts at copulation had been made by the male, it was not believed that conception had ever occurred. In the case of both other pairs, reproduction had taken place on several occasions, but the new-born animal had always perished either from the violence of its parent immediately after its birth, or from incapacity to take food when removed from its mother. The first successful instance of the reproduction of the Hippopotamus in Europe was therefore that which took place at Amsterdam, on the 29th July last, for the details of which Mr. Sclater was indebted to the well known Director of the Zoological Gardens in that city, Mr. G. F. Westerman. Copulation in the present instance had occurred on the 6th and 7th December, 1864, so that the period of gestation was estimated at 234 days, which had been likewise confirmed in the previous cases of reproduction of the same pair of animals. As soon as the birth took place the little animal was removed from the mother, not without some difficulty, as the latter was already on her legs to defend it, and transferred to a separate house, previously prepared for its reception. Here it was now thriving well, and growing fast, taking every day in six or seven meals about two and a half gallons of milk mixed with one-fifth part of water.

4. Note on a Shell from Labuan.

We have received the following letter:—

Sir,—According to Chenu and Woodward, the minute land-shell, *Scoliostoma* is known only as a fossil of the triassic limestone. Having heard a few months ago that there was a curious little shell on an island in this vicinity I one day made a trip to it. The island is a mass of limestone, rising almost perpendicularly out of the sea. It is about 80 yards in diameter, and about 30 feet high, and is full of fissures and caverns, and, like all other islands in this neighbourhood, is covered with vegetation. Upon a naked rock, well protected from the heat of the sun by the surrounding trees, and having upon it here and there scanty patches of moss, I found the shell I was looking for. crawling among the short moss, by the hundreds. I sent home some specimens to Mr. Stevens, of Bloomsbury, but it was not until some time afterwards that I identified the shell with the *Scoliostoma* of Chenu. I enclose you a few specimens, should they chance to be destroyed by the way, you can procure some more from Mr. Stevens.

The *Scoliostoma* has never been found in any other habitat hereabouts. The island of Labuan is for the most part sandstone, coal, black sand, and ferruginous clay, but it has not as yet been observed that there is any limestone formation.

I enclose also a portion of the limestone from which the shells were taken, and a piece of crystallized carbonate of lime from the same mass. Should you publish this letter, it may perhaps lead to a curious and interesting disquisition from some one of your more learned readers upon this wonderful little link which connects the present time with the remotest ages.

I am Sir, yours, &c.,

C. C. de Crespigny.

Island of Labuan, 15th March, 1865.

[We have submitted the shells forwarded by our correspondent to Mr. Henry Woodward of the British Museum. Mr. Woodward informs us that the specimens do not belong to the genus *Scoliostoma* (which is a marine form from the trias), but are closely allied to, if not identical with *Opisthostoma*, discovered in 1859, by Messrs. H. F. and W. T. Blanford, near Pykara, on the Nilgiris, in Southern India.—Ed.]

5. List of Publications received.

[*Continued from page* 456.]

(73.) Proceedings of the Literary and Philosophical Society of Liverpool, during the Fifty-third Session, 1863-64. No. XVIII. London, Longman and Co. 1864.

(74.) Das Vorkommen des Parasit ismus im Thier-und Pflazenreiche. Dargebracht von George, Ritter von Frauenfeld. Wien, 1864.

(75.) Rendiconti del Reale Istituto Lombardo di Scienze e Lettere. Classe di Scienze Matematiche e Naturali. Vol. I. Fasc. IX. X. Vol. II. Fasc. I. II. Milano, 1865.

(76.) The Geological Magazine. Edited by T. Rupert Jones, F.G.S. Longmans, London. Vol. II. Nos. 6, 7, 8, 9.

(77.) Memorie del Reale Istituto Lombardo di Scienze e Lettre, Classe di Scienze Matematiche e Naturali. Vol. X. I. della serie IV. Fasc. I. Milano, 1865.

(78.) Revision der bis jetzt bekannt gewordenen Arten der Familie der Börstenthiere oder Schweine. Von Dr. L. S. Fitzinger. Wien, 1864.

(79.) Palæontographical Society's Memoirs. Vol. XVII. Issued for 1863. London, 1865.

(80.) Homes without Hands. By the Rev. T. G. Wood, M.A., F.L.S. Part XX. London, Longmans and Co.

(81.) A Course of Lectures on Hydrophobia; its History, Pathology and Treatment. By T. C. Shinkwin, M.D., M.R.C.S.L. Dublin.

(82.) On the Ultimate Nerve-Fibres distributed to Muscle and some other Tissues, with Observations upon the structure and probable mode of action of a nervous Mechanism. Being the Croonian Lecture for 1865. Delivered by Lionel S. Beale, M.B. F.R.S. From the Proc. Roy. Soc., May 11, 1865.

(83.) The Antiquity of Man: an Essay read before the Roy. Irish Academy, Jan. 23, 1865. By John Locke, A.B., &c. Dublin, 1865.

(84.) The Declaration of Students of the Natural and Physical Sciences. London, Simpkin, Marshall and Co.

(85.) Report of the Manchester Scientific Students' Association, for the year 1864. With an Appendix, consisting of a Synonymic list of British Terrestrial and Fluviatile Mollusca. By John Hardy. Manchester, 1865.

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