THURSDAY, DECEMBER 31, 1885

TERTIARY VERTEBRATA OF THE WEST

Report of the United States Geological Survey of the Territories. F. V. Hayden, United States Geologist-in-Charge. Vol. III. "The Vertebrata of the Tertiary Formations of the West." Book I. By Edward D. Cope. (Washington, 1883-1884.)

THE American Government has in many ways shown the importance which it attaches to the diffusion of scientific knowledge; but in nothing has this been more clearly seen than in the care with which the results of the Geological Surveys have been published, and the liberality with which these works have been distributed; so that geologists on this side of the Atlantic are well acquainted with the magnificent quarto volumes in which the Reports of the Geological Survey of the Territories have been published. A number of these volumes had already appeared under the directorship of Dr. F. V. Hayden, when, in the year 1882, their publication was committed to the charge of Major J. W. Powell, Director of the United States Geological Survey. The work now before us is the first Report of the Survey of the Territories published since this change, and will take its place as the third volume of the series. While fully equal to the previous reports in the care bestowed upon the drawing and printing, it is by far the largest volume which has yet appeared, comprising, as it does, more than a thousand pages of letterpress and upwards of one hundred lithographic plates.

Prof. Cope began this work in 1872, and since then it has been carried on both in the field and in the study. It was originally intended that the Vertebrata of the "Cenozoic" and "Mesozoic" formations should form the third and fourth volumes of the Reports, but such a large amount of material has been obtained that it has become necessary to limit the work to the description of the "Cenozoic" Vertebrata, and this is to be divided into four parts, thus:—

Part I. Puerco, Wasatch, and Bridger Faunæ (Eocene).

Part II. White River and John Day Faunæ (Low. and Mid. Miocene).

Part III. Ticholeptus and Loup Fork Faunæ (Upper Miocene).

Part IV. Pliocene.

The present volume includes Part I. and Part II. as far as the Carnivora, the number of species described being 349, included in 125 genera, no less than 317 species having been determined by Prof. Cope.

The explorations, resulting in the acquisition of this splendid series of fossil Vertebrata, were conducted chiefly by the author himself, assisted by an efficient staff, and were carried on with much trouble and personal risk, not only on account of the inhospitable country in which part of the explorations had to be made, but also because of the hostility of the Cheyenne Indians, who, in certain regions, were during this time continually committing depredations and murders. No little credit is due to Prof. Cope and his able coadjutors for the manner in which this work was carried to so successful an issue in the face of many difficulties.

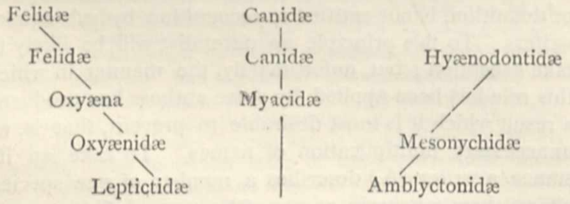
Before entering upon the description of the fossils, a short account is given of the Tertiary formations in which they were found, and an interesting and valuable comparison is made with the strata of the same age in Europe. A significant circumstance, with which geologists are to some extent already familiar, is the different story, regarding the age of these beds, told by the plants and mammals. The determination of the age of the formations known as the Loup Fork, White River, Bridger, Wasatch, Green River, and Laramie Beds, arrived at by Prof. Cope from a study of their higher vertebrate faunæ, does not agree with the conclusions of Mr. Lesquereux derived from his examination of the plant remains. The table given at p. 44 shows, in each case, the Flora a whole period in advance of the Vertebrata; for example, while the Laramie plants have an Eocene facies, the Vertebrata indicate an Upper Cretaceous age; and the fauna and flora of each of the other formations show a similar discrepancy.

The numerous *Bulletins* and reprints with which Prof. Cope has liberally supplied us during the last few years have made us to some extent acquainted with the progress of the laborious task which he has undertaken, and with the names proposed for some of the new types of animals which have been discovered. Even with this knowledge, however, one is perplexed, on first opening the book, with the array of new names. The overwhelming amount of material which had to be dealt with, including such a multitude of new forms, no doubt made it necessary to establish many new genera and species, and these would require, in some instances, to be placed in new groups; but, notwithstanding this, it will probably be felt by many palæontologists that it would have been better in some instances to extend the limits of a group rather than to make new ones. Be that as it may, Prof. Cope has laid us under no little obligation by giving us such a clear and systematic account of his herculean labours.

In the author's preface he touches upon the troublesome question of the rules of nomenclature. While agreeing with the law of priority, as generally understood, he gives half a dozen rules which have been adopted by a number of American biologists. The main principle underlying all these rules is, that a generic or specific name given by any author, without a sufficient description or definition, is not entitled to recognition by subsequent writers. To this principle no naturalist will be likely to take exception; but, unfortunately, the manner in which this rule has been applied by some authors has produced a result which it is most desirable to prevent, that is, an unnecessary multiplication of names. To take an instance, a writer (A.) describes a number of new species, giving them a generic name, without any definition, and, to quote Prof. Cope, "In these cases it is left to the reader (B.) to discover their characters. Should he do so, he becomes the real discoverer of the genus, and, as such, is entitled to name it." No doubt Mr. A. should have characterised his genus, and his name is *not entitled to be received;* but if Mr. B. is a true man of science, he will forego his right and "habilitate the *nomen nudum,*" rather than burden his brother-workers with another addition to their load of synonyms, which is already a burden almost too heavy to be borne.

This volume is essentially a detailed description of genera and species, and as such is an extensive and invaluable mine of information, wherein palæontologists may work with profit for many years to come. But besides the more special descriptions, there is much of deep interest to the naturalist and evolutionist, a flood of light being thrown on the early Eocene forms, which were probably the progenitors of our existing mammals.

The Saurian genus *Champsosaurus*, hitherto known only from Cretaceous deposits, has now been found in the Puerco Tertiary series. The remarkable marsupial genus *Plagiaulax*, was originally described by Falconer from British Purbeck beds; within the last few years an almost identical genus has been met with in Tertiary strata in France; and now closely allied forms are made known to us from the American Tertiary groups. It is, however, among the higher mammalia that the most remarkable discoveries have been made. The finding of forms, less specialised than those living at the present day, has enabled Prof. Cope to trace what he believes to be the line of descent of some of the groups of living mammals. The determination of the characters of a considerable number of new genera and species, more or less closely allied to the *Insectivora*, has led to a new classification. It is proposed to include in a new order, called the *Bunotheria*, the sub-orders:—(1) *Creodonta*, (2) *Mesodonta*, (3) *Insectivora*, (4) *Tillodonta*, (5) *Tæniodonta*, and (6) *Prosimiæ?* The *Creodonta* come nearest to the *Carnivora*, while the *Prosimiæ* come nearer to the *Quadrumana*, groups (4) and (5) being distinguished by the possession of incisor teeth with persistent pulps. It is among the Eocene *Creodonta* that Prof. Cope finds the ancestors of the *Felidæ* and *Canidæ*. "In distinguishing between the ancestors of the *Felidæ* and *Canidæ*, we naturally seek to recognise in each an anticipation of the leading characters in the dentition which distinguish those families to-day" (p. 263). In the *Felidæ* we should expect a gradual abbreviation of the true molar series from behind. The *Canidæ*, on the other hand, not only retain the true molars, but have them also of a tubercular character. "Estimated by these tests the *Myacidæ* are clearly the forerunners of the *Canidæ*, and the *Oxyænidæ* of the *Felidæ*." The following diagram will show the families through which these relations are traced (p. 264):—



Unfortunately the new names prevent our fully appreciating these affinities, which can only be properly understood when the characters of these groups have been carefully studied. The forms allied to *Canis* which have been met with in the Lower and Middle Miocene are all said to be generically distinct from *Canis*, while those from the Upper Miocene pertain to the same genus The many new species of *Carnivora* have suggested to Prof. Cope a new grouping for the *Fissipedia*. These are in the first place divided into two subdivisions:—

(1) "External nostril occupied by the complex maxilloturbinal bone; ethmoturbinals confined to the posterior part of the nasal fossa; the inferior ethmoturbinal of reduced size . . . *Hypomyceteri*.

(2) "External nostril occupied by the inferior ethmoturbinal and the reduced maxilloturbinal . . . . *Epimyceteri*."

No. 1 includes the families *Cercoleptidæ*, *Procyonidæ*, *Mustelidæ*, *Æluridæ*, *Ursidæ*, *Canidæ*.

No. 2 the *Protelidæ*, *Arctictidæ*, *Viverridæ*, *Cynictidæ*, *Suricatidæ*, *Cryptoproctidæ*, *Nimravidæ*, *Felidæ*, *Hyænidæ*.

The species of *Carnivora* described are from the Miocene, and are all referable to the *Canidæ* and *Nimravidæ*, the first being divided into eight genera, all of which are represented except *Canis;* they have much resemblance to our dogs and foxes, and are separated chiefly by the modifications of their teeth. The second includes nine extinct genera, all closely allied to the *Felidæ*, but differing in having an alisphænoid canal and post-glenoid foramen. In some of them the dental formula is the same as that of the *Felidæ;* but in others there is an increase in the number of the molars and premolars. It is these variations which are used as generic distinctions. Some of the genera, such as *Pogonodon*, have the canine teeth so largely developed as to make a near approach to the sabre-toothed tigers.

The changes which are proposed in the names and grouping of the herbivorous animals are not less numerous or less radical than those among the flesh-eaters, to which allusion has been made above. The order *Ungulata*, as it is now generally understood, is to be divided into four orders, founded on characters of the carpus and tarsus; these are as follows:—

(1) *Taxeopoda* (including sub-orders *Hyracoidea*, *Condylarthra*, and *Toxodontia* ?).

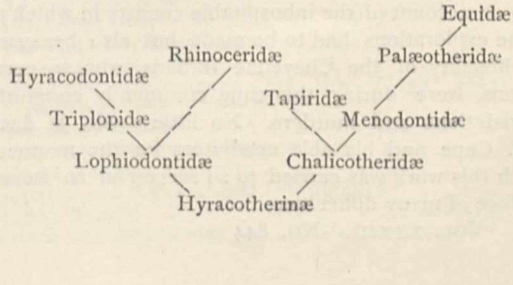
(2) *Proboscidea*.

(3) *Amblypoda* (including *Pantodonta*, *Dinocerata*, and *Talligrada*).

(4) *Diplarthra* (including *Perissodactyla* and *Artiodactyla*).

The necessity for some modification of this classification is already pointed out by Prof. Cope himself, for on p. 383, in speaking of the almost perfect skeletons of *Phenacodus primævus* and *P. Vortmani*, which genus is placed in the *Condylarthra* (Order 1), he says:—"The unexpected result is, that this genus must be placed in a special group of an order which includes also the *Proboscidea*."

Not the least important outcome of these discoveries in the Eocene deposits is the reconstruction, from numerous specimens, of the genus *Hyracotherium;* and consequent upon this the knowledge that it is, as Prof. Cope thinks, the earliest ancestor of the *Perissodactyla*. The following genealogical tree will show this relationship (p. 617):—



The *Hyracotherinæ* are here made the parent stock from which are supposed to have arisen, on the one side, the horses, through the Palæotheria; the tapirs being an offshoot from an ancient group, the Chalicotheridæ. On the other side the rhinoceroses have arisen from the Lophiodonts, from which also the Hyracodonts are to be traced.

Time alone will show whether the systems of classification proposed by Prof. Cope are founded on sufficiently important characters to render them permanent. It is probable that naturalists will hesitate before accepting such sweeping changes, especially as they necessitate the adoption of so many new ordinal names. However, it will be well to wait until we have had time to make ourselves thoroughly acquainted with the details of this work, before criticising that which is the result of years of patient labour. We are certainly under deep obligation to the author for his careful and systematic marshalling of the multitude of facts with which he has had to deal; and congratulate him, as well as the directors of the two Surveys, on the successful completion of this first half of the work, which will be a lasting testimony to the zeal and devotion of all who have shared in the labour of its production, and an enduring monument to its author's scientific skill and untiring energy.

E. T. NEWTON

THE DEPTHS OF ALPINE LAKES

La Faune profonde des Lacs suisses. Par le Dr. F. A. Forel, de Morges, Professeur à l'Académie de Lausanne. (Bâle, Genève et Lyon: chez H. Georg, 1885.)

PROFESSOR FOREL, of Morges, already so well known by his numerous pamphlets and short notices on various points in the natural history and the physical geography of the great lake beside which he lives, has in the present work given us the results of the labours of many years, casting into one mass the many fragments and gathering together and correcting where needful the many interesting papers which alone he has hitherto published.

It is a small quarto volume of over 200 pages, with a table of contents and a long bibliographical list appended; it is a pity that there is no index, and the value of the work would have been greatly enhanced had it been illustrated with figures of the new or rare species, and especially with a map of the basin of one at least of the Alpine lakes. Though it professedly deals with the deep-water fauna of the Swiss lakes as a whole, and though frequent allusions and references are made to work done by Prof. Forel and others in a very large number of these and of other lakes, this memoir, as is natural, deals most fully with the fauna of one lake only—the Léman. Of the only other great lake on the northern slope of the Alps—the Bodensee—and of the great lakes of the southern slope—Verbano, Lario, and Benaco—we are told but little. This is, however, a matter of the less importance as the physical surroundings which have affected the fauna of the Léman are almost exactly repeated in the other lakes, and the little that is known of their deep-water life is very similar to what we know of that of the Léman. Of this—his own lake—Prof. Forel has given us a study which may be called complete.

The chief agents affecting the life of the lake are temperature and light: of less importance are the shape and capacity of its basin, the matters dissolved in or held in suspension by its waters, the movements—for the most part superficial—to which its waters are subject. And light is a far more important factor than temperature,—it is at a depth of 30 metres, at the depth that is to say at which chlorophyll-forming vegetation ceases that Prof. Forel draws the line separating the littoral and deep regions of the lake: the actinic action of light ceases at 50 metres in summer, at 100 metres only in winter, owing to the greater transparency of the waters at that season.

Speaking of the conditions of this deep region Prof. Forel says: "They all tend to calm, to rest, to absence of movement. Uniformity, monotony, equality, no motion, no variation, such are the general characters of this region, with which we can compare no other region but that of the deep sea." It is after having studied the flora and fauna of this region almost uninterruptedly for six years that he now gives us what he modestly calls a sketch of the results at which he has arrived.

But in order to be able properly to understand the deep-water life of the lake we must first be properly acquainted with the inhabitants of the upper waters, whether of the shore or of the open. To this end, the first half of the book is occupied with a careful account of the littoral and pelagic flora and fauna. The most interesting point in this section is the statement that the same species of pelagic Entomostraca are common not only to the Alpine lakes but to those also of Scandinavia and the Caucasus. They exist in enormous numbers, thousands of individuals may be captured in one sweep of the net, and they form a very important part of the food of fishes, giving to them, it appears, their characteristic fishy smell; but the species are few. The very wide distribution of these few species is probably brought about by migratory water-fowl.

The deep-water flora of the Léman finds its lowest limit at a depth of 100 metres, and consists entirely of Algæ, chiefly Palmellaceæ and Diatomaceæ, of which the latter are the most abundant in species, but the Palmellaceæ are the most important, forming in many places a felted carpet on the surface of the ooze, and thus giving a more solid bottom, on which animals may move or in which they may live.

The population is much denser in the upper part of the deep region than in the lower part, but even in the deepest part life is present; in the upper part hundreds of animals, dead or alive, may often be obtained at one haul. About 100 species (22 of which are new) constitute this fauna:—Fishes, 14; Insects, 3; Arachnida, 9; Crustacea, 16; Hydroidea, 1; Rhizopoda, 13; Cilioflagellatæ, 1; Gasteropoda, 4; Lamellibranchiata, 2; Annelida, 4; Nematoidea, 3; Cestoidea, 1; Turbellariæ, 18; Bryozoa, 1; Rotifera, 2.

The greater part of these species are evidently the descendants of the inhabitants of the shallow waters, and differ from them chiefly in being smaller and less brightly coloured; the eyes are wanting in *Gyrator coccus*, and have a tendency to disappear in other species; the shells of the mollusks are thinner than is usually the case with those of the littoral zone; and *Fredericella Duplessis*, which is the representative of *F. sultana*, has so far varied from the littoral form that it is never found attached to solid bodies, such as pebbles or fragments of coke, but invariably plunged in the soft ooze after the fashion of a Pennatula.

But of two species of Crustaceans—*Niphargus puteanus* var. *Forelii*, an Amphipod, and *Asellus Forelii*, an Isopod closely related to *A. cavaticus*—Prof. Forel maintains that they are descended, not directly from the allied species of the littoral zone, but from the species *N. puteanus* and *A. cavaticus* which inhabit the subterranean waters, and are commonly found in the wells of nearly the whole of Europe. There is no doubt that *A. Forelii* is closely related to *Asellus aquaticus*, nor that *Niphargus puteanus* is equally closely related to *Gammarus pulex;* the question is merely whether the forms at present inhabiting the abysses of the Léman and other lakes are like *Fredericella Duplessis* directly descended, or indirectly descended, from the littoral forms. It was to the first of these views that Prof. Forel formerly inclined: he now gives his support to the second. And mainly for the following reasons. The modifications which *Niphargus puteanus* and *N. Forelii* have undergone are in all important respects the same; they differ at present only in such unimportant points as the number and length of hairs, setæ, and spines. It is unlikely that precisely the same changes would occur under such very different surroundings as those presented by subterranean waters and the deep waters of a lake. Again, *N. Forelii* is not confined to the Léman, and it is improbable that exactly the same variations should have arisen in different localities. And thirdly, since maintaining a lacustrine origin for *N. Forelii* would compel us to admit that it had varied so far from *Gammarus pulex* since the Glacial period, we can by supposing it to have a subterranean origin allow it a far longer time in which to have undergone modification.

"It is more simple, it is more in conformity with facts to admit that the *N. Forelii* of our lake-bottoms is descended from the *N. puteanus* of the underground waters. That is the conclusion to which I adhere. And I extend this same conclusion to *Asellus Forelii*, and seek its origin also in the *A. cavaticus* of the underground waters."

An interesting illustration of the manner in which animals can adapt themselves to their surroundings is to be found in the species of Limnea and in the larvæ of Diptera (Chironomis) which abound in the Léman. In the littoral zone the Limneas, having a pulmonary sac, are air-breathers; in the deep water, without any change of structure, their breathing is aquatic—their pulmonary sac is filled with water. The case of the Dipterous larvæ is more remarkable. We are told that they swarm in the deep water, and that their respiratory apparatus, consisting of tracheæ, is, like the sac of the Limneas, filled with water instead of air. Larvæ abound, but pupæ are very rare, if not altogether absent, and perfect insects are never seen rising from the surface of the deeper parts of the lake; moreover larvæ of all sizes and ages are found on the bottom at the same season. It would appear from the observations of O. Grimm (*Mém. Acad. imp. St. Pet.*, xv. No. 8, 1870), of St. Petersburg, that these larvæ never attain the perfect stage, but are capable of reproduction by *pædogenesis*.

I have no more space; I can only allude to the discovery of two species of Acanthopus, whose nearest relatives are marine Cythærideæ; to *Plagiostoma Lemani*, also with marine relations; to the remarkable absence in the deep water of Anodon and of Spongilla, both of them so common in the shallows. Let me conclude in Dr. Forel's words:—

"Others may perhaps regret the absence of the strange things which they had expected to meet with in these strange regions. For my part I have had the intense happiness of being the first to penetrate them, I have endeavoured to explain to myself one by one the mysteries which unfolded themselves to my gaze, and I admire and enjoy their harmony and their simplicity above all. Nature is beautiful and great because she is harmonious everywhere and in everything."

G. H. WOLLASTON

THE CRETACEOUS AND TERTIARY FLORAS OF THE UNITED STATES

The Cretaceous and Tertiary Floras of the United States. By Leo Lesquereux. (U.S. Survey of the Territories under F. V. Hayden, Vol. VII.)

AFTER an interval of nearly ten years, Dr. Hayden presents us with further contributions, by Lesquereux, to the Cretaceous and Tertiary floras of the United States. Those principally illustrated are from the Dakota, Laramie, and Green River groups. The author frankly admits at the outset, p. 4, that "the determinations of the plants are still, and must be for a long time to come, unreliable to a certain degree." This admission must be kept in mind in pronouncing on the merits of the book.

The Dakota beds rest on Permian, and contain a Cretaceous fauna associated with a very rich dicotyledonous flora. No one now doubts their Cretaceous age, although they cannot be correlated exactly, bearing in mind the flora, with anything in Europe. It appears from the revision these fossil plants have undergone, that they are much less closely related to existing genera than was previously supposed. Under such circumstances it seems a pity that less compromising generic names were not substituted for those, such as Sassafras, Acer, Quercus, Hedera, &c., as done in the case of Populites. The known flora of Dakota now consists of 5 ferns, 6 Cycads, a dozen Coniferæ, most of them very unsatisfactory, and no less than 162 Dicotyledons, chiefly remarkable for the large number of handsome palmate leaves among them. One of the most interesting genera, because determined from fruits as well as leaves, is Platanus, a genus also common to our own Lower Eocene of Reading, and thus of a high antiquity. Magnolia is another genus adequately determined, but the remainder rest mainly, if not entirely, on the characters furnished by detached leaves. The vexed question of the age of the Laramie or Great Lignitic series of America is again discussed, and a table given of all its species compared with those of Europe, especially the Eocene of Sézanne in the Paris Basin. As a result the author still holds to the opinion that the formation is an Eocene one. A larger part of the work is occupied with descriptions of the Green River plants, chiefly from Florissant, an incredibly rich locality. This is prefaced by a lucid description of the beds, which exceed 300 feet in thickness, by Mr. S. Scudder. They are principally volcanic ash accumulated in one or more old lake-basins. These and most of the other fossiliferous rocks are situated towards the top of the Green River group, which is reckoned to be 2000 feet thick. The flora contains 228 species, of which 152 are from Florissant, and is referred by Lesquereux to the Oligocene. It was originally thought by him to be Miocene, but the detailed comparisons he has made between it and that described by Saporta from Aix, in Provence, prove that he is justified in putting its age further back. Indeed it bears a marvellous resemblance to that of Bournemouth, and had he been able to make comparisons he would perhaps have assigned it a still earlier date. It is a matter of the greatest interest to find in America a flora corresponding to those of Aix and Bournemouth, and not represented anywhere to the north. The last pages are occupied with descriptions of some new Miocene plants from various localities. The book is illustrated by fifty-nine coloured plates, and however we may differ as to the value of the determinations themselves, all will agree as to the great service rendered to science by the publication of such an important mass of data for future comparison. J. STARKIE GARDNER

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Coal-Dust Question

ON several occasions during the last five years, Sir Frederick Abel has referred to the history of the coal-dust question, and to my connection therewith; and as his views on this subject do not altogether correspond with mine, I desire, with your permission, to state in this place how much, and in what particulars, I differ from him.

In his address to the Society of Arts, delivered on the 17th of November last, Sir Frederick says: "Several well-known French mining engineers published, many years after Faraday and Lyell wrote, observations and experimental results as new, which were simply confirmatory of those philosophers' original statements and conclusions, and to some extent this was also the case in still more recent publications in this country by Galloway and Freire-Marreco."

Faraday and Lyell's statements and conclusions were to the following effect:—

1. Fire-damp is not the only fuel in an explosion.
2. The coal-dust is swept up by the blast and is partially burnt.
3. (Speaking of Haswell Colliery explosion)[1] "There is every reason to believe that much coal-gas was made from this dust in the very air itself of the mine, *by the flame of the fire-damp*, which raised and swept it along, and much of the carbon of this dust remained unburnt only for want of air."

That is to say, the flame of the fire-damp is extended, and the effect of the explosion is aggravated by the presence of the coal-dust.

[1] *Phil. Mag.*, 1845.

The Committee of the Coal Trade, who replied to Faraday and Lyell's report in a letter dated February 7, 1845, do not appear to have thought those authors' remarks about coal-dust of sufficient importance to be noticed at all. Nor do the authors themselves seem to have attached any particular importance to them save as a record of a curious physical and chemical fact; for after making them they immediately turned, like all their predecessors and most of their successors, to the contemplation of imaginary magazines of fire-damp as a means of accounting for the explosion. Moreover, both of them lived for many years afterwards, during which one great explosion occurred after another, and yet we do not find that either of them ever lifted so much as the tip of his little finger to point to coal-dust as the probable cause of the catastrophes.

In 1855, M. du Souich, Ingénieur des Mines, said,[1] "A sort of crust of light coke, which could be gathered from the timber at various points, could only have originated from the coal-dust swept up in the working places and carried to a distance by the extremely violent air-current caused by the explosion. This dust being itself partially inflamed *could continue the effects of the fire-damp by carrying them further*" (*peut continuer les effets du grisou en les portant plus loin*).

In 1861,[2] M. du Souich and M. Estaunié again insisted on the same thing in similar terms.

In 1867,[3] M. du Souich again developed the same opinions.

In 1864,[4] Verpilleux de Reydellet, A. Burat, Poumairac Baretta and other engineers emitted opinions similar to the foregoing.

In 1875,[5] M. Vital wrote, "Extremely fine coal-dust is a cause of danger in dry working places in which shot-firing is carried on; in well-ventilated workings it may of itself alone give rise to accidents; in fiery workings it increases the chances of an explosion, and when an accident does occur *it aggravates the consequences of the fire-damp flame*" (*coup de feu*).

In 1875,[6] MM. Desbief and Chansselle gave a short historical *résumé* similar to that of M. Haton, and quoted an opinion of M. Verpilleux which appears to resemble my own, but has never, so far as I am aware, been put prominently forward by the author nor supported by experimental or other proof, namely: "M. Verpilleux, who attaches great importance (*importance capitale*) to coal-dust, was one of the first to call attention to it; comparing a fire-damp explosion to the detonation of a gun, he went so far as to say that the dust represents the powder and the firedamp the priming."

In March, 1875, Sir Frederick, then Professor, Abel, addressing an audience at the Royal Institution on the subject of "Accidental Explosions," referred to explosions in mines, and mentioned the researches that had been made by Mr. R. H. Scott and myself up to that date. He also speaks of dust explosions in flour mills, &c.; but, as showing the small importance he attached to anything that had been previously said or done in regard to coal-dust, it is remarkable that he does not even refer to its existence.

I had been investigating the subject of great colliery explosions since the year 1870, but had been unable to discover any explanation of their occurrence wholly satisfactory to myself. At the commencement of my work I had read all, or nearly all, the English literature connected with it then extant, and amongst other things the report and article of Faraday and Lyell on the Haswell Colliery explosion, and the reply of the Committee of the Coal Trade;[7] but, so little impression did Faraday and Lyell's remarks about coal-dust make upon me at the time, that I afterwards forgot I had read them, and was only reminded of the fact by seeing it recorded in an old note-book of my own some time after the publication of my first paper. I retained the impression, however, for in the paper[8] referred to I wrote: "The accounts of colliery explosions published in this country hardly ever allude to the existence of coal-dust; and when they do so, in one or two cases [it should have been one case only] it is for the purpose of suggesting that the gases disengaged from it by the heat of the fire-damp flame would no doubt be ignited and tend to increase the force of the explosion."

It did not for a moment occur to me that this, which is Faraday and Lyell's view, could ever be accepted as an explanation of the phenomenon I was trying to elucidate.

[1] "Rapport de M. Haton de la Goupillière: Des Moyens propres à prévenir les Explosions du Grisou," 1880.
[2] *Ibid.* [3] *Ibid.* [4] *Ibid.*
[5] *Annales des Mines*, 1875.
[6] *Comptes rendus des Réunions mensuelles de Saint Etienne*, June, 1875.
[7] *Iron*, June 1, 1878. [8] *Proc. Roy. Soc.*, 1876.

In the beginning of the year 1875 I removed to South Wales, and soon discovered that all the collieries in which great explosions had occurred were dry and dusty. My previous experience was almost wholly confined to damp mines, in all of which, with one exception (Nitshill), there was no coal-dust, and in none of which, with the same exception, a great explosion had ever occurred. The impression referred to above probably exercised a certain influence at that time in helping me to form the conception of what I believe to be the true explanation of great colliery explosions. In the words of my first paper[1] it is as follows: "If it could be shown that a mixture of air and coal-dust is inflammable at ordinary pressure and temperature, there would be no difficulty in accounting for the extent and violence of many explosions which have occurred in mines in which no large accumulations of fire-damp were known to exist; for it is only necessary to suppose that a violent gust of wind (originated, for example, by the explosion of a small accumulation of fire-damp) had swept through the adjoining galleries, raising a cloud of dust into the air, and then all the other phenomena would follow in regular order. The flame of the originally inflammable mixture would pass into the newly-formed one, expanding its volume; the disturbance would be propagated over an ever-widening area, until that area might possibly become co-extensive with the workings themselves; and *the consequences would be the same as if the whole space had been filled with an inflammable mixture before the disturbance began.*"

I demonstrated by an experiment first made on the 3rd of July, 1875, that air containing less fire-damp than can be detected by the ordinary means of testing the air in mines, is rendered inflammable at ordinary pressure and temperature when fine dry coal-dust is added to it. This was the first step towards proving the truth of my theory.

In the same paper I also stated, "It is always possible that if coal-dust could be made fine enough and were thoroughly mixed with dry air in the proportion of about 1 pound to 160 cubic feet of air, the mixture might be inflammable at ordinary temperature, or, *if not*, it might at least be so nearly inflammable that an explosion begun in it, in a confined space, might be propagated through it."

In my second (1879) and subsequent papers to the Royal Society, I stated the further opinion, first, as the result of more elaborate experiments, and secondly, as the result of a careful personal investigation and consideration of all the circumstances attending the occurrence of several great explosions, that, "A fire-damp explosion occurring in a dry coal-mine is liable to be indefinitely extended by the mixture of air and coal-dust produced by the disturbance which it initiates." This was the final step.

Of this, Sir Frederick says:[2] "Mr. Galloway was certainly the first to enunciate the conclusion that a small proportion of fire-damp is essential to impart to a mixture of air and coal-dust the power of propagating flame, though *he afterwards abandoned this conclusion in favour of the one some time previously accepted by Marreco*, to the effect that fire-damp is altogether unnecessary for the conveyance of flame with explosive effect by a mixture of dry coal-dust and air."

In January, 1878, I commenced a series of articles in *Iron* on coal-dust explosions, hoping thereby to arouse an interest in the subject, and, amongst other items of information, I gave translations of Vital's and Desbief and Chansselle's papers. Seven of these articles had already appeared when, in April, 1878, Prof. Marreco (to whom I had myself sent copies of them) and Mr. Morison, read their first paper before the Chesterfield Institute. They say, "Before the writers had the opportunity of learning what had already been accomplished abroad, their attention was directed to the subject by a paper read by Mr. W. Galloway before the Royal Society, in which he related his experiment in producing explosion in a mixture of fire-damp and air impregnated with dust. The opinion expressed in that paper, viz., that coal-dust was explosive only in an atmosphere containing a minute proportion of fire-damp, induced the writers to still further extend the scope of the experiments, and endeavour to discover whether coal-dust could by any means be exploded in an atmosphere totally free from fire-damp."

The arrangement to carry out the experiments here spoken of was made between Marreco and myself in the end of 1875 or beginning of 1876, and was referred to in my first paper (1876) thus: "It would be premature to draw any positive inference from my experiments with gunpowder shots, as they are by no means so satisfactory as I could wish, and I am glad to be able to state that Prof. Marreco, of Newcastle-on-Tyne, intends to investigate this question with more substantial apparatus."

[1] *Proc. Roy. Soc.*, 1876.
[2] *Journal Soc. Arts* No. 20, 1885, p. 23.

Returning to Sir Frederick's remark, I would say that I abandoned no previous conclusion "in favour of one some time previously accepted by Marreco." I then held, and still hold, what is now a universally accepted opinion amongst mining men, that a mixture of air and fire-damp, which is not inflammable at ordinary pressure and temperature, may be rendered inflammable by the addition of dry coal-dust, and I was prepared, as soon as proof satisfactory to myself was forthcoming, to extend the area of my opinion, so as to include a mixture of fine dry coal-dust and air in the same category. This latter proof alone was necessary to the firm establishment of the theory enunciated at the commencement of my first paper, and for that reason Sir Frederick's statement appears to me to be wanting in logical sequence.

Neither the statement made by Marreco and Morison, that they intended to "endeavour to discover whether coal-dust could by any means be exploded in an atmosphere totally free from fire-damp," nor the results of the experiments published by them, appear to me to warrant Sir Frederick in taking up this position; for, concerning these very experiments of Prof. Marreco's he had himself remarked in the year 1880:[1] "It does *not appear that* in the numerous experiments made at Harton Colliery by the exposure of naked flames in currents of air laden with coal-dust, and by firing small cannon (representing blown-out shots) placed in various positions in such air-currents, *any indication has been obtained of a propagation of flame by the coal-dust.*" How then could Marreco have concluded that "fire-damp is altogether unnecessary for the conveyance of flame with explosive effect in a mixture of coal-dust and air"?

Sir Frederick continues to say, regarding myself: "Even his latest publication on the subject tends in the same direction, and emphasises his desire to 'claim that no earlier author had gone the length of crediting coal-dust with the *rôle* of principal agent, and relegating fire-damp to a secondary position.' The more recent results of other writers in this direction have, however, conclusively demonstrated that this is far too great a length to go, and that while on the one hand a very fine dry and highly inflammable coal-dust may, when raised and mixed with air by the force of a blown-out shot, become inflamed, and may then carry flame to considerable distances with a rapidity and violence of action similar to that of a fire-damp explosion, the extent to which, on the other hand, flame is propagated under corresponding conditions by most descriptions of coal-dust in the complete absence of fire-damp is very limited."

Sir Frederick and those whose opinions he here quotes appear to have omitted to take one element into consideration which has an important bearing upon the case. To this I may have occasion to refer more particularly at an early date.

W. GALLOWAY

Sunset-Glows

I WISH to call the attention of observers to a peculiar phenomenon which has been frequently noticed by me lately in connection with these sky-scenes. A very bright after-glow was visible here on October 27 last. I believe the date is correct, although I have unfortunately mislaid my day-book; the facts, however, I can vouch for otherwise, as they were detailed at the time. At 5 p.m. a heavy bank of cumulus was to be seen extending along the south-western sky-line, about 5° above and closely parallel to the horizon. High over this bluish bank of cloud rose the yellow haze of departing sunlight. This diffused after-glow was plainly intersected by numerous (I counted twenty-two) delicate streaks of nebulous stratus. These intersecting lines (they were scarcely "bands") were horizontal and parallel, piled up, as it were, above one another as high as 25° from the sea-line. The lowest hung apparently about half a degree above the gilded upper edge of the dark cumulus. On November 4, just before sunset, I exposed a gelatine plate, and succeeded in obtaining a photograph, in which seven of these narrow horizontal cloud-streaks can be faintly seen. On December 1 the following note was made:—4.20 p.m. Wind light,

[1] "Report on the Results of Experiments made with Samples of Dust collected at Seaham Colliery, &c.," 1880.

N.N.W. Sunset-glow intersected by five horizontal dark cloud-streaks in the west. On the 2nd inst., at 4.20 p.m., five cumulo-strati were visible in the west, separated by parallel and horizontal orange-coloured bands. Above these were numerous (probably twenty) delicate dark lines traversing—also horizontally—the upper roseate after-glow. On the 10th and 11th inst., somewhat similar phenomena were visible here. On the 15th inst., with a light southerly air, eleven cloud-bands were seen by me at 4.30 p.m. In this case only, they were not parallel to the sea-line, but followed the direction of the west-north-west horizon. I have seen the same appearances once or twice since the last date. The above phenomena are new to me, and I have not met with any detailed account of them elsewhere. I have therefore ventured to address you on the subj ect. Can these cloud-streaks represent stratified air-dust in the upper regions of our atmosphere? W. AINSLIE HOLLIS

Hove, Brighton, December 26

Iridescent Clouds

THERE was a very striking display of iridescent clouds this afternoon. I noticed it first at about 3.40 p.m. The prismatic colours were pretty strongly marked, and the intense pearly brilliance of the delicate cirri was most striking. It is still visible (4.40 p.m.), though, of course, its lustre is much diminished. A gale is blowing from the west, and there has been an orange after-glow. Similar phenomena were described in your columns about this time last year. They were well seen in this part of the country. EDWARD GREENHOW

Earsdon, Newcastle-on-Tyne, December 28

YESTERDAY, clouds very similar to those seen a year ago made their appearance, and there were a few of them again this morning. I first noticed them at 11.30 a.m., and they were extremely magnificent after sunset, showing three or four spectra of colour, and they were especially striking about 4.10 p.m., when they appeared very bright against the purple glow of the sky. Their chief difference from the clouds last December was that they were not bounded by straight lines, and that there was no special amount of blue in the colouring, as was usually the case a year ago. The chief colours were pink and green.

Sunderland, December 29 T W. BACKHOUSE

Ventilation

IN reply to the query of J. F. Tennant, there can be no doubt that the cause of the failure of the ceiling ventilators is a deficiency of fresh-air supply to the room. An ordinary chimney with a fire will, if unchecked, draw an amount of cold air into the room which would make the temperature about the same as that of the outside air, and without enormous volumes of warmed air it is, I think, impossible to expect any service whatever from the system of ventilation from ceiling-flues, as recommended by the writer of the article referred to. Since writing my first letter I have seen a regenerator lamp attached to one of these ceiling-flues, and the down-draught was so strong and persistent as to reverse the natural current of the lamp, rendering its use impossible. The air-inlet to my own rooms consists of a channel in the wall of every room opening into ten one-inch holes at the fireplace, but this, of course, is utterly inadequate to supply one-tenth of the air required by the flue, and the ventilator and the ventilating-shaft supplement this supply by working the wrong way. THOS. FLETCHER

Warrington

A VERY common source of trouble with respect to ventilation is the absence of any arrangement for the supply of air to fires. So long as a fire draws on the general atmosphere of the room it is supposed to warm for its supply of oxygen, there must be the "draughts" so often complained of, and people are warm on the side next the fire, and cold on the other. I should suppose this is what happens in Mr. Fletcher's case, described in his letter in NATURE (pp. 153-4). If so, there is simply a sort of "tug-of-war" between the longer chimney-flue and the shorter ventilation flue, with the additional advantage on the side of the former that the column of air ascending the chimney is necessarily much warmer than that which should ascend the ventilation flue. If, however, Mr. Fletcher will have a couple of holes bored in his floor, one on each side of the fireplace, so as to supply air directly to the fire, the "pull" of the fire on the air of the room will cease, the room will be warmer, and his ventilation flue should work satisfactorily. I warm thoroughly a room with considerably over 2000 square feet of floor area by means of three small stoves. When first used the stoves were inefficient, as there was a draught all round each towards it. A common rain-water pipe "bend," inserted in the floor immediately in front of the aperture of each stove for admitting the air-supply, stopped the draughts, and at least doubled the efficiency of the stoves as warmers. With the help of Tobin tubes there is now a gentle current of warmer air *from* each stove. The heated and vitiated air escapes through ventilators fixed in the ridge of the roof. W. WILKINSON

Eldon, Bishop Auckland, December 23

Friction and Molecular Structure

IN your number of December 17 (p. 154) is a letter signed by Mr. E. Geoghegan, referring to the effect of moderate friction on the molecular structure of glass lamp-chimneys. This I have very frequently observed, and it would be very interesting to have suggestions as to its cause and means of prevention. I often read under one of Sugg's Argand gas-burners, the chimney of which almost invariably breaks on first heating after cleaning. First of all, washing was tried, to remove the mottled milky stain which forms on the glass, and then rubbing with a silk cloth or cotton rubber, but there does not seem to be much difference in the result, as the glasses, the best I can obtain, generally break. C. K. BUSHE

Bramhope, Old Charlton, Kent, December 25

The Longevity of Insects

WITH reference to the longevity of insects, it is worth while to record that we kept a ladybird from the September of one year to the September of the following. She was a handsome specimen of the seven-spotted ladybird, and her eggs, which were laid in the winter, after passing through the miniature crocodile stage, produced perfect insects in February. It is curious to watch the imago emerging from its dusky case; at first no spots are visible on its buttercup-yellow "shards," which contrast strongly with the jet-black legs and underneath; but in a very few hours the first brilliancy has gone, the spots appear faintly, and in a few days the final red with the black spots is established. E.

December 28

SOUTH AMERICAN BIRD-MUSIC

MR. BURROUGHS, an American naturalist, in his "Impressions of some British Song Birds," has said:—"Many of the American songsters are shy wood-birds, seldom seen or heard near the habitations of men, while nearly all the British birds are semi-domesticated, and sing in the garden and orchard. This fact, I had said, in connection with their more soft and plaintive voices, made our song-birds seem less to a foreign traveller than his own." These words apply with much greater force to the birds of South America, the species being much more numerous and less well known than in the northern portion of the continent; while the true songsters are relatively fewer, owing to the presence of several large songless families, such as the tyrants, humming-birds, and others.

The South American songsters certainly do not, like those of Europe, mass themselves about the habitations of men, to sing there as if sweet voices were given to them solely for the delectation of human listeners; they are pre-eminently birds of the wild forest, the marsh, and the savannah; and the ornithologist or collector from Europe, whose principal object is to make a large collection, has little time to make himself acquainted with the accomplishments of the species he desires above all things to shoot. Nor is this all. Doubtless there remains in the minds of most people something of that ancient notion that brilliant-plumaged birds utter only harsh, disagreeable sounds; while the sober-toned songsters of temperate regions—especially those of Europe—have the gift of melody; that sweet songs are heard in England, and screams and grating notes within the tropics. Only we know now that the obscure species there are greatly in excess of the brilliant ones. It is quite possible, however, that the tropics, so rich in other respects, though by no means the realms "where birds forget to sing," do not excel, or even equal, the temperate regions in the amount and quality of their bird melody. Mr. im Thurn only echoes the words of many English travellers in the tropics, when he says, in his recent work on British Guiana:—"The almost entire absence of sweet bird-notes at once strikes the traveller who comes from thrush and warbler-haunted temperate lands." Mr. Bates, on this subject, says:—"The few sounds of birds are of that pensive and mysterious character which intensifies the feeling of solitude rather than imparts a sense of life and cheerfulness."

On the question of tropical bird-music much remains to be said by future travellers; but South America is not all tropical, and travellers visiting the southern temperate portion of that continent might have looked to find there melodists equal to those of Europe and North America; for even assuming that to utter agreeable sounds a bird, wherever found, must be fashioned after the pattern of some European form, we find that the typical songsters of the north—the thrushes, wrens, warblers, finches, &c.—are well represented in the Plata, Chilian, and Patagonian regions. As a fact, the best songsters there belong to the wide-ranging American genus *Mimus*, while in the more tropical Icterine family there is great variety of language, and some exceedingly sweet voices.

Of the great naturalists of recent times who have depreciated South American bird-music, I will mention Darwin only, as very great importance must always be attached to his words, even when he fails to show his usual discrimination. He says of the common *Mimus calandria*:—"It is remarkable from possessing a song far superior to that of any other bird in the country; indeed, it is nearly the only bird in South America which I have observed to take its stand for the purpose of singing." He then adds that the song is like that of the sedge warbler.

There are many better singers than the *M. calandria*; and as to its being nearly the only bird that takes its stand for the purpose of singing, there are, in the Plata district alone, a greater number of birds with that habit than in England; though, taking the number of species in the two countries, the Plata singers are relatively fewer. It is equally beside the mark to compare the sedge warbler with the Calandria, the performance of the former bird resembling that of the other only as a slight sketch may be said to resemble a finished painting.

Darwin does not say much about the singing of birds, and appears to have taken but little interest in the subject, possibly because this species of natural melody gave him little or no pleasure; otherwise he could scarcely have written of the Diuca Finch that "the male during incubation has two or three pleasant notes, which Molina, in an exaggerated description, has called a fine song." The fact is, the old Chilian naturalist scarcely does justice to the song of the Diuca, which is mellower in sound than any other finch-melody I am acquainted with. Of his account of the singing of the Thenca mocking-bird, the Thili, the black-headed finch, Loyca, and various other species, Darwin says nothing.

Not all the European writers whose words carry weight, however, have turned a deaf, or, at any rate, a very unappreciative ear to the bird-music of the great bird-continent. Azara is a notable exception. He was not a mere collector, nor was he even a naturalist in the strictest sense of the word; but, made fit for his task by a keen faculty of observation, and an insatiable craving for knowledge of all kinds, he went into the forest to watch the birds and write the history of their lives. In Spain he had been familiar from childhood with the best songsters of Europe, and in Paraguay he paid great attention to the language of the species he noticed. He makes mistakes sometimes, when speaking of the nesting or other habits, but when describing their songs, he records his own impressions only. With the works of his contemporary, Buffon, he only became acquainted after having completed his own observations; and the voluminous strictures on the French naturalist, which burden, and to some extent spoil, the otherwise delightful "Apuntamientos," were only inserted after his own descriptions had been written.

In his introductory pages, entitled "De los Paxaros en General," he refers to Buffon's well-known opinion concerning the inferiority of American songsters, and says:—"But if a choir of singers were selected in the Old World, and compared with one of an equal number gathered in Paraguay, I am not sure which would win the victory." In another place, in allusion to the same subject, he says:—"They are mistaken who think there are not as many and as good singers here as in Europe."

To return for a moment to Mr. Bates's words, already quoted, bird-music of that "pensive and mysterious" character he mentions is to many minds more pleasing than the loud, cheerful, persistent singing of many highly-esteemed British singers, like the chaffinch and song-thrush.

Mr. Bates also heard in the Amazonian forest, "another bird that had a most sweet and melancholy song, uttered in a plaintive key, commencing high, and descending by harmonic intervals."

Of the common house-wren of the Plata, Azara says that its song is "in style comparable to that of the nightingale, though its phrases are not so delicate and expressive; nevertheless, I count it amongst the first songsters." He speaks even more highly of the voice of the Todo Voz (*Cistothorus platensis*), which greatly delighted him with its sweet, varied, and expressive melody. The members of this melodious genus, and of the allied genera, are found throughout South America, from Panama to Patagonia, and we know from others besides Azara that their music does not dissolve away in the tropics, or turn to harsh sounds. Mr. Wallace heard a Cistothorus singing very sweetly on the shores of the Amazon, and D'Orbigny, in the "Voyage dans l'Amérique Méridionale," thus describes the singing of the *Thryothorus modulator*, which he heard in Yungas, in Bolivia:—"Perched on a bough overhanging the torrent, its rich melodious voice seemed in strange contrast to the melancholy aspect of its surroundings. Its voice, which is not comparable with anything we have in Europe, exceeds that of the nightingale in volume and expression, if not in flexibility. Frequently it sounds like a melody rendered by a flute at a great distance; at other times its sweet and varied cadences are mingled with clear piercing tones or deep throat-notes,—in one word, a grave music composed of the purest sounds. We have really no words adequate to express the effect of this song, heard in the midst of a nature so redundant, and of mountain scenery so wild and savage."

It might be thought that in this description allowance must be made for the enthusiasm natural to a Frenchman, but Mr. Bates, certainly the most sober-minded naturalist that ever penetrated the Brazilian forests, gives a scarcely less fascinating account of a melodist closely allied to D'Orbigny's bird, if not identical with it. "I frequently heard," he says, "in the neighbourhood of these huts the realejo or organ-bird (*Cyphorhinus* *cantans*), the most remarkable songster by far of the Amazonian forest. When its singular notes strike the ear for the first time the impression cannot be resisted that they are produced by a human voice. Some musical boy must be gathering fruits in the thickets, and is singing a few notes to cheer himself. The tones become more fluty and plaintive; they are now those of a flageolet, and, notwithstanding the utter impossibility of the thing, one is for the moment convinced that some one is playing that instrument. . . . It is the only songster which makes an impression on the natives, who sometimes rest their paddles whilst travelling in their small canoes, along the shady by-paths, as if struck by the mysterious sound."

Outside of these pre-eminently tuneful groups—thrushes, warblers, finches, &c.—there are many species belonging to groups considered songless which nevertheless do sing, or have, at any rate, some highly musical notes. Dendrocolaptine birds are not, strictly speaking, songsters; but they are loquacious, and fill the woods with sound, often pleasant and laughter-like in character; and in many species the male and female combine their voices in a pretty kind of chorus. In the well-known oven-bird this is very striking, the male and female singing a ringing joyous duet in different tones, producing an harmonious effect. D'Orbigny notices this harmonious singing of the *Furnarius*. The hirundines in many cases have voices utterly unlike those of Europe, which as a rule only emit a squeaking twitter. They have, on the contrary, rather thick tones, in many cases resembling the throat-notes of the skylark, and some have a very pleasing set song. The human-like tones of some of the pigeons, the plaintive fluting of the Tinamous, even the notes of some kingfishers and cuckoos, contribute not a little to the bird-music of South America. Waterton's words about the "songless" bell-bird are well known, and, allowing that he goes too far when he says that Orpheus himself would drop his lyre to listen to this romantic sound, it is still certain that there are hundreds of species, which, like the bell-bird of the Orinoco forests, utter a few delightful notes, or produce a pleasing effect by joining their voices in a chorus. Thus, Mr. Bates speaks of the *Monasa nigrofrons*—a barbet:—"This flock of Tamburi-para were the reverse of dull: they were gamboling and chasing each other amongst the branches. As they sported about they emitted a few short tuneful notes, which altogether produced a ringing musical chorus that greatly surprised me."

But even leaving out all these irregular melodists; also omitting the tanagers, the tyrants, and their nearest allies; the Dendrocolaptidæ and Formicaridæ, and the humming-birds—these few families I have mentioned comprising about 1800 species—there would still be a far greater number of regular songsters than Europe can show, so great is the bird-wealth of South America; and concerning the merits of their music I can only say that Azara and D'Orbigny did not hear the best singer—the *Mimus triurus*. It would have been strange indeed if in that portion of the globe, so inconceivably rich in species, and where bird-life has had its greatest development, the faculty of melody had not been as highly perfected as in other regions.

A very long time has passed since Azara made that remark about a choir of song-birds selected in Paraguay, and our knowledge on this subject—possibly because it has been thought unimportant—has scarcely been added to since his day; but it seems to me that when the best singers of two regions have been compared, and a verdict arrived at, something more remains to be said. The species which "formally take their stand for the purpose of singing" sometimes delight us less than others which have no set song, but yet utter notes of exquisite purity. Nor is this all. To most minds the dulcet strains of a few favoured songsters contribute only a part, and not always the largest part, of the pleasurable sensations received from the bird-voices of any district. All natural sounds produce, in some measure, agreeable sensations: the pattering of rain on the leaves, the lowing of cattle, the dash of waves on the beach, the "springs and dying gales" of a breeze in the pines; and so, coming to birds, the clear piercing tones of the sandpiper, the cry, etherealised by distance, of a passing migrant, the cawing of rooks on the tree-tops, afford as much pleasure as the whistle of the blackbird. There is a charm in the infinite variety of bird-language heard in a sub-tropical forest, where birds are most abundant, exceeding that of many monotonously melodious voices; the listener would not willingly lose any of the many indescribable sounds emitted by the smaller species, or the screams and human-like calls, or solemn, deep booming or drumming of the larger kinds, or even the piercing shrieks which may be heard miles away. The bird-language of an English wood or orchard, made up in most part of melodious tones, may be compared to a band composed entirely of small wind-instruments with a very limited range of sound, and which produces no storms of noise, eccentric flights, or violent contrasts, or anything to startle the listener—a sweet but somewhat tame performance. The sub-tropical forest is more like an orchestra in which a countless number of varied instruments take part in a performance in which there are many noisy discords, while the tender, spiritual tones heard at intervals seem, by contrast, infinitely sweet and precious.

W. H. HUDSON

FORESTRY

THE report of the proceedings of the Select Committee on Forestry which sat during the past summer does not, perhaps, throw any more light on the condition of forestry in this country than was possessed before the appointment of the Committee, for the substance of the evidence given is for the most part to be found in the various works and reports on forestry that have appeared from time to time during the past few years; nevertheless the evidence of such men so well versed in forest conservancy, especially with regard to India, as Dr. Cleghorn, Col. Michael, Col. Pearson, and Mr. W. G. Pedder is of much value, as it brings together in a collected form information that has hitherto been much scattered.

The subject of forest produce is one that is but little understood or even thought of by people in general. It is supposed by most people to relate only to the supply of timber, which indeed of itself is of very great importance; but when we consider the other products—such as gums, resins, oils, fibres, and such like—the enormous money value becomes more apparent, as well as the great importance of the forests as sources of many absolute necessities of life. The evidence of Col. Michael fully illustrates this and is especially valuable from this point of view. Taking the subject of Indian timbers alone, the value of teak was fully set forth when it was shown to be unequalled for the backing of ironclads and for ship-building generally, as offering the greatest resistance of any known woods. Questioned as to whether teak was capable of being brought into this country as a commercial article at a remunerative profit, Col. Michael replied that, judging from the price realised for some logs sold at the Forestry Exhibition at Edinburgh and from other information obtained, no doubt existed that the trade in teak might become a very remunerative one. It was shown further that in 1883 647,000*l*. worth of teak was imported into England; but Col. Michael also touched upon what, if put upon a proper footing, might equally, or perhaps more so, become a source of revenue to India and a boon to this country—namely, the introduction of the more ornamental woods for cabinet purposes. There is, of course, always a steady demand for British-grown timbers such as oak, elm, ash, maple, &c., but these have to be supplemented by foreign woods of a more ornamental character, and of these mahogany, rosewood, ebony, satinwood, and such like are the best known. From amongst Indian timber trees a long list might be made of woods which are now almost unknown out of their native country—such, for instance, as the East Indian cedar (*Cedrela toona*), which is a reddish-coloured wood with a splendid wavy or feathery figure; the tree is also found in Australia, where the wood is highly valued; the padouk (*Pterocarpus indicus*), the deep-red-coloured wood of which attracted so much attention at the Edinburgh Exhibition last year; the Malabar Kino tree (*Pterocarpus marsupium*), also a finely-marked deep-red wood, several species of *Terminalia*, durable woods of a brown colour with darker brown markings. Many others might be mentioned, but the most beautiful of all the Indian woods for its ornamental character is the Chittagong wood (*Chickrassia tabularis*). This is of a brown colour, with transverse lighter silvery-brown wavy markings, which impart to it a varying depth of light and shade, which, when polished, imparts a peculiar and charming lustre. All these woods take a high polish, and would be invaluable for cabinet-work. Fine specimens of these and many others are in the collection of Indian timbers exhibited in the No. 3 Museum at Kew.

On the question as to the durability of the Scotch fir (*Pinus sylvestris*) Col. Pearson gave an opinion which is worth quoting. He says:—"I think myself that as the value of the foreign imported timber increases, as it must do as the quantity diminishes, people will come to appreciate more the Scotch fir, because I know many barns which have been boarded with Scotch fir for twenty years, and which are standing perfectly well: but it is convenient to get the imported boards ready sawn out, and where the people can get them cheap they do not pay attention to the Scotch and home-grown timber. But, speaking for myself, I should say that Scotch fir is a perfectly good wood as long as it is sufficiently mature, and I think, as foreign wood becomes dearer, as it will in a few years, English timber and Scotch timber will become of a value which it has not now."

On the general subject of the proposed Forest School Col. Pearson expressed himself in favour of a Chair of Forestry at the Edinburgh University, but he further stated that he had no actual faith in lectures in the school unless illustrated by practical instruction. "If," he says, "you tell a man in the lecture room that such and such consequences will take place, and do not show him the consequences on the spot, he does not believe anything about it; it goes in at one ear and out at the other; he will think it all nonsense; but if you want to impress your teaching upon him, you must take him out into the forests and show him the operations of Nature." Regarding the extent or scope of the School, Mr. Thiselton Dyer, in reply to Sir Edmund Lechmere whether he would not make the School of Forestry applicable to India and the Colonies as well as to our own country, said, "I should like to get all the fish possible into the net, and if we had such a school, to make it as useful as possible. I think it is surprising, considering how large is the interest of the English race in forestry, that except in India we have taken no kind of active interest in the subject: although we own more forests in the world than any other race, we are at present, except in the most piecemeal fashion, absolutely washing our hands of the whole business." Mr. Dyer, in his evidence, further pointed out by way of illustration a few of what are usually called the minor industries of forest produce, which in the aggregate become of considerable national importance.

It is to be regretted that the Committee was not nominated at an earlier period of the session. The first sitting was on July 14, and at the two subsequent sittings on July 21 and 24, witnesses only were examined. The report of the Committee refers to the impossibility of concluding their investigations during the Session, and "recommends that a Committee on the same subject should be appointed in the next Session of Parliament."

JOHN R. JACKSON

OBSERVATIONS ON THE RECENT CALCAREOUS FORMATIONS OF THE SOLOMON GROUP, MADE DURING 1882-84[1]

ON account of the treacherous character of the natives of the Solomon Group, no extensive geological observations have ever been made in these islands from the period of their discovery by the Spaniards three centuries ago. For this reason my excursions in these regions were not free from personal risk; in many places they were considerably curtailed, and in some islands they had to be abandoned altogether.

This archipelago includes seven or eight large islands, some of which are from seventy to eighty miles in length, and the highest from 8000 to 10,000 feet in height. Besides these, there are a great number of smaller islands and islets, some of volcanic and others of recent calcareous formations. Restricting my remarks to those islands which are wholly or in part composed of these calcareous rocks, I may observe that, although only able to become acquainted with a small portion of the Solomon Group, the islands which I examined represent the different types of islands that there exist.

In this, the largest of the Pacific groups, I not only found existing fringing-reefs, barrier-reefs, and atolls, but I discovered pre-existing reefs of these three chief classes which have been recently elevated to a height often of several hundred feet above the sea. My observations on these recently-elevated reefs and their foundations have enabled me to approach the problem of the formation of coral reefs by the inductive rather than by the *a priori* method: for it is evident that in passing from the consideration of a probable cause of the formation of existing reefs to the examination of ancient reefs that have been raised with their foundations above the sea, we enter a domain of greater certainty. I purpose in this abstract to state concisely the principal characters of the islands which are wholly or in part of calcareous formations; then to draw four limited inferences from these facts of observation without reference to any particular views that may be held on the subject of the origin of coral reefs; and finally to compare such conclusions with the prevailing views on that subject.

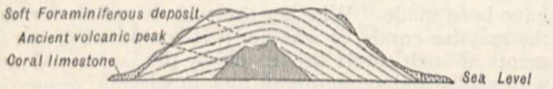
In the first place there are numerous small islands and islets less than a hundred feet in height, which are composed in mass of coral limestone. Of this class Stirling Island may be taken as an example. In the bold cliffs, which form the weather coast of this small island, there are numerous imbedded masses of the reef-building corals, many of them measuring four feet across, the majority of them in the position of growth, but some of them inverted.

The island of Ugi, which is six miles in length and about 500 feet in height, may be taken as a type of the next class. Its geological structure may be briefly described as composed in bulk of a soft earthy bedded deposit, possessing the characters of the "volcanic muds" of the *Challenger* soundings, containing numerous Foraminifera, and encrusted near the coast by coral limestone, which almost disappears in the higher regions. The greatest thickness of the coral limestone that I found in this island was between 90 and 100 feet. As one ascends the higher slopes of the island the coral limestone thins away, and

[1] By H. B. Guppy, M.B., F.G.S., late Surgeon of H.M.S. *Lark*. [Abstract of a paper read before the Royal Society of Edinburgh, on June 15th, 1885, being communicated by Mr. John Murray.]

only occasional fragments occur in the red argillaceous soil. The greatest elevation at which I found the coral rock was about 425 feet above the sea. The soft Foraminiferous deposit, which forms the mass of the island, is regularly bedded, the dip varying usually between 10° and 15°, but it may rise to as much as 35°. Entire shells are rarely found in these beds, the Foraminiferous tests being usually the only organic remains visible to the naked eye.

The island of Treasury affords an example of the next type of island. It is oval in shape, has a length of nine miles, and rises about 1150 feet above the sea. Here we have exposed the nucleus of volcanic rock which has been covered over by soft bedded deposits that resemble, like those of Ugi, the muds found in the *Challenger* Expedition to be at present forming around oceanic volcanic islands, whilst the coral limestone only attains any thickness near the coast, and is wanting altogether in the higher regions of the island. At elevations exceeding 400 feet above the sea the coral rock generally disappears from the surface. Above this height it is only found occasionally, 900 feet being the greatest elevation at which I found a fragment. The thickness of the coral limestone does not exceed 100 feet. The soft deposit, which is regularly bedded, the dip varying between 10° and 30°, displays a greater variety in its characters than the similar deposit in the island of Ugi. As a rule it presents to the naked eye no other conspicuous organic remains than the white specks of the more minute Foraminiferous tests and the larger microscopic tests of such species as *Cristellaria calcar*, *C. mamilligera*, and others; but in some localities this deposit becomes highly fossiliferous, when it assumes a more compact texture, and displays to the eye fragments of corals with Pteropod and Lamellibranchiate shells. As shown in the accompanying diagram, the structural history



Ideal section of an island displaying the originally-submerged volcanic peak, the overlying soft deposits, and the encrusting coral limestone.

of this island of Treasury may be readily inferred. An ancient submerged volcanic peak, having been covered by a thickness of some hundreds of feet of deposits, for the most part resembling the muds now being formed around volcanic islands, has by this means and by the movement of elevation been brought up to the zone of reef-building corals. After the coral reefs had become established, the whole structure experienced an upheaval of nearly 1200 feet.

In the island of Alu, the principal of the Shortland Islands, another type of structure is exhibited. This island, which has a breadth of eleven or twelve miles and an elevation of about 500 feet, is composed in its north-west portion of ancient and originally deep-seated volcanic rocks (mostly quartz-diorites), while the greater part of it, together with the off-lying lesser islands and islets, is made up of more recent calcareous formations. In describing its structural history I shall be describing its structure. We have the original land of volcanic formation in the north-west part of the island, from which, as from a neucleus, line after line of barrier-reef has been advanced in a south-easterly direction based on a foundation of Pteropod and Foraminiferous muds, and forming ultimately, as the upheaving movement continued, the large island of Alu, which yet preserves in the ridges of its interior these ancient barrier-reefs now removed far from the coast and elevated some hundreds of feet above the present sea-level. The soft deposit underlying the elevated reef-masses contains in abundance the shells of Pteropods and bivalves, the otoliths of fish, the tests of pelagic and bottom-living Foraminifera, and some simple corals of deep-sea genera. The overlying coral limestone sometimes assumes a chalk-like character, and in the interior of the island it may give place to a Foraminiferal limestone. The characters of these different rocks are described in the second part of this paper. The thickness of the coral limestones in this island is probably under 100 feet. When it caps the upraised island barrier-reefs it does not exceed forty feet; but these regions have been subjected to great denudation.

In the small island of Santa Anna, which is two and a half miles in length, we have an upraised atoll that displays within the small compass of a height of 470 feet the several stages of its growth. There is, in the first place, the originally submerged volcanic peak; then the investing soft deposit which, according to Mr. Murray, has the characters of a deep-sea clay; and over all the ring of coral limestone that cannot far exceed 150 feet in thickness. The interior of this upraised atoll is a closed basin containing a fresh-water lake, the bottom of which lies about a hundred feet below the present sea-level: so the island may be roughly compared to a bowl of fresh water floating on the sea. In the vicinity of the locality where the deep-sea clay was exposed, Lieut. Malan observed a concretionary block of manganese peroxide between one and two cubic feet in size, which, according to Mr. Murray, who examined a typical fragment, is quite similar in characters to the smaller masses obtained in deep-sea soundings. The structural history of this island may be briefly summed up. A submarine volcanic peak, having been invested by a deep-sea clay, was brought up by upheaval to the coral zone. An atoll was established on it, and the whole was subsequently raised to a height of nearly 500 feet above the sea.

Lastly, I come to the large mountainous islands, of which St. Christoval may be taken as the type. This island is more than seventy miles in length, and about 4100 feet in height. It is composed in mass of ancient volcanic rocks, which are flanked on their lower slopes by recent calcareous formations. A fawn-coloured crystalline limestone, containing reef débris, lies directly on the volcanic rock, and is itself overlain by the coral limestone. I did not find these calcareous rocks above 500 feet above the sea; so great has been the denudation of this island that these calcareous formations constitute a much thinner crust than that which came under my notice in the smaller and more recent islands.

Such being the facts, I come now to the four general conclusions, which are as follows:—

1. *That these upraised reef masses, whether atoll, barrier-reef, or fringing-reef, were formed in a region of elevation.*

This is self-evident. The last upheaval that occurred, of which I found proofs in different parts of the group, was to the extent of about five feet; but at the present day there are signs of this movement being still in operation, and, for the purposes of future observation, I have established datum-marks in different islands. This, therefore, being a region of elevation, it is apparent that that portion of Mr. Darwin's theory of coral reefs which ascribes the formation of atolls and barrier-reefs to a movement of subsidence cannot be applied to the islands of the Solomon Group, since we here find upraised atolls and barrier-reefs associated with existing reefs of the same description. This conclusion accords with the results obtained by Prof. Semper in the case of the Pelew Islands, and by Prof. A. Agassiz in the case of the Florida reefs.

2. *That such upraised reefs are of moderate thickness, their vertical measurement not exceeding the limit of depth of the reef-coral zone.* Amongst the numerous islands which I examined I never found one that exhibited a greater thickness of coral limestone than 150 feet, or 200 feet at the very outside. In fact, so great has been the denudation of these islands, where, according to my own

observations, there is an annual rainfall at the coast of 150 inches, that I rarely came upon a thickness of a hundred feet of coral limestone. One of the corollaries of the theory of subsidence is concerned with the great thickness of atolls and barrier-reefs. My observations in this region—and it is such regions that can alone afford such evidence—show that atolls and barrier-reefs can be formed with no greater thickness than they would possess in accordance with the depths in which reef-corals thrive, the vertical thickness of the reef not exceeding the depth of the reef-coral zone. . . . The only objection worthy of attention that had been advanced against the atoll-theory of Mr. Darwin was, in the opinion of Sir Charles Lyell,[1] the circumstance that, as far as was known, no bed or formation of coral of any thickness had been discovered. This objection, which was proposed by Mr. Maclaren in 1842, derives additional force at the present day in the light of my observations in the Solomon Islands.

3. *That these upraised reef-masses in the majority of islands rest on a partially consolidated deposit which possesses the characters of the "volcanic muds" which were found during the "Challenger" Expedition to be at present forming around volcanic islands.*

4. *That this deposit envelops anciently submerged volcanic peaks.*

These two latter conclusions corroborate in a remarkable manner the views, based on the observations of the *Challenger* Expedition, which Mr. Murray has advanced. I will cite the structures of two islands to illustrate these views. In the small island of Santa Catalina I found that the elevated reef was based on volcanic rock with the intervention of a thin brecciated conglomerate. In the island of Treasury I found the volcanic rock covered by a soft, partially consolidated volcanic mud, which attained a thickness of some 300 or 400 feet, and was itself incrusted on the lower slopes of the island by the elevated reef-mass. In the one island, the volcanic peak had been exposed to breaker-action before the reef-corals established themselves. In the other island, the submerged volcanic peak was first brought within the reef-coral zone by the deposition of layers of "volcanic mud" upon it, assisted by the movement of elevation.

With reference to my own bias on this subject, I may here add that during the first eighteen months I passed in the Solomon Islands I was only acquainted with the theory of subsidence, and that after having failed to make my observations harmonise with the theory of Mr. Darwin, I collected my facts with a very confused idea of the direction towards which they were tending. It was therefore a cause of great satisfaction to myself when I first became acquainted with the views held by Mr. Murray.

These calcareous rocks, in the examination of which Mr. Murray used the methods he employed in the case of the deep-sea deposits, may be grouped into two chief classes, according to the proportion of volcanic débris they contain.

The *first class* comprises those rocks which, being largely composed of volcanic débris mixed with the tests of Foraminifera, Pteropods, and other Mollusks, have a composition very similar to that of the volcanic muds at present forming around oceanic volcanic islands in the Pacific. These rocks contain both pelagic and bottom forms of Foraminifera, and four prevailing kinds of them may be distinguished.

1. A friable rock, containing from 5 to 20 per cent. of carbonate of lime, and displaying to the eye only the white specks of minute Foraminiferous tests, with a few of microscopic size, entire Molluscan shells being rarely embedded. The carbonate of lime consists of Coccoliths, Rhabdoliths, Gasteropod, and Lamellibranchiate shells, Echinoderm fragments, calcareous Algæ, and many pelagic and bottom forms of Foraminifera. The residue consists for the most part of the minerals felspar, magnetite, augite, hornblende, fragments of pumice, scoriæ, and other volcanic rocks, with many glassy fragments, and of a fine argillaceous matter which forms about a third of the rock-substance. Rocks of this character form the masses of Treasury and Ugi Islands.

2. A very friable rock, containing from 30 to 35 per cent. of carbonate of lime. These rocks resemble in their general composition the rocks of the previous group, but they differ in the circumstance that they inclose in great numbers the entire shells of Pteropods, Gasteropods, Lamellibranchiates, together with simple corals of deep-sea genera, and the otoliths of fish. There are contained in the residue, in addition to the mineral particles and fine argillaceous material, a great many glauconitic-like casts of Foraminifera. Rocks of this character largely compose Alu, the principal island of the Shortland Islands, and are exposed in the low hills in the rear of Choiseul Bay.

3. A hard, grey fossiliferous limestone, containing usually about 60 per cent. of carbonate of lime and much volcanic débris. Such a rock, which is exposed in the lower courses of the Treasury streams, is chiefly composed of the broken-down fragments of corals and Lamellibranchiate shells, with calcareous Algæ and a few Foraminifera.

4 Coarse-grained rocks composed of the fragments of volcanic and coral rocks in rounded grains. Occasionally larger fragments, together with shells, are imbedded. Such rocks occur on the northern slopes of St. Christoval near the coast.

The *second class* includes those rocks which are largely composed of coral, Molluscan shells, Foraminiferous tests, and calcareous Algæ, with but a small proportion of volcanic débris. The share that each of these four principal constituents takes in the building up of the rock differs widely, and on this basis the following groups have been made. Whether the rock is mainly formed of the massive corals, or whether it is composed of the fragments of such corals broken off by the waves and mixed with shells and other organisms in varying proportions, such a rock as must be forming on the outer slopes of reefs, or whether it is composed of the consolidated calcareous muds and sands which are found at the bottom of lagoons, it has in all cases the same coral origin. The variety in character exhibited in the following groups of coral limestones may be thus in a great measure explained.

1. Coral rocks, properly so-called, which are merely the massive reef-corals in different stages of fossilisation.

2. Coral rocks, which are chiefly made up of calcareous Algæ, fragments of Molluscan shells, corals, and Echinoderms, the interstices being filled up by the tests of Foraminifera and other small calcareous organisms. In the composition of such rocks, which form *the majority of the so-called coral limestones* in the Solomon Islands, coral fragments take only a secondary part. The percentage of carbonate of lime in these rocks varies between 90 and 95, the residue consisting of the common volcanic minerals, siliceous casts of Foraminifera and a fine argillaceous matter.

3. Chalk-like coral limestones, which contain about 95 per cent. of carbonate of lime, and are chiefly composed of the fragments of Molluscan shells, Echinoderms, corals, calcareous Algæ, and Foraminifera. These rocks, therefore, in their general composition resemble the rocks of the second group of coral limestones; but they differ conspicuously in their chalk-like appearance and in being more friable. They occupy the usual surface position of other coral rocks, although not being of common occurrence. I found them overlying the soft Foraminiferous and Pteropod deposit in the Shortland Islands, and they may be sometimes found forming the central elevated portions of existing reefs. One of the specimens of coral this rock contained, according to a determination made

[1] "Principles of Geology," 12th edit. vol. ii. p. 612

by Dr. Leonard Dobbin, a considerable amount of magnesia, and thus approaches a magnesian limestone.

4. Compact fawn-coloured crystalline limestones of a homogeneous texture, in which sometimes reef débris may be observed. These rocks, which are of common occurrence on the lower slopes of the large island of St. Christoval, where they overlie the volcanic rocks of the district, are apparently formed by the consolidation of the ooze found at the bottom of lagoons inside coral reefs.

5. Foraminiferal limestones, which are hard and compact in texture, and are chiefly made up of pelagic and bottom-living Foraminifera, and contain occasionally a few simple corals of deep-sea genera. They contain generally from 75 to 85 per cent. of carbonate of lime, the residue being formed of the common volcanic minerals, siliceous casts of Foraminifera and fine argillaceous matter. These limestones are found at the surface, and in the island of Alu they may be seen to overlie the soft Foraminiferous and Pteropod deposits.

Such are the calcareous formations which are of most frequent occurrence in the Solomon Islands. Three other highly interesting rocks came under my notice, but in each case only in one locality.

(*a*) A Rhynconella limestone. In one of the islets of the Shortland Islands I found a hard grey limestone composed of numbers of Brachiopod, Gasteropod, and Lamellibranchiate shells, with many simple corals of deep-sea genera, embedded in a calcareous matrix largely made up of the tests of Foraminifera (chiefly pelagic forms). The Brachiopod shells belonged to the same species of Rhynconella. Mr. Davidson is inclined to look upon it as the same as *R. Grayii*, a species hitherto represented by a single specimen discovered in the British Museum amongst other natural history objects from the Fiji Islands (?) collected by Mr. J. M'Gillivray more than thirty years since.[1] The simple corals, as Mr. Quelch informs me, belong to the deep-sea genera, Leptocyathus, Stephanophyllia, Odontocyathus, Flabellum, &c. The Gasteropod and Lamellibranchiate shells are, as I learn from Mr. E. Smith, of shallow-water habit. This limestone contained 75 per cent. of carbonate of lime, the residue being made up of the common volcanic minerals, reddish siliceous casts of Foraminifera, and fine washings.

(*b*) A friable earthy rock, which, from the small size of the minerals, the absence of bottom-living Foraminifera, and the scarcity of pelagic forms, resembles a deep-sea clay, and contains a thin coating of manganese between the small layers or folds of the rock. This deposit, which contains about 20 per cent. of carbonate of lime, occurs in the upraised atoll of Santa Anna underneath the elevated reef-mass. On the reef-flat in the vicinity of this deposit there was observed by Lieut. Malan, as already observed, a detached concretionary block of manganese peroxides, one to two cubic feet in size: a typical fragment that I brought home is, according to Mr. Murray, quite similar to smaller masses dredged by the *Challenger* and *Blake*.

(*c*) A hard Foraminiferal limestone, chiefly composed of pelagic Foraminifera. Of this rock, which was found at the surface in Treasury Island, Mr. Murray observes that the organisms, together with the minerals, are similar to those found in deposits of modern seas near volcanic islands at depths of from 500 to 800 fathoms. The Foraminifera are identical with those found in the surface-waters of the tropics at the present day.

With such data as the foregoing at my disposal, it might appear an easy matter to gauge the amount of elevation that has occurred in these regions in recent times. But so great has been the sub-aërial denudation in these islands that although the elevatory movements have brought up to our view a deep-sea clay, with its concretion of manganese, and a Foraminiferal limestone that was probably formed in a depth of from 500 to 800 fathoms, two rocks which occur in islands at opposite extremities of the group, yet, notwithstanding this great upheaval, the calcareous envelopes usually disappear from the slopes of the volcanic islands at heights of 500 or 600 feet above the sea, and never came under my observation in such islands at greater elevations than 900 feet. The rainfall in the elevated interior of the large islands cannot be much under 300 inches in the year, since my own observations place it at about 150 inches at the coast. Of the rapid degradation of the surface which these calcareous districts undergo during a heavy fall of rain, of as much as two to three inches in the same number of hours, I was a frequent witness. In a few minutes the whole hill-slope discharges a continuous sheet of muddy water, the rivulets swell to turbid streams, and the water rushes down the permanent courses with the roar of a mountain torrent. After the rain-storm has passed away, the band of muddy water that fringes the whole length of the coast, to a distance of one-quarter or one-third of a mile from the shore, indicates the loss of material which the land-surface has sustained.

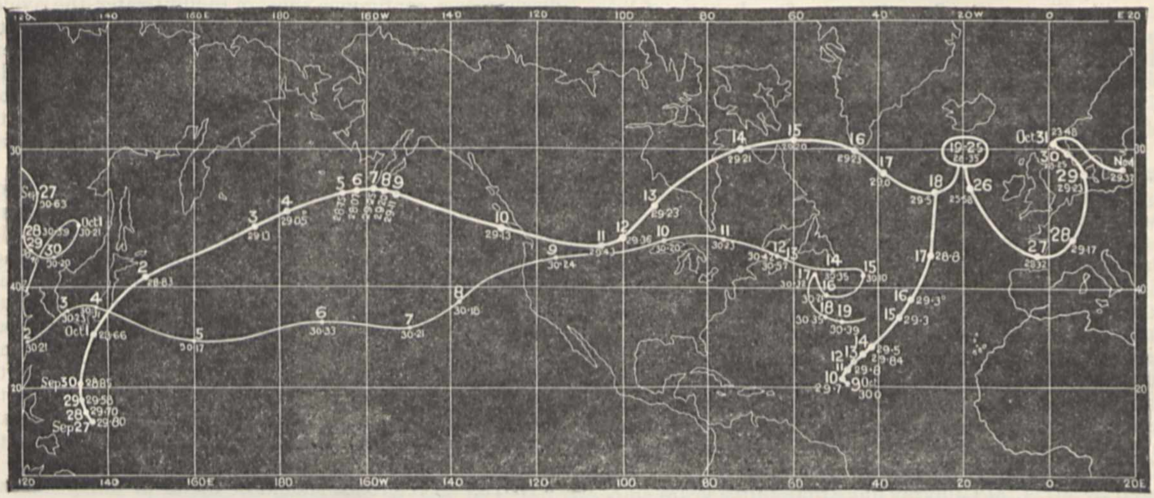
[1] Vide *Annals and Magazine of Natural History*, vol. xvi. p. 444.

From the general character of these calcareous formations it may be safely inferred that they will be found wherever there has been elevation during the recent period in regions where coral reefs are flourishing. Amongst other localities we may look to the West Indies, the Indian Archipelago, New Guinea (more particularly the south-coast), New Britain, New Ireland, the Santa Cruz Group, the New Hebrides, the Loyalty Islands, New Caledonia, and the Fiji and Tonga Groups, as likely to possess at the sea-border formations of a similar character. In the Solomon Islands, many other islands, such as Ulaua and Ronongo, will be probably found to be counterparts of the islands of Ugi and Treasury.

NOTE.—A reference should be made to the occurrence of worked flints of the palæolithic type in the soil of the cultivated districts of these islands. The natives say they have fallen from the sky, which reminds one of a similar superstition prevalent in the country districts at home as to the source of celts. I was never successful in finding where they came from originally, and would recommend future visitors to this group to pay attention to this point. They are said to occur together with a chalk-like rock on the beaches of Ulaua, an island which I was unable to visit. (For further information on this subject, *vide* some notes of my own read by Prof. Liversidge before the Royal Society of New South Wales, *Journal* for 1883, vol. xvii. p. 328.)

TRACING A TYPHOON TO EUROPE

AT the meeting of the Royal Meteorological Society held on November 18, a paper by Mr. Henry Harries, on "The Typhoon Origin of the Weather over the British Isles during the second half of October, 1882," was read. The author had prepared daily charts of the North Pacific Ocean from September 26 to October 10, and by permission of the Meteorological Council the charts of the area between the western coast of America and Eastern Europe were utilised. The earliest evidence of the formation of the typhoon was on September 27, some distance east-south-east of Manilla. At first the movement was towards north-west, 5 miles an hour, but on September 30, when the storm-area extended to 1300 miles north-west of the centre, it curved towards north-east, crossed the south-eastern corner of Japan at 33 miles an hour, and attained a maximum rate of 51 miles per hour on October 2 to 3, after leaving the Japanese coast. In the neighbourhood of the Aleutian Archipelago the progress was very slow until the 9th, when it rapidly increased to 35 miles an hour, and entered Oregon on the 10th. The Rocky Mountains proved to be no obstacle to the progress of the typhoon, which crossed the range at $36\frac{3}{4}$ miles an hour, and, maintaining this rate, passed across the Northern States into Canada. Thence it crossed Hudson's Bay and Labrador, into Davis Strait. Altering its course to south of east it passed the southern point of Greenland on October 16, and two days later, in lat. 55° N., long. 27° W., it was joined by another disturbance, which seems to have formed about October 9 in 20° N., 48° W. The junction of the two storms was followed by a complete cessation of progressive movement for a week (October 19 to 25), and it was during this period was formed as a subsidiary the gale which suddenly arrived over our south-eastern counties upon the morning of October 24, completely upsetting the Meteorological Office forecasts of the previous night The author quoted several records from ships, which went to show that this secondary storm had not formed until nearly midnight; and that reports from outlying coast-stations would not have enabled successful forecasts to be issued before 3 a.m. on the 24th. The 8 a.m. observations for the Daily Weather Report show that with the exception of Hurst Castle the winds on the northern side of the Channel were moderate, but along the French coast heavy gales were blowing. Ships' records indicate that off Start Point a moderate easterly gale began at 6.20 a.m. By 8 a.m. a whole gale from S.E. was blowing



Tracks of the Typhoon and Anticyclone of September and October 1882. The thick line shows the track of the typhoon, the thin line that of the anticyclone. The dates and the lowest and highest ascertained readings of the barometer for the day being given near the positions of the centres at Greenwich noon.

to south-west of Portland, while off the Start at 8.30 a.m. the wind veered to W.N.W. a strong gale. At 9 a.m. the wind off Portland veered to W. and blew with terrific violence. Further east, as far as the Downs, the wind had by noon changed to W. and S.W., and increased to a furious storm, with violent squalls and a terrible sea. As this gale passed away the primary moved into the Bay of Biscay and entered France on the 27th. As in Japan and America, its advance was marked by violent gales and destructive floods over a very extensive area—from Algeria northwards. The damage caused by the floods in England was serious, but trifling compared with the losses in Southern and Central Europe, the destruction being enormous. This typhoon was the principal contributor in making October, 1882, by far the worst within living memory. With this final effort it seemed to have expended its fury, and in crossing France and the Netherlands it gradually filled up. The last trace of the typhoon was in the Baltic on November 1, when it quietly dispersed, after covering over 14,000 nautical miles in thirty-six days, the longest track hitherto followed day by day.

THE NIVAL FLORA OF SWITZERLAND

IN the spring of 1883 (the last year of his life), the eminent Swiss naturalist, Prof. Oswald Heer, having finished his "Flora fossilis Arctica," resumed a work with which he had been long occupied before—viz. the preparation of a Nival Flora of Switzerland, in which he proposed to give an account of all the plants found above 8000 feet in that country, and a comparison of these with the Nival flora of other countries. This work, based on very abundant material, was nearly completed before the author's lamented death;—he anticipated being able to finish it in about eight days more had health allowed. The work has now been published in full (as he left it) in the *Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles* (vol. xxix. part 1). The summary of results of this research, which were communicated at a gathering of Swiss naturalists in Zurich, we will here reproduce.

(1) We know at present in Switzerland 337 species of flowering plants which have been observed at from 8000 to 13,000 feet above the sea; 12 of these species have still been found above 12,000 feet.

(2) All these species are found in the lowest division of the Nival region, 8000 to 8500 feet. Above 8500 feet there is no species which is peculiar to this height.

(3) One-tenth of the species of the Nival region consists of species of lowland flora, nine-tenths of mountain plants. Most of the latter belong to the Alpine region, and about a quarter of the species has its greatest distribution over 8000 feet. These are the Nival plants in the narrower sense. While the lowland plants and the plants of the hilly and sub-Alpine region disappear at about 9500 feet, the Nival plants, with a few Alpine species, are the last children of the flora.

(4) The mountain mass of Monte Rosa has the richest Nival flora; which here rises higher than in the Rhætian Alps, and in the latter higher than in the Glärnisch Alps.

(5) The majority of the species are distributed throughout the whole region of the Alps; only a small portion is found exclusively in the east from Orteler to the Gothard, or in the west from the Gothard to Savoy.

(6) About half of the plants of the Nival region come from the Arctic zone, and very probably came over Scandinavia to our region in the Glacial period, since Arctic Europe has the largest number (140) of species

which our Nival flora has in common with the Arctic zone.

(7) This Arctic flora probably arose on the mountains of the Arctic zone, and stood in the same relation, in the Miocene period, to the flora of the Arctic lowland as the present Alpine flora to the flora of the Swiss lowland.

(8) The Miocene Arctic flora advanced to Europe in the Tertiary period, and the European Tertiary flora received from it the types which now characterise the temperate zone, viz. the pine-woods and foliage-trees with deciduous leaves. In course of time these dominated more and more over the tropical and sub-tropical forms, which were the original occupiers of these regions, and became the mother-plants of a portion of the present lowland flora.

(9) In the Glacial period the mountain plants of the Arctic zone descended into the lowland, and spread southwards with the glaciers. As in the Tertiary period the trees and bushes with deciduous foliage wandered southwards, so in the Glacial period did the mountain plants; and that this migration took place radially from the north is proved by the fact that not only in the snow region of our Alps nearly the half of the plant species consists of Arctic species, but also the American mountains, and on the other side the Altai, and even the Himalaya, have quite a number of such Arctic species, and have them in common with the Swiss Alps. We know that already in the Tertiary period, and also in the period of the Upper Cretaceous, a number of plants can be traced from Greenland on to Nebraska, in North America, and on the other hand to Bohemia, Moravia, and on to Southern Europe. Thus in the period of the Cretaceous formation, in the Tertiary, and in the present formation, we find the same phenomenon: that Europe with America has a number of species in common which were formerly indigenous in the Arctic zone, and therefore very probably went out from that as their original home. The same process is thus repeated in different ages; the plant-world of the high north has at all times exercised a great influence on the formation of the plant-covering of Europe.

(10) The endemic flora of the Nival region arose in our Alps. A principal centre of its formation seems to have been the Monte Rosa chain, in which probably, even during the Glacial period, extensive mountain masses of ice and *névé* were liberated.

(11) This flora received at the beginning of the Quaternary period its present character, and spread on the moraines of the glaciers into the lowland and into the mountainous regions of the neighbouring countries.

(12) Its mother flora had probably its abode in the Tertiary mountain country of Switzerland.

NOTES

We understand that the post of Assistant Director of the Royal Gardens, Kew, has been offered to Mr. D. Morris, M.A., F.G.S., the Director of Public Gardens and Plantations, Jamaica. The appointment is in the gift of the First Lord of the Treasury.

So much has been heard during the last few years of the services rendered to the science, industry, and commerce of the West Indies by the public gardens and Government plantations of Jamaica under the superintendence of Mr. Morris, that it is with surprise and regret that we learn that the future efficiency of these institutions is seriously threatened. A Select Committee, it appears, was recently appointed, under a resolution of the Council of Jamaica, "to consider the means of diminishing the expenses of the Government," and, among other suggestions and recommendations, it proposed that the Government cinchona plantations should be sold, and that the public gardens at Kingston should be handed over to the local authorities of that town to be maintained by them, instead of, as heretofore, by the Government, under the Director of Public Gardens. Committees appointed under these circumstances are generally more anxious to justify their existence by making recommendations than careful to inquire where they would be always possible or desirable. The cinchona plantations, thus threatened with extinction, were founded in 1868 by Sir John Peter Grant, and now consist of 150 acres under cinchona, with smaller areas under jalap, tea, and nurseries for timber and shade trees. According to the "Handbook of Jamaica," they distributed in five years to private planters 1200 ounces of cinchona-seed, 1,200,000 cinchona seedlings, 400,000 cinchona plants, besides large quantities of timber and shade trees for re-foresting purposes. The Kingston Gardens, which are to be taken from under Mr. Morris's control, are used as a depot for plants from the other establishments, and also as the centre of distribution of plants and seeds to all parts of Jamaica and of the West Indies; there is no doubt, therefore, that they fulfil important functions.

If there was a single department in the whole Government service on which West Indian economists should have refrained from laying their hands except by way of increasing its scope and efficiency, we should have thought Mr. Morris's department that one. For if the West Indian Islands are ever to emerge from the disastrous economical condition of the past thirty years, and regain their previous flourishing state, it will be by the labours of institutions such as the public gardens, and of men such as Mr. Morris. Their old staples are useless to them, for Europe can buy them cheaper in other markets, and they must find new ones, or plunge deeper into the mire of financial embarrassment and bankruptcy, public and private. This can only be done by experiments and careful observations which no one but a public department and skilled botanists can carry out. Happily the economic value of the gardens in Jamaica have been recognised by the highest authorities. The Royal Commissioners stated that the department was invaluable, and that it was in as good a state as the sums placed at Mr. Morris's disposal would allow. The Governor coincided in this testimony, and added that "Mr. Morris was untiring in his endeavours to induce persons to commence new industries calculated to develop the resources of the island, and to bring about a condition of prosperity which would go far to counterbalance the depression under which the sugar industry of Jamaica now labours." It may be hoped therefore, notwithstanding the report of the Committee on Government Economy, that the department may be permitted to pursue its "invaluable" work on the same lines and with undiminished means.

Mr. Samuel Birch, D.C.L., LL.D., F.S.A., Keeper of the Egyptian and Oriental Antiquities in the British Museum, died, on the 27th inst., in his seventy-second year. Dr. Birch had served in the British Museum for fifty years, during the last part of which he was in charge of the Egyptian and Assyrian antiquities, and it is with this department of Oriental scholarship that his name will ever be associated. His early writings of nearly fifty years ago dealt mainly with Chinese subjects, and one of his first duties at the British Museum was to catalogue the large collection of Chinese coins, and throughout the greater part of his life he manifested his interest in Chinese subjects by various publications. He was twice despatched to Italy on archæological missions on behalf of the Government, and in 1860 founded the Society of Biblical Archæology. His works on all departments of Egyptology fill many volumes, and extend over more than forty years, and at the time of his death he had in the press one work, while another, a new dictionary of hieroglyphics, was nearly completed.

No authentic information is to hand yet to explain the terrible and disastrous colliery explosion at the Mardy mine last week. The atmospheric pressure had been unusually high, and so far as we have been able to gather, coal-dust played an important part in the explosion. No doubt some facts as to the condition of the mine will come out at the inquest on January 12.

THE following are the arrangements for the Friday evening lectures at the Royal Institution before Easter:—January 22: Prof. Tyndall, F.R.S., Thomas Young and the Wave Theory; January 29: Sir William Thomson, F.R.S., Capillary Attraction; February 5: T. Pridgin Teal, F.R.C.S., The Principles of Domestic Fireplace Construction; February 12: Prof. Osborne Reynolds, F.R.S., Experiments showing Dilatancy, a Property of Granular Material, Possibly Connected with Gravitation; February 19: W. K. Parker, F.R.S., Birds, their Structure, Classification, and Origin; February 26: A. A. Common, F.R.S., Photography as an Aid to Astronomy; March 5: Prof. Alexander Macalister, F.R.S., Anatomical and Medical Knowledge of Ancient Egypt; March 12: Reginald Stuart Poole, Corresp. Inst. France, The Discovery of the Biblical Cities of Egypt; March 19: W. H. M. Christie, F.R.S., Astronomer Royal, Universal Time; March 26: Wm. Chandler Roberts-Austen, F.R.S., M.R.I., Chemist of the Mint, on Certain Properties Common to Fluids and Solid Metals; April 2: Howard Grubb, F.R.S., Telescopic Objectives and Mirrors—their Preparation and Testing; April 9: William Anderson, M.Inst.C.E., New Applications of the Mechanical Properties of Cork to the Arts; April 16: Prof. Sir Henry E. Roscoe, M.P., F.R.S.

WE regret to learn that Dr. W. Sklarek, who founded *Naturforscher* eighteen years ago, and has conducted it since, has resigned the editorship of that well-known journal, which will now be published by the Laupp'schen Buchhandlung, Tübingen. Dr. Sklarek, we understand, will edit a new journal of a similar kind to be published in Brunswick.

IT is stated that experiments are being made at Prof. Lieben's chemical laboratory at Vienna, with a new gaslight invented by Dr. Auer. A cotton wick, saturated with an incombustible metal solution, is introduced into the flame of an ordinary Bunsen lamp, the result being a light similar to the incandescent electric light.

MR. LESLIE STEPHEN'S "Life of Henry Fawcett," just published by Messrs. Smith, Elder and Co., contains two very characteristic letters from Darwin, which now see the light for the first time. Mr. Stephen refers to the deep impression made on Fawcett's mind by the "Origin of Species." He became an enthusiastic Darwinian, and in December 1860 published an article in which "he states with his usual firmness the true logical position of Darwin's theory; distinguishing carefully between a fruitful hypothesis and a scientific demonstration; exhibiting the general nature of the argument and the geological difficulty with great clearness, and taking some pains to prove that religion is in no danger from Darwinism." This led to a correspondence with Darwin, and in one of the letters the latter, after referring to his satisfaction at hearing that Mill considered his book a piece of thorough logical argument, adds:—"Until your review appeared I began to think that perhaps I did not understand at all how to argue." In a second letter, dated September 18, 1861, thanking Fawcett for a paper of his read before the British Association, Darwin writes:—"You will have done good service in calling the attention of scientific men to means and laws of philosophising. As far as I could judge by the papers, your opponents were unworthy of you. How miserably A talked of my reputation, as if that had anything to do with it. How profoundly ignorant B [who had said that Darwin should have published facts alone] must be of the very soul of observation! About thirty years ago there was much talk that geologists ought only to observe and not theorise; and I well remember some saying that at this rate a man might as well go into a gravel-pit and count the pebbles and describe the colours. How odd it is that any one should not see that all observation must be for or against some view if it is to be of any service!" Referring to his health Darwin says he is one of those miserable creatures who are never comfortable for twenty-four hours; "and it is clear to me that I ought to be exterminated." Again he says that to him "observing is much better sport than writing." Referring to the timidity with which men of science received his theory, he wrote: "The naturalists seem as timid as young ladies should be, about their scientific reputation." The whole of the correspondence at this time (1860-61) between Darwin and Fawcett, of which Mr. Stephen only gives the two letters here quoted, should be of very great general interest.

THE Vienna Correspondent of the *Times* reports that Dr. Gautsch, the new Minister of Public Instruction in Austria, has prohibited the use of paper ruled in square or diagonal lines within all public schools. The reason of this is that such paper has been found to injure the eyesight of pupils. It has been largely used hitherto in primary schools to facilitate writing and arithmetic lessons; but in future only paper plain or ruled in straight lines is be used.

A STRIKING case of vital resistance in fishes has been lately reported by M. Douaret de Bellesme, Manager of the Aquarium of the Trocadéro in Paris. On November 18 a fishmonger, M. Heydendare, received from Gonda (the centre of fisheries in the region about Rotterdam) a large consignment of fishes packed and preserved in ice. They could not have been caught later than the 16th, and were probably caught on the 15th. On unpacking, a jack was seen to move its gills slightly, and the idea occurred to wash it with fresh water, and immerse it in a vessel. In a few hours the fish was in its normal state, and very lively. M. Heydendare sent it to the Trocadéro Aquarium, where it is to be seen now; it is a fine animal, about 2 feet 4 inches long. Here, then, is a case of a fish out of water more than forty-eight hours (probably three days), packed with little care, along with dead fish and pieces of ice—travelling thus 280 miles, and coming to life again. The lowering of temperature was doubtless very favourable to maintenance of the vital functions.

THREE tall chimneys belonging to Kunheim and Co., of Berlin, were lately destroyed by means of gun-cotton. The largest was about 147 feet high, and 10 feet diameter at the base. In order that it should fall outwards from the city, the charge of gun-cotton (about 57 lbs.) was attached in portions to the side next the city, and to the adjacent sides. All three were exploded simultaneously with a magneto-electric apparatus. The chimney, instead of falling obliquely, collapsed vertically, and on inspection the four walls of the pedestal were found to have been driven outwards. The bricks were all detached from each other, and nearly all entire. The debris was thrown a very little distance. The two other chimneys, treated similarly, fell as was expected, *i.e.* obliquely away from the city. One of them, in falling, broke in two about the middle.

RECENT issues of *Globus* contain two most interesting articles on the investigations into the antiquities of the I land of Bornholm, carried on for a considerable period by its former chief official, Herr Wedel. The Stone Age is extensively represented, although kitchen-middens appear to be wholly absent, by graves, stone coffins, and other objects. The first contain unburnt, as well as the remains of cremated, bodies, but the latter are found under such circumstances as to lead to the conclusion that they belong to a later period. With the exception of stone chisels, all the objects usually found in graves belonging to the Stone Age are found, such as axes, arrow-heads, and the like. Amber ornaments also frequently occur. The stone coffins, which are sometimes very large, are also numerous, and in the mounds with them are frequently found the bones of cremated bodies. On this question, Herr Wedel comes to the conclusion that cremation in Bornholm must have been introduced towards the close of the Stone Age. Most of the objects were apparently made in the island itself; but it is not improbable that the larger flint articles, or possibly the blocks from which they are made, come from places where flint is more plentiful than in Bornholm. Traces of houses belonging to this age have also been found. On the whole, the island during this period does not appear to have been thickly populated; the people moved hither and thither, and appear to have had domestic animals. The remains of the Bronze Age are also very numerous and interesting; of these a full account is given, and it is interesting to notice that, during this period, cremation appears to have been the usual method of disposing of bodies of the dead. Similarly, the finds belonging to the Iron Age are described, and, in conclusion, the writer says that in Bornholm we can trace, without important breaks, human development from the Stone Age down to historic times. Nothing appears, he says, in this long history to show that there was any sudden alteration in the growth of civilisation such as might be caused by the influx of a new tribe. Such an influx, had it taken place, would certainly have left recognisable marks behind it; and, indeed, the thick population of the island in the Bronze and earlier Iron Ages left no opportunity for the settlement of any external people in Bornholm.

THE method of placing electric lamps in front of locomotives to illuminate the line, has been tried on many lines, but apparently has not found much favour. Recent experience in Russia appears to show that financial considerations are not alone unfavourable to the system. On the railway between St. Petersburg and Moscow several locomotives were fitted with electric lamps. For a time they gave great satisfaction, lighting the way more than a kilometre in front. But the *employés* began to complain of the contrast between the lighted and the unlighted surfaces painfully affecting the eyes; and doctors ere long reported that there had been several cases of grave injury to the eyes in this way. Hence the lamps were abandoned. The directors have not, however, given up the idea of better illumination of the line, and they now contemplate placing electric lamps so as to illuminate about 1 kilometre on either side of the station.

THE best plant at present known for consolidating, by the interlacing of its roots the loose soil of a newly-made embankment is, according to M. Cambier (of the French Railway Service), the double poppy. While the usual grasses and clovers need several months for the development of their comparatively feeble roots, the double poppy germinates in a few days, and in two weeks grows enough to give some protection to the slope, while at the end of three or four months, the roots, which are 10 or 12 inches long, are found to have interlaced so as to retain the earth far more firmly than those of any grass or grain. Though the plant is an annual, it sows itself after the first year, and with a little care the bank is always in good condition.

ACCORDING to an official statement issued by the Japanese Government, there occurred 553 earthquakes during the nine years and six months preceding December 1884, averaging one earthquake for every six days and six hours. This must, however, refer to the capital and the surrounding district only, and earthquakes of great violence can alone be counted, for Prof. Milne was able to trace an average of an earthquake per day in Nagasaki, in the extreme south of the Japanese archipelago. The official statistics, on the other hand, may possibly be compiled from the returns of local officials all over the country, in which case only those shocks which caused loss of life or damage to property would be included. If this hypothesis is correct, we should have an average of more than an earthquake per week which was so violent that it caused injuries to life or property sufficiently serious to attract the attention of the local authorities, and, in their judgment, to require a report to the central Government.

M. HERZEN contributes to a recent number of the *Revue Scientifique* an account of certain experiments which he made recently on the thermic sense in animals. His observations on man had already led him to the conclusion that impressions of heat are conveyed to the brain by the gray substance of the spinal marrow. Animals, he found, on the other hand, do not react under the impressions of moderate heat, and when the latter is excessive the reaction is one of pain, not of the specific sensation of heat. On the contrary, however, cold operates on them actively, and M. Herzen succeeded in demonstrating by his experiments that impressions of cold in animals are really conveyed by the medullary rays which transmit the impressions of touch. The various experiments which are briefly described in the article satisfied him that the cortical lesions which destroy sensibility to touch also destroy that of cold, and, when the first is preserved, the latter likewise remains; and that, in brief, impressions of contact and of cold are transmitted in the same way to the same regions of the cortical layer of the hemispheres.

IN a recent article on the work of the Asiatic Society of Bengal, originally founded by Sir William Jones, during the first century of its existence, we referred to the division of its publications into literary and scientific, the numbers of the *Journal* of the Society in each case being quite distinct. We have now before us the scientific numbers of the *Journal* for the past year, and they show remarkable activity. It should be remembered that there are independent societies in Madras and Bombay, so that the Bengal Society's publications represent the work of one Presidency only. Amongst the scientific papers published during the year are the following:—The theory of the winter rains in Northern India, by Mr. Blanford, the President of the Society, and the Meteorological Reporter to the Government of India; descriptions of some new Asiatic diurnal *Lepidoptera*, chiefly from specimens contained in the Indian Museum in Calcutta, by Mr. Frederic Moore; a new species of *Simulium* from Assam, by Dr. Becher, of Vienna; variations of rainfall in Northern India during the sun-spot period, by Mr. Pearson, the Meteorological Reporter for Western India; a description of a new Lepidopterous insect belonging to the Heterocerous genus *Trabala*, by Mr. Moore; *Phyllothelys*, a remarkable genus of *Mantodea*, from the Oriental region, by Prof. Wood-Mason; notes on the Indian *Rhynchota*, by Mr. Atkinson; a list of Lepidopterous insects collected in Cachar, by Mr. Moore (the first part, dealing with *Heterocera*, has alone been published so far); revised synopsis of the species of *Chæradodis*, a remarkable genus of *Mantodea*, common to India and tropical America, by Prof. Wood-Mason; and finally, an account of the two remarkable south-west monsoon storms in the Bay of Bengal in 1883, by Mr. Eliot, the Meteorologist to the Bengal Government. It should be added that these papers are, where necessary or desirable, copiously illustrated.

IT is interesting to note that the various species of Salmonidæ at the Aquarium, South Kensington, have been recently spawned by artificial means, the sea trout being crossed with the Gilleroo and Levenensis trout. A very large yield of ova was obtained, all of which presented signs of healthiness and complete impregnation. Although the fish spawned have been in captivity for four years, they shed their eggs with the same ease as those subjected to natural conditions.

A LARGE number of Salmonidæ eggs are being incubated at the Buckland Museum. It will be remembered that fish-hatching operations were carried out extensively here by the late Frank Buckland, but after his death they subsided, and until this year the apparatus used by him were not called into use. The re-introduction of this feature will afford much gratification to visitors, and especially to those having the interest of the great naturalist's collection at heart. Besides, the authorities have, by this act, shown their sympathy with fish-culture, and have also set an example which might be emulated by the public elsewhere. It may not be generally known, but the Museum does not contain nearly all the exhibits comprised in the Buckland Collection, which cannot be adequately shown to the public in the limited space allotted to the exhibits.

THE Dutch Government has instituted Christmas telegraphic messages at a reduced rate, containing merely the name and address of senders and receivers.

THE numbers of that valuable periodical, the *Indian Antiquary* for 1885, though of course mainly occupied with papers on the special field of Indian scholarship, contain also many of general scientific interest. Thus a considerable space is devoted to folk-lore: there are four papers on the folk-lore of Southern India; one on that of Western India; a paper on the omens from the falling of house-lizards, which is curious from the minuteness with which every part of the body, even the smallest, on which a lizard could fall is provided with its appropriate omen, that for men and women being different. The modes by which evil omens may be averted are added. There is also a selection of Kanarese popular ballads. There are also two learned articles by Prof. V. Ball, in which he seeks to identify the animals and plants of India which were known to early Greek authors. One result of his interesting investigations (as indeed of all similar investigations into the works of early writers, Marco Polo, for example), is to show that most of the statements of these writers, usually ridiculed as extravagant or fictitious, rest on substantial bases of fact.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mrs. A. Murray; an American Robin (*Turdus migratorius*) from North America, presented by Mr. A. Saunders; two Hybrid Ruddy Sheldrakes (between *Tadorna rutila* and *Chenalopex ægyptiaca*), bred in France, deposited; a Sing-Sing Antelope (*Cobus sing-sing* ♂) from West Africa, received in exchange.

OUR ASTRONOMICAL COLUMN

EFFECT UPON THE EARTH'S MOTION PRODUCED BY SMALL BODIES PASSING NEAR IT.—Prof. H. A. Newton has published a paper on this subject in the *American Journal of Science* for December, 1885. He points out that the space through which the earth travels is traversed also by small bodies or meteoroids. The impact of these bodies upon the earth and the consequent increase of the earth's mass have their effect upon the earth's motions both of rotation and revolution. The moon's orbit and the length of the month likewise suffer change. Prof. Oppolzer (*Astron. Nachrichten*, No. 2573) has considered the amount of these actions, and has computed the density which the meteoroid matter must have in the space which the earth is traversing in order to account for the observed and unexplained acceleration of the moon's mean motion. But a body that passes near the earth has also an action of like character by reason of the attraction of gravitation alone, and the conclusion at which Prof. Newton arrives is that these latter bodies do not have an effect at all comparable with that produced by those which actually come into the earth's atmosphere. In fact his investigation shows that the effect upon the earth's motion of the meteors that come into its atmosphere exceeds at least one-hundredfold that of the meteors that pass by without impact.

THE TEMPERATURE OF THE SURFACE OF THE MOON.—Two important memoirs on this subject have recently been published in a separate form. Of these the first is one by the Earl of Rosse and Dr. Otto Boeddicker on "The Changes of the Radiation of Heat from the Moon during the Total Eclipse of October 4, 1884," communicated to the Dublin Royal Society. It will be remembered that Dr. Boeddicker gave a summary of his observations in a communication to NATURE, vol. xxx. p. 589, and stated that the minimum of heat was observed later than the minimum of light. As, however, the diminution of heat was very rapid, and amounted to $\frac{89}{90}$ of the entire amount received from the unobscured full moon, the conclusion from these observations would appear to be that the amount of heat radiated to us from the moon itself as distinguished from that merely reflected or diffused by it, is almost insensible.

The second memoir is by Prof. Langley (the conclusions of which will be found on p. 211), and was communicated to the American National Academy of Sciences, October 17, 1884. It commences with a review of previous researches, Lord Rosse's papers being carefully summarised. The diathermancy of glass for solar and lunar rays respectively, is next investigated, and it was found, as Lord Rosse had previously done, that a much larger percentage of the solar than of the lunar rays was transmitted through glass. Prof. Langley next endeavoured to ascertain whether this effect was due to a general absorption resulting in a heating of the moon's soil with a consequent radiation of heat of a much lower refrangibility than that received, or to a *selective* absorption by the moon of the more refrangible rays. His observations convinced him that the latter condition prevails to a remarkable extent, so that there is "a preponderance in the lunar spectrum of the rays of long wave-length, and hence a tendency to cause a smaller percentage of lunar rays to be transmitted by glass than of solar, and this independently of any effect from heat re-radiated by the lunar soil."

It had been generally assumed, prior to Prof. Langley's bolometer researches, that our atmosphere was most transparent to the visible portion of the spectrum. Prof. Langley has shown, on the contrary, that the coefficient of transmission steadily increases towards the extreme infra-red, up to the point $\lambda = 3\mu$, where the solar spectrum ceases to give any further evidence of its existence. The present research seems to show that this sudden termination of the spectrum is not due to our atmosphere, for Prof. Langley has been able to form a heat-spectrum from the lunar rays, which he is able to trace considerably further in the longer wave-lengths than that of the sun. This lunar spectrum shows two maxima, one fairly corresponding with "the solar curve maximum, the second indefinitely lower down in the spectrum, corresponding to a greater amount of heat at a lower temperature." This latter portion of the spectrum Prof. Langley considers as being clearly due to the moon itself, and as revealing its real temperature. This temperature, he concludes from his study of the spectra of cold bodies, is lower than that of melting ice. In a further paper read before the National Academy in November last, Prof. Langley states that a comparison of the spectra obtained from the moon in summer with those obtained in winter, shows that a much greater amount of heat is received in the latter season than the former, a difference probably due to the greater amount of aqueous vapour in our atmosphere during summer. He also mentions that he has made the first attempt to determine the temperature of space by direct experiment.

NEW COMET.—A telegram from Prof. Krueger, Kiel, announces the discovery of a new comet by Mr. W. R. Brooks, Red House Observatory, Phelps, New York. The following places have been obtained at the Harvard College Observatory:—

Cambridge M.T.		R.A.		Decl.
h. m.		h. m. s.		° ′
1885 Dec. 27, 8 11·6	...	19 55 40	...	4 8·0 N.
28, 6 30·0	...	19 59 3	...	4 31·6 N.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 JANUARY 3-9

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on January 3

Sun rises, 8h. 8m.; souths, 12h. 4m. 48·8s.; sets, 16h. 2m.; decl. on meridian, 22° 48′ S.: Sidereal Time at Sunset, 22h. 55m.

Moon (New on January 5) rises, 6h. 7m.; souths, 10h. 36m.; sets, 15h. 3m.; decl. on meridian, 18° 12′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	6 17	10 28	14 39	20 41 S.
Venus	10 6	15 6	20 6	12 23 S.
Mars	22 13*	4 46	11 19	5 45 N.
Jupiter	23 32*	5 31	11 30	0 59 S.
Saturn	15 14	23 24	7 34*	22 33 N.

* Indicates that the rising is that of the preceding and the setting that of the following day.

Phenomena of Jupiter's Satellites

Jan.	h. m.		Jan.	h. m.	
4	1 13	IV. ecl. reap.	6	6 58	I. occ. reap.
4	1 29	II. ecl. disap.	7	1 51	I. tr. ing.
4	6 44	II. occ. reap.	7	4 6	I. tr. egr.
5	6 29	III. ecl. disap.	8	1 26	I. occ. reap.
5	7 23	I. tr. ing.	9	1 11	III. tr. ing.
6	1 46	II. tr. egr.	9	4 0	III. tr. egr.
6	3 31	I. ecl. disap.			

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Saturn, January 3.—Outer major axis of outer ring 46″·6; outer minor axis of outer ring 20″·5; southern surface visible.

Jan.	h.	
9	2	Mercury at greatest elongation from the Sun, 23° west.

Variable Stars

Star	R.A. h. m.	Decl. ° ′			h. m.	
U Cephei	0 52·2	81 16 N.	Jan.	3,	1 5	*m*
W Virginis	13 20·2	2 47 S.	,,	4,	9 30	*M*
δ Libræ	14 54·9	8 4 S.	,,	5,	18 13	*m*
U Coronæ	15 13·6	32 4 N.	,,	6,	3 41	*m*
R Serpentis	15 45·4	15 29 N.	,,	5,		*M*
U Ophiuchi	17 10·8	1 20 N.	,,	5,	4 45	*m*
			,,	6,	0 53	*m*
			,,	6,	21 1	*m*
δ Cephei	22 24·9	57 50 N.	,,	6,	17 0	*m*
S Aquarii	22 51·0	20 57 S.	,,	6,		*M*

M signifies maximum; *m* minimum.

Meteor Showers

Meteors have been observed during this week in former years from the following radiants:—Near β Aurigæ, R.A. 93°, Decl. 43° N.; R.A. 145°, Decl. 5° N.; R.A. 150°, Decl. 67° N.; and R.A. 181°, Decl. 35° N.

GEOGRAPHICAL NOTES

The current number of *Petermann's Mittheilungen* contains an account of Herr Menge's second journey in the Somali Peninsula, accompanied by an excellent map showing the courses of both journeys. The traveller's meteorological observations and measurements, worked out by Dr. Schmidt of Gotha, are appended to the paper. Dr. Paulitschke's account of his journeys to Harar and amongst the Northern Gallas is concluded in this number. It contains a mass of interesting information of all descriptions with regard to this region. In an appendix a sketch is given of the scientific results of the journey, arranged under the heads—astronomical and magnetic observations, topography, anthropology and ethnography, and natural history.

The *Bulletin* of the Paris Society of Geography just published (3e trimestre, 1885) contains the full text, with maps, of Dr. Heis's journeys amongst the Laos. M. Errington de la Croix, under the title of "Seven Months in the Tin Country," describes the method of working the tin-mines of Perak, in the Malay Peninsula. The only other paper in the number is one of great interest by M. Pinast on certain explorations of his in the State of Panama, especially in the regions around the Chiriqui lagoon, and the districts inhabited by the Guaymi Indians.

The last Ergänzungsheft, or supplementary number of *Petermann's Mittheilungen*, is a lengthy account by Dr. Boas of his journeys during 1883 and 1884 in Baffin Land. It is divided into four main parts: an account of the journey from day to day, worked into a narrative; the history of past discoveries in the same region; geography; and, lastly, anthropo-geography. One appendix contains a long list of Eskimo place-names in Baffin Land, with their meanings; another gives a number of astronomical observations at various stations. The work is accompanied by two maps, one of Cumberland Sound and Cumberland Peninsula; the other represents the distribution of Eskimo tribes in Baffin Land.

The current number of the *Proceedings* of the Vienna Geographical Society (Bd. xxviii. No. 11) contains a paper entitled "Shamanism in Upper Austria," by Dr. Zehden. The district specially referred to is the wide granite plateau which forms the watershed between Bohemia and Upper Austria, and the paper describes the old superstitions and practices still surviving amongst the comparatively primitive people who inhabit the district. The application of the term "Shamanism" to these in the bulk is curious, and somewhat questionable. Shamanism is the form of Buddhism ("Northern Buddhism") prevailing amongst the Mongols and Thibetans, the *Shaman*, or priest, being one who has overcome all his passions. It is said to be a word of Hindu origin. The Pope of this sect, which differs from the Buddhism of India and Ceylon more in state and power than in doctrine, is the Dalai Lama at Lhassa. It has an enormous literature, which is described as the dreariest in existence. Like every other form of religion, and perhaps more than most religions of civilised peoples, it has its superstitious practices and beliefs; but there appears no more excuse for transferring this name from Thibet and Mongolia to Austria, and applying it to superstitions there, than for calling the latter Babylonian, Chaldean, or something else that has no connection whatever with them. The number also contains further letters from Dr. Lenz, in charge of the Austrian expedition to the Congo.

A telegram was received in Berlin on the 27th inst., announcing the death of Dr. Büttner, a German explorer travelling in Bonnyland, in Africa. The deceased, like Livingstone, was formerly engaged in missionary work in South Africa.

TEMPERATURE OF THE SURFACE OF THE MOON

In a memoir on this subject presented to the U.S. National Academy of Sciences by Prof. S. P. Langley, the author concludes by reviewing as follows our sources of information, and weighing the imperfect and contradictory results each has brought us:—

(1) *Direct Measurement of Lunar Heat as compared with Solar.*—Our direct comparison indicates that we receive nearly the whole proportion of solar energy from the full moon that we should expect to get from a diffusive disk of the same angular aperture. This heat must in reality be partly diffused and partly radiated, and we do not know (from the present observations) in what proportions these two kinds enter. So far as the observation itself is reliable, we may, however, infer that our atmosphere is permeable to most of the lunar heat of either kind, but the method is unfortunately subject to such large sources of constant error, that we cannot derive great confidence from the apparent agreement of different observations or even of different observers. It may be said, however, to create a certain presumption that the earth's atmosphere is diathermanous to heat of lower wave-length than has been heretofore supposed, *and of lower wave-length than appears to reach us from the sun.*

(2) *Comparison of Moon's Heat with that of Leslie Cube.*—If we may draw any inference from this class of observations it is that the sunlit surface of the moon is not far from the freezing temperature, but not so far below as we might expect to find that of an absolutely airless planet.

(3) *Transmission of Lunar Heat by the Earth's Atmosphere.*—Our observations indicate a not materially greater co-efficient of transmission for lunar heat than for solar; and though their

limited number and the uncertainty of the correction for change of heat with phase render more certainty as to the fact desirable, we may (accepting them as probable) reason thus.

Previous observations both at Allegheny and Mount Whitney have shown that the solar rays are transmitted with greater and greater facility (except for cold bands) as the wave-length increases up to the point (near $\lambda = 3^{\mu}$) where they suddenly disappear altogether. This shows either that (1) the solar heat, which, according to the customary assumption, exists to an unlimited wave-length before absorption, has here been cut off by a suddenly absorbent action, like that of a cold band extending indefinitely below 3^{μ}, or (2) that, either through a precedent absorption of such rays in the sun's own atmosphere or their non-existence, no solar rays below 3^{μ} present themselves to our atmosphere for admission.

The first view is that which I have treated as most in accordance with received opinion. It is not, however, the only one, since the second is not to be absolutely rejected, considering our experimental ignorance of the laws of radiation from gaseous bodies for great wave-lengths. Of these two hypotheses we see that, according to the first, our atmosphere is quite opaque to all heat below 3^{μ}, and the writer's (unpublished) experiments show that heat above this point must come almost wholly from a source much above 100° C. In this view, then (unless we agree that the radiations from the lunar soil correspond to a source much above 100° C.), we conclude that sensibly none of them pass our atmosphere, but that what we receive is diffused and reflected heat coming within the range of the known solar energy spectrum, and transmitted with nearly the same facility as solar heat, or if with a little greater, because lowered in wave-length by selective reflection at the lunar surface, not by absorption and re-radiation from the lunar soil.

In the second view, for anything we have absolutely known to the contrary, our atmosphere may be permeable to radiations of any wave-length below 3^{μ}, and we could draw no certain inference, even if the lunar radiation were more distinctly different in transmissibility than it is.

As a matter of fact, with the actually limited difference in the character of its transmissibility, a difference which, as so far determined, is of the same order as that of the error of observation, we have no ground then from this present class of observation (*i.e.* Class 3) for any absolute conclusion one way or the other. But, we repeat, it seems to be a probable inference from our whole work that the earth's atmosphere is more diathermanous to heat of extremely low refrangibility than has heretofore been supposed.

(4) *Comparative Transmission of Glass for Lunar and Solar Heat.*—The evidence here, which at first seems to so directly support the view of a sensible radiation from the surface of the moon, proves, on examination, to be subject to other interpretation, for the observed effect is almost certainly due in part to a degradation of wave-length by selective reflection from the lunar soil.

We can draw no absolute conclusion, then, from this evidence, at first in appearance so promising, though we may say that it certainly indicates an increased probability for the view that radiations from the lunar soil may be transmissible by our atmosphere.

(5) *Observations during a Lunar Eclipse.*—If our own observations in this respect are imperfect, those of Lord Rosse, before cited, are, on the other hand, clear. They appear to bear but one interpretation—that all heat from the moon disappears immediately that it passes into the earth's shadow, and there is no evidence of any being retained, for any sensible time, more than if it were reflected.

It is so difficult to conceive that while the moon has been storing heat during many days of sunshine, it can part with it instantly, so that the temperature of the whole earthward surface of the planet disappears in an inappreciable interval, that most will see in this observation an argument against the existence of any such heat sensible to us at any time whatever.

(6) *Formation of a Lunar Heat Spectrum.*—The observations made here with the lunar heat spectrum are as yet incomplete. With improving experience and apparatus, we hope to make others which shall give information of a character no other means can furnish (see note, *infra*).

Conclusion.—While we have found abundant evidence of heat from the moon, every method we have tried, or that has been tried by others, for determining the character of this heat appears to us inconclusive; and, without questioning that the moon radiates heat earthward from its soil, we have not yet found any experimental means of discriminating with such certainty between this and reflected heat that it is not open to misinterpretation. Whether we do so or not in the future will probably depend on our ability to measure by some process which will inform us directly of the wave-lengths of the heat observed.

Note added February, 1885.—Since the above paragraph was written, we have succeeded in obtaining measures with rock-salt prisms and lenses in a lunar *heat spectrum*. These difficult measures must be repeated at many lunations before complete results can be obtained; but, considering their importance to the present subject, we think it best to state now in general terms, and with the reserve due to the necessity of future experiment, that they indicate two maxima in the heat curve—one corresponding within the limits of errors of observation to the solar curve maximum, the second indefinitely lower down in the spectrum, corresponding to a greater amount of heat at a lower temperature. Exactly what temperature this latter corresponds to we have no present means of knowing. We have succeeded, however, in forming a measurable heat-spectrum from the surface of a Leslie cube containing boiling water, and the maximum ordinate in the lunar heat curve appears to be below the maximum ordinate in the hot water curve. The inference from this is, of course, that the temperature of the lunar soil is, at any rate, below that of boiling water, and in an indefinite degree.

We cannot close this note without calling attention to the remarkable fact that we here seem to have radiations from the moon of lower wave-length than from the sun, which implies an apparent contradiction to the almost universally accepted belief that the sun's emanations, like those from any heated solid body, include all low wave-lengths representing temperatures inferior to those certainly emitted.

SYMBIOSIS BETWEEN FUNGI AND THE ROOTS OF FLOWERING PLANTS

A VERY remarkable phenomenon has for some time past attracted the attention of a few physiological botanists in France and Germany, and was the subject of an interesting discussion at the annual meeting of the Association of German Naturalists and Physicians at Strassburg in September last. This is no less than the discovery of the fact, which may now be considered fairly established, that a considerable number of phanerogams, especially forest trees, do not draw their nourishment directly from the soil, but through the medium of an investing layer of fungus-mycelium, to which B. Frank gives the name of Mycorhiza.

The observations which first called the attention of botanists to this interesting subject were those of F. Kamienski, on *Monotropa hypopitys*, published in the *Mém. de la Soc. Nationale des Sci. Nat. de Cherbourg*. He came to the conclusion that this plant is not, as is usually believed, a parasite, the most careful observation failing to detect any haustoria or other parasitic union with the root of any host. On the other hand, he found the root of the *Monotropa* to be completely covered by the mycelium of a fungus, which branches abundantly, and forms a pseudo-parenchymatous envelope, often two or three times the thickness of the epidermis, and especially well developed at the apex of the root. This fungus, the species of which M. Kamienski is unable to determine, is entirely superficial, not penetrating into the living cells, though occasionally forcing its way between those of the epidermis. He contends that the *Monotropa* derives its nourishment from the soil entirely through the medium of this fungus-mycelium; the only parts of the root which are in actual contact with the soil are composed of lifeless cells with no power of deriving nutriment from them. The connection of the fungus with the roots of the *Monotropa* is not one of parasitism, but of true symbiosis, each of the two organisms deriving support and nutriment from the other.

More recently similar observations on the mode of nutrition of trees belonging to the natural order Cupuliferæ have been made by Dr. B. Frank and confirmed by M. Woronin (both recorded in the *Berichte der Deutsch. Bot. Gesellschaft*). Dr. Frank finds the roots of our native oaks, beeches, hornbeams, chestnuts, and hazels, to be covered by a dense cortex of Mycorhiza, organically associated in growth with the root, and composed entirely of fungus-hyphæ, completely enveloping the whole of the root, even the growing point. The structure of this cortex is that of a sclerotium; it is composed of a dense mass of hyphæ, varying in diameter from 2 to 10 micro-millimetres, usually in several layers, other endophyllic hyphæ penetrating from them into the root between the epidermal cells, these being still slenderer than those of the envelope. By this structure, the formation by the tree of root-hairs is entirely prevented, and it is through it alone that nutriment is absorbed out of the soil. It makes its appearance first on lateral roots of the young seedling, and is constantly being replaced by fresh formations on older roots. Dr. Frank found this Mycorhiza invariably present on every root examined of trees belonging to the Cupuliferæ, also occasionally on Salicaceæ and Coniferæ, but not on woody plants belonging to other natural orders, nor on any herbaceous plant. He also regards the phenomenon as an example of symbiosis, comparable in all essential points to that of lichens, the Mycorhiza corresponding to the fungal element, the tree itself to the algal gonidia. Dr. Woronin confirms these statements in relation to Coniferæ, Salicaceæ, and some other trees, and thinks it probable that the fungus is the mycelium of a *Boletus*. He regards it, however, as truly parasitic.

In the discussion which took place at Strassburg, Dr. Frank stated that the fact of this phenomenon having been observed especially in the Cupuliferæ, was probably due to the partiality of these trees for soil rich in humus. He had observed it also in the Abietineæ among Coniferæ, the Salicaceæ, the alder and birch among Betulaceæ, and in one instance each in the lime and blackthorn. He regards it as probably much more widely diffused than previous observations had suggested. Prof. de Bary, who accepts the explanation of the phenomenon as an example of symbiosis, pointed out that a similar relationship has long been known between Orchideæ and fungus-hyphæ. Observations in the same direction have also been made by Riess and Janczewski. ALFRED W. BENNETT

NORWEGIAN TOADSTOOLS

AMONG the various interesting facts regarding the history of cryptogamic plants given in the new edition of Prof. Schübeler's great work on the flora of Norway, special interest attaches to the results of his experiments on *Amanita muscaria*, one of the commonest of the Norwegian toadstools. According to Dr. Schübeler, we have in this mushroom the source whence the ancient Scandinavians derived a preparation whose intoxicating and half poisonous properties induced symptoms of frenzied excitement, similar in all respects to those exhibited by the old northern warriors when taking part in a "Berserksgang," which appears to have been very similar to the so-called "running amok." Prof. Schübeler founds his opinion on the evidence given by the Russian writers, Krascheninnikow, Erman, and others, as to the effects produced on the Kamchatkans by a decoction of the Amanita, which they used as an intoxicating drink until they were brought into closer contact with the Russians, from whom they have acquired the practice of drinking spirits. In the present day this use of the Amanita seems to be limited to the nomadic Korjakes, with whom the neighbouring Kamchatkan tribes carry on a profitable trade, giving only one or two of these mushrooms in exchange for a reindeer. According to the testimony of the Kamchatkans, the first symptom noticed after drinking this so-called "Muchamór liqueur," one of whose ingredients is said to be the juice of *Epilobium angustifolium*, is a trembling in the limbs, followed after a time by great flushing of the face and general excitement and irritability, which in the case of many is accompanied with an abnormal increase of muscular force. Thus an instance is recorded in which a man while under the influence of this stimulant ran 15 versts carrying a sack of flour on his back weighing 120 lbs., which in his ordinary condition he could barely lift. On comparing the symptoms of intoxication by muchamór recorded among the nomads of North-Eastern Asia with the accounts given by Icelandic and other northern authorities of the condition of the Berserkers in their frenzy, Dr. Schübeler finds such complete harmony that there can be no doubt of the identity of the causes to which both may be referred. We know, moreover, that while the descriptions of the Berserkergang forcibly recall the frenzy induced by the use of hachish, or opium, neither of these stimulants could have been attainable in Iceland in ancient times, nor could brandy have been used by the northmen, since it was not introduced into Norway before 1531. The employment of mead or ale by the Bersekers is equally negatived by the symptoms recorded, which the writer seems to have traced beyond a doubt to their true source. It is worthy of notice that as early as the beginning of the eleventh century the law-givers of Iceland recognised the Berserkergang as a manifestation of frenzy, for which the actors were to be held accountable, while a law was introduced in 1123 which ordained that every man who took part in these outbreaks should be banished from the island for three years, and that a similar punishment should be awarded to all who were present and who did not help to bind the Berserkers and watch over them till their excitement had passed away.

SCIENTIFIC SERIALS

Bulletin de l'Académie royale de Belgique, October 10.—Note on the crepuscular lights observed towards the end of the year 1883, by M. Hirn. A new explanation is here suggested of this phenomenon, which is attributed to a highly electric condition of the upper atmospheric layers in combination with particles of matter floating round the globe, and possibly due to the Krakatoa eruption.—On the notion of force in modern science, by M. Hirn. In this essay force is removed from the almost mystic domain it has hitherto occupied, and brought within the sphere of actual experience. The question to be determined by science is, whether gravitation, electricity, heat, &c., are to be regarded as distinct entities, or different forms of the same element absolutely distinct from what we call ponderable matter. But owing to the prevailing confusion regarding the nature of force, it is better for the present to study its various dynamic manifestations, than to attempt to reduce them to one element.—Analysis of some rocks from the "rivers of stone" in the Falkland Islands, by A. Renard. Amongst these specimens is a square prism with regular polyhedric breakage showing a granitoid texture, and altogether typical of the eruptive masses frequently interspersed amongst Palæozoic formations like those of the Falkland Islands. This fragment must be classed in the group of diabase rocks, and may serve to throw some light on the origin of the remarkable "rivers of stone" described by Darwin and Wyville Thomson.—Note on the gemmation of the channels in the planet Mars, by F. Terby. It is suggested that this curious phenomenon may be the beginning of a periodical enlargement of the channels due to causes for which no analogy can be found on the terrestrial globe.—The ancient geography of Western Asia elucidated by means of the cuneiform inscriptions, by M. Delattre. By a careful study of the itineraries and warlike expeditions described in the Assyrian and Babylonian records the author endeavours to determine the position of numerous localities unknown to the Greek and Latin writers.—The origin of the Flemish people, by L. Vanderkinden. In reply to M. Wauters' recent memoir, the author shows conclusively that the Saxon and Frisian elements are largely represented in the present populations especially of Western Flanders.

Rivista Scientifico-Industriale, October 31.—Paramagnetism and diamagnetism, by Prof. Carlo Marangoni.—On the velocity of the rays polarised round the interior of a body endowed with rotatory power, by Prof. Augusto Righi.—Experiments on the heating of boilers with petroleum, by the editor.—On the native arsenic of the Valtellona district, by D. Bizzari and G. Campani.

Rendiconti del Reale Istituto Lombardo, November 12.—Critical and exegetic essays on the sources of Roman jurisprudence, by Prof. C. Ferrini.—Theoretical treatment of the question of the ventilation of rooms, showing that in all cases the ventilating apparatus should be placed above, by Prof. R. Ferrini.—On a question of priority of discovery in bacterio-therapeutics, by E. L. Maggi.—Analytical functions of a single variant with any number of periods, by E. F. Casorati.—Meteorological observations made at the Brera Observatory, Milan, during the months of August and September.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 17.—"An Experimental Investigation into the Form of the Wave-Surface of Quartz," by James C. McConnel, B.A. Communicated by R. T. Glazebrook, M.A., F.R.S.

The paper contains an account of a number of measurements of the well-known "dark rings" of quartz. Each ring is due to one wave being retarded in the quartz behind the other by an integral number of wave-lengths, so the measurements give the directions through the plate of quartz corresponding to a series of known retardations. The relative retardation is, especially in a crystal of weak double-refracting power like quartz, mainly dependent on the distance between the two sheets of the wave-surface. Thus my observations really give the separation between the two sheets at various points, and it is in this separation that the peculiarities of quartz are most strongly marked, and the various expressions put forward by theory most widely divergent.

I found it convenient to treat separately the region near the axis, where the abnormal form of the wave-surface of quartz is most obvious. I have compared my results with nine different theories, each of which gives an expression of one of the two following forms:—

$$D^2 = P_1^2 \sin^4\phi + D_0^2.$$
$$D^2 = P_2^2 \sin^4\phi + D_0^2 \cos^4\phi.$$

Here D is "the number of wave-lengths by which one wave lags behind the other in air, after the light has traversed normally a plate of quartz 1 millimetre thick, the normal to whose faces makes an angle ϕ with the optic axis." D_0 is the value of D when $\phi=0$, and is known from the rotatory power, and P_1 and P_2 are constants to which the theories assign different values. By inserting the observed values of D and ϕ, I obtained a value of P_1 and P_2 from each ring. The results from one plate about 20 millimetres thick were as follows:—

ϕ ...	4° 24′	5° 51½′	6° 51½′	7° 40½′	8° 23½′	9° 38′	11° 41′
P_1 ...	15·054	15·207	15·220	15·260	15·249	15·258	15·269
P_2 ...	15·220	15·293	15·290	15·311	15·295	15·292	15·292

Similar results were obtained from a second plate about 27 millimetres thick.

From these figures I concluded that the second expression was the correct one, and that $P_2 = 15·30 \pm ·01$. There is a considerable discrepancy in the case of the first ring, of which two possible explanations are given in the paper.

Cauchy gives $P_2 = \frac{a-b}{a^2\lambda} = 15·351$, where a and b are the wave-velocities perpendicular to the optic axis.

Lommel gives $$P_2 = \frac{1-a^2}{1-b^2}\,\frac{a+b}{2a}\,\frac{a-b}{a^2\lambda} = 15·178.$$

Kettler " $$P_2 = \frac{a+b}{2b}\,\frac{a-b}{a^2\lambda} = 15·486.$$

Sarrau " $$P_2 = \frac{a+b}{2a}\,\frac{a-b}{a^2\lambda} = 15·306.$$

The other five, MacCullagh, Clebsch, Lang, Boussinesq, and Voigt, have the first form of expression giving

$$P_1 = \frac{a+b}{2a}\,\frac{a-b}{a^2\lambda} = 15·306.$$

Thus Sarrau alone succeeds in explaining the observations satisfactorily.

For the larger values of ϕ I calculated on Sarrau's theory what values of $a-b$ were required to give the retardation observed in each ring, and obtained as follows:—

ϕ	15° 14′	18° 21′	23° 16½′	28° 7½′	32° 7′	35° 34′	38° 36′
$a-b$ ...	·0037916	·0037922	·0037927	·0037931	·0037939	·0037932	·0037936

The observations on the plate cut parallel to the axis gave—

ϕ	53° 58′	57° 11′	64° 45′	72° 13′	79° 53′	83° 40′	85° 37′
$a-b$ ...	·0037949	·0037947	·0037945	·0037944	·0037943	·0037946	·0037944

The observations were taken in the Cavendish Laboratory, Cambridge, during the months of March and June, 1885.

For full details as to the apparatus, the plates of quartz used, the mode of observation, the precautions necessary, the temperature effects, and the calculations, reference must be made to the paper.

Edinburgh

Royal Society, December 7.—Mr. J. Murray, Ph.D., Vice-President, in the chair.—Sir W. Thomson read a paper on certain cases of motion of a liquid filling an ellipsoidal hollow; and a paper on the communication of motion from a liquid to a rigid containing shell. He showed that the motion of a liquid when rotating about the long axis of a prolate spheroid is essentially unstable, so that no great speed of rotation can be got up in the liquid in this case by making the containing shell rotate about the long axis.—Prof. Turner showed that the relative length and breadth of the sacrum may be taken as a test of development in different races of mankind. In the higher races the length exceeds the breadth.—Prof. Crum Brown read a paper on a case of interlacing surfaces. In this paper he extended the problem of the locking of threads to surfaces, pointing out that only certain surfaces can be covered over by such an interlacing system. For example, the sphere cannot be so covered, while the cylinder and anchor-ring can.—Prof. Tait communicated an elementary examination of the laws of collision of two systems of spheres, showing as clearly as possible what assumptions are necessary in obtaining average results, and how they are justified. The case in which one system of spheres gains energy from without, while the other loses to external objects, is investigated, and shows that the final average energy is not the same in the two systems, thus affording an escape from the difficulties raised by Botzmann's theorem.—In a second paper Prof. Tait defined the mean free path as the average of the free paths at any moment being described by all the particles. The definition, as usually given, is the average speed of a particle divided by the average number of collisions per particle per second. When the former definition is employed, the factor by which the mean free path is reduced in consequence of the motion of the other particles, is found to be 0·68 nearly, instead of 0·71 nearly, as found from the second definition.

Royal Physical Society, November 18.—Mr. B. N. Peach, the retiring President, delivered an address on some of the relations of Palæontology to Geology, illustrated chiefly by examples from the Scottish rocks.

December 16.—Prof. Duns, Vice-President, in the chair.—Prof. Turner, F.R.S., was elected President, and Mr. J. Harvie Brown, Prof. Duns, and Prof. Ewart were elected Vice-Presidents.—The Secretary read a paper by Mr. Robert Kidston, on the species of the genus Palæoxyris, occurring in British Carboniferous rocks.—A paper was read by Prof. Ewart, on the hatching of herring in deep water. Prof. Ewart pointed out that during recent years the herring-fishing had undergone marked changes in several respects:—(1) There had been a great increase in the "take." In 1820 only 450,000 barrels were cured, while in 1885 nearly 1,500,000 barrels were cured. (2) There had been a change in the fishing-ground; the greater number of the fish during the autumn are now caught from forty to sixty miles off shore. (3) The herring captured during the last few years off the east coast during the autumn were much smaller than those captured some ten years ago. The herring having, to a great extent, deserted the spawning-grounds in the Moray Firth, it was feared that the shoals might diminish in numbers, owing to the ova being unable to develop on the deep off-shore banks. A reference to the charts showed that the North Sea was, on the whole, very shallow—the fifty-fathom line running from fifty to thirty miles from the coast—and that there was only one small area (off Fraserburgh) where there was 100 fathoms of water. By depositing artificially-fertilised eggs in ninety-eight fathoms of water in Lochfyne, off Tarbert, it was proved that the ova develop normally, and that the only difference is one of time, the hatching being delayed owing to the lower temperature of the deep water. It was pointed out further that there was abundance of food for the fry in the off-shore waters of the Moray Firth, and that the fry, on the second day after hatching, were able to ascend at the rate of 100 fathoms in five hours.—A communication was read from Mr. A. Smith on the sucker fishes, Liparis and Lepadogaster.—Mr. Brook called attention to a peculiar method of cell-division in the early segmentation stages of fish ova. A series of vacuoles form in the plane of cleavage either at the surface or in the interior of the cell-protoplasm. By an increase in the size of these vacuoles, the two new cells become separated. Several cells may, however, remain connected together by bridge-like strands of the cell-plasma. This method of cell-division has been observed in Salmonidæ and Gadidæ, but most distinctly in the herring.—Mr. Gulland read a paper on the sense of touch in Astacus, in which he described the distribution and nature of the tactile setæ and their corresponding nerve end-organs, and discussed their origin and relations, and also the nature of certain glands in the great claw.

Mathematical Society, December 11.—Dr. R. M. Ferguson, President, in the chair.—Prof. Tait communicated a paper, which was read by Mr. William Peddie, on integrals occurring in the kinetic theory of gases. Mr. Peddie explained a method of breaking up a rectangle to form a square, and gave the first part of a paper on the theory of contours, and its application to physical science.

SYDNEY

Royal Society of New South Wales, September 2.—Prof. Liversidge, F.R.S., President, in the chair.—Mr. J. P. Josephson, A.M.I.C.E., read a paper on the history of the floods in the Hawkesbury. A number of chromogenic and pathogenic micro-organisms were exhibited and described by W. Camac Wilkinson, M.D. Lond.—An advanced copy of a work containing a series of photographs and descriptions of a case of variola occurring at the Quarantine Station was shown by Dr. J. Ashburton Thompson.—A number of microscopical slides, mounted without pressure, were shown by Mr. H. Sharp, of Adelong.

PARIS

Academy of Sciences, December 21.—M. Jurien de la Gravière, Vice-President, in the chair.—Allocution on the progress of science during the past year, by the Vice-President.—Prizes awarded during the year 1885:—Geometry: Bordin prize to M. P. Appell (2000 fr.) and M. Otto Ohnesorge (1000 fr.); Francœur prize, M. Emile Barbier. Mechanics: Extraordinary prize of 6000 fr. to M. Hélie (2000 fr.) and MM. Hugoniot, Doneaud du Plan, Hatt, and Lucy (1000 fr. each); Poncelet prize to M. Henri Poincaré; Montyon to M. Amsler-Laffon; Plumey to MM. Bienaymé and Daymard; Dalmont to M. Lucas; Fourneyron to M. Colladon. Astronomy: Lalande prize to M. Thollon; Valz to M. Spörer; Bordin to M. Edlund; Lacaze to M. Gernez. Statistics: Two prizes to MM. de Pietra Santa and Keller. Chemistry: Jecker prize to MM. Prunier and Silva (4000 fr. each) and M. G. Rousseau (2000 fr.). Geology: Delesse prize to M. Lapparent. Botany: Barbier prize to MM. Dubois, Heckel, and Schlagdenhauffen; Desmazières to M. Leclerc du Sablon; Montagne to M. Patouillard. Anatomy and Zoology: Grand prize of the Physical Sciences to M. Joannès Chatin; Da Gama Machado to M. Girod. Medicine and Surgery: Montyon to MM. Charpentier, Farabeuf, Regnauld, and Villejean (2500 fr. each), Bréant to M. Mahé; Godard to M. Desnos; Lallemand to M. Grasset. Physiology: Lacaze prize to M. Duclaux; Montyon to M. Remy. Physical Geography: Gay prize to Capt. Defforges. General prizes: Montyon (industries injurious to the health) to MM. Girard and Chamberland (2500 fr. each); Cuvier to M. Van Beneden; Trémont to MM. Bourbouze and Sidot (1000 fr. each); Gegner to M. Valson; Petit d'Ormoy (Mathematical Sciences) to M Halphen; Petit d'Ormoy (Natural Sciences) to M. Sappey; Laplace to M. E. G. A. Coste.—Prizes proposed for the year 1886:—Geometry: A study of the surfaces admitting all the symmetrical planes of one of the regular polyhedrons (3000 fr.); Francœur prize, The work most conducive to the progress of the pure and applied mathematical sciences (1000 fr.). Mechanics: Extraordinary prize of 6000 fr. for any work tending most to increase the efficiency of the French naval forces; Montyon (700 fr.), Invention or improvement of instruments useful to the progress of agriculture, of the mechanical arts or sciences; Plumey (2500 fr.), Improvement of steam-engines, or any other invention contributing most to the progress of steam navigation; Dalmont (3000 fr.), The best work by any of the Ingénieurs des Ponts et Chaussées in connection with any section of the Academy. Astronomy: Laland prize (gold medal worth 540 fr.), for the most interesting observation on work most conducive to the progress of astronomy; Damoiseau (10,000 fr.), Best work on the theory of Jupiter's satellites, discussing the observations and deducing the constants contained in it, especially that which furnishes a direct determination of the velocity of light; Valz (460 fr.), for the most interesting astronomical observation made during the course of the year. Physics: Grand prize of the Mathematical Sciences (3000 fr.), for any important improvement in the theory of the application of electricity to the transmission of force. Statistics: A prize of 500 fr. for the best work on the statistics of France. Chemistry: Jecker prize (5000 fr.), for the work most conducive to the progress of organic chemistry. Geology: Vaillant prize, on the influence exercised on earthquakes by the geological constitution of a country by the action of water or of any other physical causes. Botany: Barbier prize (2000 fr.), for any valuable discovery in the medical and botanical sciences bearing on the healing art; Desmazières (1600 fr.), for the best or most useful work, by a Frenchman or a foreigner, on the cryptogamic plants. Anatomy and Zoology: Savigny prize (975 fr.), for the best work on the invertebrate animals of Syria and Egypt. Medicine and Surgery: Bréant prize (100,000 fr.), for an efficacious remedy against cholera,—discovery of the true causes of Asiatic cholera, with a view to its suppression, or for the discovery of any certain prophylactic against cholera. Physiology: Montyon prize (750 fr.), for the best work on experimental physiology. Physical Geography: Gay prize (2500 fr.), researches on the differences of sea-level in the vicinity of the continents due to local attraction or relief of the land, with examples illustrating the reality of this phenomenon. General prizes: Montyon prize, for any discovery useful to the healing art or tending to render unhealthy industries less injurious; Delalande-Guérineau prize (1000 fr.), for any French traveller or any naturalist who shall have rendered the greatest service to France or to science; Jerome Ponti prize (3500 fr.), for any work judged most useful for the advancement of science. Competitors for these prizes are reminded that all papers must be sent in before June 1, 1886, and that no documents will be returned by the Academy. Copies, however, may be procured through the Secretary.

BERLIN

Physiological Society, Nov. 13.—Prof. Munk reported on experiments carried out by Dr. Ziehen in his laboratory, with a view to deciding the question whether epileptic convulsions, artificially induced by electric stimulation of the brain, proceeded from the cerebral cortex or from centres of deeper situation. By weak electric stimulation of a motory region of the cortex continued for a longer time, or by a stronger stimulation for a shorter time, it was found, after removing the electrode, that convulsions originated in the muscles corresponding with the stimulated region, thence propagating themselves gradually over the whole body. After the stimulation of one region of the cortex, a cause of convulsion was accordingly left in it, gradually overtaking the other centres of the groups of muscles. The question was, whether this propagation of the cause of convulsion took place in the cortex, where, map-like, were situated, adjacent to each other, the regions for the muscles of the eyes, ears, face, anterior and posterior extremities—or whether the propagation got transferred directly to the deeper centres of the muscle sections, gradually taking possession of them. This problem Prof. Luciani endeavoured to solve by exciding a centre of muscle groups out of the cortex, such as that of the anterior extremity, and then causing the convulsive fit artificially. The result he found was that all the muscles gradually fell into a state of convulsion, with the exception of those of the anterior extremity. This experiment, apparently settling the question, had been confirmed by some physiologists, but not by others, so that it became necessary to institute experiments afresh. Dr. Ziehen had now made the observation that under sufficiently long application of weak stimulations the convulsion ensuing and gradually spreading over the whole body was a clonical one, and that under moderately strong stimulation tetanic allied themselves to the clonical spasms, while under very strong stimulations the tetanic contractions preponderated. When, in accordance with Prof. Luciani's procedure, he had excided a region of the cortex and then applied stimulation by weak currents, the clonical spasms showed themselves in all groups of muscles, with the exception of those corresponding with the excided portion of the cortex. When, on the other hand, he applied stimulation by strong currents, he observed the tetanic convulsions assert themselves at those parts likewise of the body, the cortex region of which had been excided, even if weaker at this latter part than in the other muscles. From this result the speaker inferred that the spasmodic stimulation, in the case of clonical contractions, propagated itself in the cortex, and that in the case of tetanic contractions the spasmodic stimulation propagated itself in the deeper parts of the brain. In support of this inference Prof. Munk adduced the succession of the groups of muscles overtaken by spasm. The position of the motory centres in the cortex was precisely known, whereas the local distribution of the deeper centres was unknown. Now, the clonical spasms proceeding from the spot of excitation followed each other precisely in that succession in which the centres of the cortex arranged themselves conterminously, while the succession of tetanic spasms formed a different and irregular series. Further evidence in support of the conclusions just stated was afforded by the following experiment. A region of the cortex having been stimulated by weak currents sufficiently long to induce clonical spasms in the muscles corresponding therewith, and in the muscles belonging to the adjacent region, the part of the cortex first affected was excided. The consequence was that the spasm now propagated itself no further, but ceased entirely. In the case, however, of tetanic spasms, the excision of the stimulated part of the brain had no effect. In refutation of the objection that might possibly be urged, namely, that in the main experiment the excision of a determinate part of the cortex was followed by an exemption from spasms in the group of muscles belonging to that part, for the reason that the excision caused a stimulation which induced a counteracting excitation in the muscles in question, Prof. Munk adduced the fact that he had observed the same result in animals that had been tested in this manner eight months after the excision, when there could no longer be any question as to a stimulation in the part where the excision had been made.—Prof. H. Munk next communicated the observations he had made on pigeons from which he had cut out the corpora striata. The conditions in respect of the corpora striata were very different in birds from those obtaining in Mammalia, seeing that in the brain of birds the corpora striata composed the main mass, whereas in the brain of the Mammalia they retired considerably into the background. If these were now removed on both sides from pigeons, the pigeons yet acted altogether normally, and the functions of all their senses continued unimpaired. With careful attention for a length of time three deviations from the normal state could yet, however, be remarked. The back of the pigeons was curved strongly convex; they never perched either by day or by night; and could never snap up a pea, however much exactness they showed in pecking at any pea laid before them, seeing that in pecking they never opened the beak. The animals had therefore to be fed artificially. In consequence of these observations Prof. Munk conjectured that the corpora striata were the seat for the combination of movements. —Following up this subject Dr. Lehmann stated some provisional results which, in conjunction with Dr. Baginski, he had found in rabbits, in which the corpora striata had been injured. The phenomena resulting under like conditions in pigeons had not been observed. The investigation in this field was still being continued.—Prof. Liebreich gave a short sketch of a series of investigations which had engaged him for some years, and had led to the introduction of a new substance into the pharmacopœia. He premised that the denomination "fats" would have to cover more than it had hitherto done, and not merely such substances as were capable of decomposition in fatty acids and glycerine. All substances, on the contrary, would have to be conceived of as neutral fats, which contained sebacic acids, no matter with what organic base these were combined. Such a neutral fat was discovered by Herr E. Schulze, in 1869, in the yolk of the fleece of sheep, and which consisted of a sebacic acid and cholesterine. This cholesterine fat of sheep's wool, or "lanoline," had been studied by Prof. Liebreich, as to the method of obtaining it on account of its excellent qualities in the way of a salve constituent; it was now being extracted from woollen hairs by means of a centrifugal machine and had become an article of trade. Prof. Liebreich had next investigated the origin of this cholesterine fat, and, with the help of the uncommonly sensitive cholestol reaction of Prof. Liebermann, had come to the conclusion that the cholesterine fat contained in the yolk of sheep was derived neither from the sudorific glands nor from the sebaceous glands, nor from the sebaceous texture of the under-skin, but was seated exclusively in the hairs and in the epidermis cells. This fact led, on the one hand, to the production of the substance as a kind of manufacture, while on the other hand it induced a very extensive series of experiments respecting the distribution of cholesterine fat in the animal kingdom. The speaker found it in the epidermis, the hairs and nails of men, in the hairs of all Mammalia he had examined, in the hoofs of horses, in the paws of swine, in the horns of cattle, in the prickles of the hedgehog, in the feathers of fowls, geese, and a large number of other birds, in the plated sheaths of the tortoise; in short, in all horned textures which, with long and toilsome labour, he had examined. The speaker had, in addition, found the cholesterine fat in the kidneys and the liver of Mammalia; yet it was not beyond question that in these organs the cholesterine fat did not proceed from the blood, in which it was always present in small quantities. It might be conjectured that it would likewise be found in the intestinal canal, and generally wherever epithelial cells occurred. The constant presence in all epithelial formations of a particular fat, which was there formed in the keratine cells, rendered it highly probable that the hairs of the Mammalia and the feathers of birds owed their elasticity and pliancy not, or at all events not exclusively, to the secretion of the sebaceous or caudal glands, but to the cholesterine fat generated in the horn cells themselves. The quality possessed by cholesterine fat of not oxidising, or oxidising only under very rare conditions, rendered it, as was very readily conceivable, most peculiarly adapted for lubricating the skin and feathers. Beyond the property of not becoming rancid, lanoline possessed a whole series of other advantages distinguishing it quite peculiarly as a salve constituent. It absorbed, for example, 100 per cent. of water, and by so doing became a soft substance easy to the touch, penetrating the skin with altogether extraordinary facility, and after but a short rubbing into the cutis, disappeared from view. Prof. Liebreich had already prepared into salves a great number of medicamental stuffs by means of "lanoline," and had made experiments with them which yielded entirely satisfactory results. Lanoline, dark brown in a dry state, grew pale like wax in light, and showed other qualities besides assigning it a place between the ordinary glycerine fats and the wax kind of fats.

STOCKHOLM

Academy of Sciences, November 11.—The following papers were read and accepted for publication in the Society's *Journal*:—Lois de l'équilibre chimique dans l'état dilué, gazeux, ou dissous, by Herr J. H. van't Hoff.—Recherches sur les réactions chimiques dans le champ du microscope, by Prof. E. G. Fatigoti, of Madrid.—Some remarks and experiments on filtration, with reference to its bearing upon the process of transudation in the animal body, by Drs. R. Tigerstedt and G. Santesson.—*Hæmatodeptes terebellidis*, une nouvelle Annélide parasitique de la famille des Euniciens, by Prof. A. Wirén.—On the constitution of some derivatives of naphthaline, by Dr. A. G. Ekstrand.—On combinations of phenyl-textra-zol, by Herr J. A. Bladin.—On the integration of the differential equations of the intermediate orbits, by M. C. V. L. Charlier.

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