THURSDAY, APRIL 5, 1888.

THE FORESTRY SCHOOL AT COOPER'S HILL.

THE Forestry School at Cooper's Hill is intended in the first place for the education of a certain number annually of young officers for the Indian Forest Department. The arrangements are, nevertheless, of such a kind that private students are admitted to the forestry course, in as far as space is available, and on condition that they conform to the rules.

It is in many ways advantageous that the Forestry School is attached to the Royal Indian Engineering College at Cooper's Hill. Although the course for forest students is necessarily different from that designed for engineering students, there are several subjects to be studied in common, and consequently the present arrangements admit of the forest students obtaining their training in surveying, descriptive engineering, and mathematics, for instance, in the excellent courses provided by the well-known Professors in the Engineering College.

The Forestry School itself consists of a block of buildings attached to the Royal Indian Engineering College, on the brow of Cooper's Hill, near Staines, and looking north over Runnymede and the Valley of the Thames. It is within a convenient distance from London, the traveller arriving at Egham (the nearest station on the London and South-Western Railway) in from forty-five to sixty minutes from Waterloo. Windsor Great Park is within a mile of the beautiful and spacious grounds in which the College stands, and the fine trees of all kinds to be met with in the neighbourhood give to the situation much that is desirable for a centre for the teaching of forest botany, and several parts can be made use of to a certain extent for illustrating subjects in forestry proper.

The building of the Forest School itself consists of large and small class-rooms, a museum, and the well-designed and appointed botanical laboratory. In this block the students pursue their main studies—botany, forestry, and entomology. Their other studies—engineering, surveying, mathematics, geometrical and freehand drawing, physics, geology, and one or two other subjects to be referred to presently—are pursued under the direction of the various Professors in the class-rooms and laboratories of the Royal Indian Engineering College, to which the Forestry School is attached.

The forest museum is a convenient, well-lighted room, rapidly filling with useful collections of specimens illustrating the chief departments of forestry. Among the most valuable and conspicuous objects in this splendid collection may be mentioned the series of European and Indian timbers, which are so disposed that the student has ready access to them, while the Professors are able to refer to them in lecturing, and thus to make the teaching, in the best sense of the word, practical. Then there is a remarkably complete and interesting collection of implements used in forestry, and there are models of timber-slides, apparatus for catching timber, and other forest works, also so disposed that every student can handle and examine them and learn their uses with facility. Another valuable feature in this museum is the series of economic products of Indian plants. This is of course not complete, but the greatest credit is due to all concerned for bringing together for such useful purposes so many instructive specimens of fibres, seeds, barks, fruits, food-materials, &c., from the chief representative Indian plants; and when it is remembered that the Forestry School is so young, in this country (it was started in September 1885), it is the more praiseworthy that the authorities have made such good use of their opportunities and time. The collections must no doubt receive numerous additions as time passes, for it is well known that a museum takes many years to bring within measurable distance of completeness, but the Cooper's Hill museum is already fairly filled, the nucleus of the collections having been derived from the late Indo-Colonial Exhibition, and from the Royal Gardens, Kew. It would require too much space to enumerate the remaining interesting features of these instructive series of forest objects: specimens of timber showing the changes due to abnormal growths, the healing of wounds, the various injuries produced by unsuitable environment or by the attacks of insects and other living organisms, and last, but by no means least, a unique collection showing the ravages of those fungi which injure timber-trees, collected by Prof. Robert Hartig, of Munich, and presented to the School, and a collection of the more injurious forest insects, presented by Herr Oberforstrath Judeich, of Tharand. There is also a small herbarium, of a particularly interesting character, containing an excellent series of Conifers and other trees.

The botanical laboratory has just been completed, and is, without doubt, one of the best designed small laboratories, for its purpose, that we have seen. It consists of an oblong room running east and west, and lighted from the north and east by windows arranged conveniently for work with the microscope. There are also tables and apparatus for experimental demonstrations in vegetable physiology; provision will exist for cultivating seedlings and plants at constant temperatures, for measuring growth, and for exhibiting the influence of light, gravitation, &c., on the growth of plants; and arrangements for showing the quantities of water given off from transpiring leaves, for developing plants in water-cultures, &c. The students are supplied with microscopes, reagents, and accessories, and are taught to familiarize themselves thoroughly with all modern appliances bearing practically on their studies.

The above-mentioned block of buildings also includes one small and one larger lecture-room, which are provided with necessary teaching appliances. The series of botanical diagrams especially are remarkably good, and in fact many of them are unique, being the private property of the Professor of Botany, and drawn and coloured by himself. Another feature which must not be overlooked is the projected botanic garden. This will consist of a series of seed-beds, &c., illustrating the raising of forest trees, and of beds of plants chosen from the most important natural families, in order that the students may familiarize themselves on the spot with their chief characteristics. This botanic garden is now in process of being laid out, and it will be ready for the use of students in a short time.

The courses of studies followed by the forest students are admirably adapted to the wants of practical men whose lives will be largely spent in the creating, planting, preserving, and using of forest and other trees. Obviously, such a course must comprise several branches of teaching, the one thing common to all being that they bear upon the practical needs of the future forester. That the same training applies to a planter or estate-manager needs no remark, and portions of the course would be suited for others engaged in work in woodlands, and in the colonies, &c. The full course, as at present set forth in the syllabus of studies, is as follows.

The student begins work in September, and attends lectures regularly during two academical years. In engineering, he is taught the principles of road-making, and the building of forest bridges and other structures; he is also instructed in the practice and theory of surveying under the care of the Professor of Surveying. In his first year he studies for two terms under the Instructor in Geometrical Drawing, and in his second year receives lessons in the keeping of accounts. To these subjects may be added freehand drawing, and a modern language. In addition to these more technical subjects, the student attends certain short courses in mathematics and in applied mathematics, under the Professors of these sciences; he also studies physics—in lectures, as well as in the laboratory—entomology, and geology. A short course on organic chemistry is now being commenced.

The rest of his work consists in the special training as a forester, and it may safely be stated that there is no other centre in the Empire where so thorough and excellently designed a curriculum for a forester or planter can be obtained. The two subjects of forestry and botany are under the care of separate Professors. Dr. Schlich lectures on forestry, dividing his subject as follows:—In the first year he deals with the various soils, climates, and the regulating effects of forests on these; sylviculture, artificial and natural woods; the tending, thinning, pruning, &c.; the protection of forests against man and other animals, and especially insects, and against injurious plants, climatic influences, &c. During the second year the student is instructed in the utilization of forests; the technical qualities of woods; the felling, shaping, transportation, &c., of timber; the utilization of minor forest produce; the preservation of wood; sawmills; charcoal, &c. He then passes to the study of working plans, and especially the arrangement of cuttings; surveying and mapping forests; measurement and determination of ages of trees and forests; and the methods of regulating the yield of forests. The final course of lectures is on forest law. In addition to the lectures, the students also make occasional excursions, under the direction of Dr. Schlich; the neighbourhood of Windsor Forest facilitating this important object, and enabling the Professor of Forestry to make his teaching thoroughly practical.

In botany, under the management of Prof. Marshall Ward, the students are instructed by means of lectures, and practical work in the laboratory and in the fields and woods of the neighbourhood. The course in botany is designed to train foresters, not technical botanists: its aim is throughout practical, and directed to teaching the students exact and thorough knowledge of the life-phenomena of the trees and plants which it will be their duty to rear, and take care of, and utilize in the future. Commencing with a short course of thoroughly practical instruction in the elementary biology of plants selected as illustrative types of the vegetable kingdom, the young student is taught the use of the microscope and how to apply it practically in examining the tissues of plants. He is then instructed in the organography and anatomy of plants, learning (not only in lectures, but also in the laboratory and in the field) what the organs of plants *are*, and what they *do*; so that roots, stems, leaves, buds, bulbs, tubers, tendrils, thorns, &c., become to him not mere abstractions, but objects on which his attention will be continually fixed as active parts of plants. The study of cells and their contents, of epidermis and stomata, of vascular bundles and other tissues—of wood, bark, cambium, and so forth—is carried on thoroughly, not only that the forester may know the principles by which to classify and recognize timbers and forest products, and learn their uses, but also that he may understand what these various parts of the plants do in nature: how heart-wood is formed, how the timber grows and may be improved, how wounds may be healed over, how the roots take up substances from the soil, and how the plant makes use of them, and so forth. The student concludes his first year's study in botany (in the early summer) by familiarizing himself with the names and systematic position of the plants in the neighbouring fields and woods, especial attention being paid to the important trees and shrubs, and their relations to the forest flora of India.

During his second year, the student is instructed in the physiology of plants—how they feed, respire, and chemically change substances in their interior; how they grow, and are affected by light, gravitation, temperature, moisture, &c.; how they are reproduced, hybridized, and so on; the effects of various agents in the production of wood, in influencing the fertility, and so forth. The course is completed by the study of the diseases of plants, and especially of timbers, and how their effects may be minimized or healed.

As special features of the greatest importance, it should be mentioned that the senior students pay periodic visits to the magnificent gardens, museums, and plant-houses at Kew, under the direction of Prof. Marshall Ward, in order that their knowledge of the important economic plants and their products shall be real. They see the plants growing, learn to familiarize themselves with their peculiarities and habits and uses, and are thus not strangers to them when they land in India. Secondly, the young foresters are taken abroad, and taught what life in the forest really is. At the completion of their first year's studies, they accompany the Professor of Forestry to Scotland, or to the New Forest, or to the Forest of Dean, as may be decided for the year; and at the end of their second year they are taken to the Continent for three or four months' practical work in Germany and France, to examine the systems pursued in the large and more systematically managed forests of those countries, and thus to study the art of forestry in practice under conditions more resembling those met with in the huge and valuable forests of India.

During the summer of 1887, for instance, the young officers who are now in India were taken to Bavaria, under the direction of Dr. Schlich, accompanied by Prof. Marshall Ward and Mr. Gamble. They visited the magnificent museum and laboratories of the Forestry School at Munich, the Forest of Freising, the willow nurseries and plantations at Oberberghausen, the spruce forests at Hohenaschau, and the timber depot at Traunstein. They then proceeded to the Austrian forests of the Salzkammergut; and later to the Forest School and school forests at Nancy, the cork oaks and pine forests in the Esterel, and the *Pinus maritima* forests on the west coast of France, used for the preparation of turpentine as well as for timber.

With this practical tour, the training of the young forester in Europe stops, and he departs for India to assume the new duties and large responsibilities of his life as a forest officer under the Imperial Government.

THE BALTIC AMBER COAST IN PREHISTORIC TIMES.

Die prähistorischen Denkmäler der Provinz Westpreussen und der angrenzenden Gebiete. Von Dr. A. Lissauer. (Leipzig: Engelmann, 1887.)

THE prehistoric antiquities of that part of the Baltic coast that lies about the mouth of the Vistula have something more than a local interest. The old Prussian shore—the land of the Æstii of Tacitus and Cassiodorus, of the Estas of King Alfred—had already in very early times a European importance in its connection with the widely ramifying amber commerce of antiquity, of which this was in historic times the richest field of production. The present work by Dr. Lissauer, the President and founder of the Anthropological Section of the Natural History Society of Danzig, is peculiarly welcome as giving in a thoroughly scientific form a summary of the results of the archæological discoveries made in recent years relating to the prehistoric period in the province of West Prussia and its border districts. The author has divided the work into several sections, corresponding to the Neolithic, Hallstatt, and the successive Iron Age periods, and has accompanied each with an excellent synoptic list of the various individual finds.

Of the earlier Palæolithic Age there are, of course, no remains in this Baltic tract, which was still covered with an ice-sheet at a time when primæval man had already begun to tenant the caves of Cracow. As the ice retreated there was formed the great glacier stream at present represented by the Vistula, but which then prolonged its course to the west, and, joining with the Elbe, poured its waters into the German Ocean. The physical event which in this region dominates all the succeeding history is the breaking through of the Vistula at Fordon, near Bromberg, and the formation of the new channel by which it poured itself henceforth into the Gulf of Danzig; and this, geologically speaking, was a comparatively recent consummation. The author has reproduced an elaborate calculation of Jentzsch, based on the formation of the delta and the average amount of sediment conveyed by the waters of the Vistula, according to which the breaking through of that river to the north must have taken place approximately about 3000 B.C. That the Neolithic immigration into the Old Prussian land from the south must have taken place at an early period is seen from the local distribution of these remains, which tends to show that the ice and snow still lingered on the higher parts of the country. On the other hand, from the fact that Neolithic settlements are peculiarly abundant in the old bed of the Vistula itself, Dr. Lissauer concludes that this immigration did not take place till well after the date when the river had taken its new course. Here, too, as elsewhere, we find the same entire revolution in the character of the Neolithic fauna as contrasted with the Palæolithic group of the Polish caves for example. Not a single representative remains. No reindeer bones even have been discovered on the Neolithic sites of the lands of the Lower Vistula, though the remains both of aurochs and of bison have been found.

Among the most interesting and characteristic objects that appear in association with the Neolithic deposits of the Lower Vistula are certain rude representations of human and animal figures cut out of amber. These remarkable productions, perforated as if for suspension, and engraved with fine lines, are more frequent to the east than to the west of the Vistula mouth; but one of the most striking, a figure of a boar, ranked by Virchow amongst the best relics of the plastic art that have reached us from the Stone Age, was found in the neighbourhood of Danzig. These amber men and animals have been the object of a special study by Dr. Tischler, of Königsberg, whose researches into the prehistoric remains of East Prussia are the complement to those of Dr. Lissauer in the Western Province. In his admirable papers on the Stone Age in East Prussia, Dr. Tischler has shown that these figures are characteristic of an extensive East Baltic region; they have been found in the same shapes and with the same perforations, but cut out of bone and stalagmite instead of amber, in the Polish cave of Pod-kochanka; and, what is still more remarkable, bone figures of analogous character have been discovered amidst the remains of a Neolithic station, described by the Russian explorer Inostranzeff, on the shores of the Lake of Ladoga. From these and other parallels, Dr. Tischler has been able to establish the existence of a distinct East Baltic Stone Province extending from the Oder to the Lake of Ladoga, and in all probability to the Onega shores, and including not only the provinces of East and West Prussia but the greater part of Poland. The relation of these northern "idols" to the clay figures of men and animals found in the Swiss lake-dwellings, in the pile settlements of Laibach, and some of the prehistoric sites of Hungary and Transylvania, where one has been found of alabaster; and the relation again of these latter to the "Pallas" of Dr. Schliemann's Trojan excavations, or the rude "Carian" and Cypriote figures, suggest wide and far-reaching inquiries on which it is impossible here to embark.

Of the Bronze Age, pure and simple, there are very scanty remains in these East Baltic coast-lands; though there are sufficient examples, both of Hungarian and West Baltic forms, to show that before the close of the period in Central and North-Western Europe its arts were already taking root in this region. Dr. Lissauer's remarks on what he terms the "so-called Bronze Age," but which, in the greater part of our Continent at least, represents a very well defined stage of culture, reflect an attitude of mind not yet wholly extinct amongst German scholars. How far the Hallstatt culture can in this district be regarded as the immediate successor of that of Neolithic times is a question, however, of comparatively secondary importance. The main fact with which we have to deal is that it is only in the transitional age that takes its name from the great Salzkammergut Cemetery, and when iron was already coming into use, that we have the evidence of intimate and extended relations between the Amber Coast of the Baltic and the lands to the south and south-east. The importance of this fact in its bearing on the early course of the amber trade does not seem to me to be clearly brought out by Dr. Lissauer. Montelius, however, has conclusively shown that throughout the earlier and purer Bronze Age in Central and North-Western Europe the source of the amber supply was not the East Baltic, but the coast of Jutland and the mouths of the Elbe and Weser, where, as Müllenhoff has demonstrated on purely literary grounds, lay the Amber Islands of Pytheas. The main course of this early commerce, as indicated by the connection of the Bronze Age forms discovered, was up the course of the Elbe; and the first appearance of an intrusive southern culture at the Vistula mouth in Hallstatt times shows that it was not till this comparatively recent period that the Baltic amber route was opened up. But, when once this, then probably as now, far more prolific field was known, southern commerce showed more and more a tendency to follow this route, to the final desertion of the older line to the north-west. Among the most characteristic evidences of the trade relations thus established between the Old Prussian Amber Coast and the Mediterranean may be cited the discovery of a "cordoned" bronze bucket of the class common to Northern and Southern Italy, and of which large finds have come to light in Southern Hungary,—a class of objects which there seems no longer any warrant for qualifying, as Dr. Lissauer does, as "Etruscan," but which, as Helbig has shown, may very well represent an old Chalcidian fabric. A whole succession of finds of Greek coins further mark in somewhat later times the continued intercourse with the south. Dr. Lissauer apparently accepts the much-disputed Schubin find of Archaic coins of Athens and Erchomenos, and though the inclusion in this sixth century hoard of two later pieces of Athens and Miletus, and a modern Siamese coin, render the circumstances of the find open to grave suspicion, the later series of discoveries of coins of Thasos, Macedon, &c., extending from Hungary to Gothland, throws a retrospective light on the probable direction followed by one branch of this Baltic commerce. It appears equally clear, however, both from archæological and historic sources, that another line crossed the Julian Alps to the head of the Adriatic, finding in all probability its southern continuation by the East Adriatic coasting route. This, it will be remembered, was the route followed by those who, in Herodotus's account, conveyed the mysterious gifts of the Hyperboreans to the Delian shrine of the Sun-god—a mission which seems to have an inseparable connection with the "Sun-stone" Islands of Eridanos's mouth and the Phaethontid maidens.

Among the most interesting and characteristic features of the Hallstatt period in West Prussia are the "face-urns," or cinerary vases with human features rudely modelled on their neck; and Dr. Lissauer is probably on the right track when he compares them with the early vases of the same kind discovered by Fräulein von Torma in the Valley of the Maros in Transylvania. That they have any relation with the "face-urns" of Etruria seems out of the question, especially since the appearance of the monograph of Prof. Milani, tracing the evolution of the developed Tuscan type from an earlier class of cinerary vases with funeral masks attached to them. But the parallels from the Maros Valley may be more plausibly regarded as supplying an intermediate link in space and time between the face-urns of the Baltic coast and those of prehistoric Troy. In other respects the ceramic forms that occur in West Prussia and its borderlands during this period, such as the "twin" and painted vases, show strong southern and south-eastern affinities; while the occurrence amongst the ornaments of *Cypræa moneta* and *Cypræa annulus* from the Red Sea and Indian Ocean point to still more extensive eastern relations. Cowry ornaments, it may be worth observing, are of frequent occurrence in the prehistoric cemeteries of the Caucasian region, and there is here perhaps an indication of old Pontic communications by the Dniester or Dnieper Valleys—lines of intercourse which Dr. Lissauer does not seem to have kept sufficiently in view.

The Hallstatt culture on the Old Prussian shore is in its turn cut short by that to which we in England give the name of "Late Celtic," but which on the Continent passes by the name of La Tène from the Swiss station of that name. The Roman taste for amber ornaments subsequently gave a great impulse to the commercial intercourse between south and north *viâ* the Pannonian frontier station of Carnuntum, and we have abundant evidence of the progress of Roman provincial arts on the Lower Vistula. The finds of Roman coins become more and more frequent, and culminate in the reign of Severus, after which time they as suddenly fall off. There can be little doubt, as Dr. Lissauer has suggested, that this sudden break in the commercial relations with the south is due to the great migration of the Gothic tribes, who had before this time established themselves in this part of the Baltic coast, to their new seats on the shores of the Black Sea and Trajan's Dacia. Into the depopulated lands west of the Vistula the new tide of Slavonic settlement now poured, while the older branch of the Litu-Slavic race, the Æstii or "Old Prussians," still held their own on the Amber Coast to the east of the river-mouth, as we know from the offerings made by them to King Theodoric. The last section of Dr. Lissauer's work is directed to this Wendish period of East Baltic history, to the "Burgwall" and the "Bergwall," the pile-dwellings, the characteristic pottery and ornaments of the primitive Slavonic race, and to the monuments of their rising commerce with Byzantium and the Arabian East. To a somewhat later date, perhaps, may be assigned the curious stone figures included by Dr. Lissauer in an appendix to his Neolithic section, and as to the date and origin of which he refrains from conjecture. There can, however, as the author himself admits, be no reasonable doubt that they belong to the same category of monuments as the well-known *Kamienne baby* or "stone wives" of the Russian steppes. They extend, in fact, in an unbroken zone through Poland and Lithuania to the steppes of the Dnieper and the Sea of Azoff, and find their analogies in Central Asia and in the rude stone figures on the Siberian kurgans. As to the ethnic character of the people who spread them over this vast Scythian region, we have the direct testimony of the traveller Rubruquis, who, when visiting the Polovtzi or Kumans—the scourge of mediæval Russia—actually witnessed their erection over the grave-mounds or kurgans of that race. Their Turko-Tataric origin is indeed entirely borne out by their physiognomy, which, as I have myself had occasion for observing in various parts of Southern Russia, is of an unmistakably Mongolian cast, and their dress and accoutrements thoroughly bear out this identification, the head-gear in some instances being identical with that still worn by some Tekke-Turkomans. Individual divergences of type in some of the western examples may of course show that these Mongolian images were imitated by Wendish or Old Prussian, Polish, or Lithuanian hands. Two things, however, may be regarded as certain: that the stone figures of the steppes are of Turko-Tataric origin, and that the date of their Baltic reproductions is considerably later than Neolithic times.

ARTHUR J. EVANS.

VOLTAIC ELECTRICITY.

Voltaic Electricity. By T. P. Treglohan, Head Master, St. James's Science and Art Schools, Keyham, Devonport. (London: Longmans, Green, and Co., 1888.)

ONE occasionally hears of the evil effects of cram and bad teaching which the system of examination and payment by results so extensively made use of by the Science and Art Department is supposed to encourage. If such books as the above are in general use by teachers or candidates, it cannot be denied that the evil is very serious.

There is little of reasoning or explanation anywhere; but, instead, there are strings of statements which would, if they were accurate, consist of ready-made answers for such questions as may be set for the first stage or elementary course of voltaic electricity. At the end of the book will be found the elementary questions in voltaic electricity for the last twenty years, with numbers attached showing the pages where the answers may be found.

The book professes to be largely experimental, and the student is urged to make the apparatus and to try the experiments described. A few extracts will show how utterly misleading it is in this respect.

If the tongue is placed between a penny and a half-crown, "a feeble spark is seen as contact is made between the two metals."

"The missing Zn" (owing to the action of a voltaic cell) "is found in the cell, either in the liquid or at the bottom, as a grayish-coloured deposit."

"This" (the bichromate) "was a strong cell, and was tolerably constant; but, after a short time, was weakened in consequence of crystals of chrome alum forming in the liquid. To prevent this crystallization, the liquid must be frequently disturbed, either by lifting the plates out of it, or by some other means."

After speaking of the Daniell, Bunsen, and Grove, the author describes the Leclanché as "another very constant cell."

To show that zinc and carbon have a greater E.M.F. than zinc and copper in a cell, a condenser and two electroscopes are recommended to be used. In the figure the plates are shown separated and connected each to the zinc or copper and to one electroscope, of which the leaves are widely divergent. The student is not told that the connections must not be so made, nor is any practicable method of making the experiment described.

"In brine the positive and negative elements have the same relative order as in dilute acids; but in ammonia the relation is reversed, and those that were negative in the former case will be positive in the latter."

"It is found that the wire attached to the Cu, C, or Pt has free statical electricity apparent at its terminal, which repels the glass rod rubbed with silk, and that attached to the Zn free statical electricity, which repels the sealing-wax rubbed with flannel."

This extraordinary statement appears five times in a few pages.

Three or four Grove's cells are "necessary" to electrolyze acidulated water; the hydrogen gas collected in one of the tubes of a voltameter explodes "with a tolerably loud report." When a solution of common salt is electrolyzed, "the sodium of the salt and the hydrogen of the water" (appear) "where the current leaves the cell."

"Another simple experiment is to send the current through a solution of iodide of potassium. A brown substance—iodine—is seen at the anode, and the metal potassium at the cathode."

It is doubtful what some passages mean, as for, instance, the paragraph:

"If any number of plates be used together, the E.M.F. of such a cell would be the result of the difference of potential of the two plates which are furthest apart in the electromotive series."

Frequently, the language is more than careless; thus, after speaking of sulphuric acid and sulphate of copper, the author says *other* binary compounds; and, after describing the action of a solenoid, he says coils and helices *also* exhibit magnetic properties.

Those expressions of doubtful meaning—intensity and quantity—are freely used, as is the word potential, which fortunately has not its meaning explained. The names of some of the units are met with for the first time in the sentence: "Current strength is calculated in amperes, electromotive force in volts, and resistan*ces* in ohms." Not a word of explanation is given.

NATURAL HISTORY OF VICTORIA.

Prodromus of the Zoology of Victoria. Decades 1–15. By Prof. F. McCoy. (Melbourne, 1878–87.)

JUST ten years ago, Prof. Frederick McCoy decided, under instructions from the Victorian Government of the day, to commence the publication of a series of short descriptions, accompanied by coloured figures, of the indigenous members of the different classes of the animal kingdom. These were to be published in parts containing ten plates in each, which have appeared with commendable regularity to the present time. As the fauna of Victoria was not as well known as its flora, it was a necessary preliminary, in order to effectually carry out such a scheme, to have a large number of drawings made, as opportunity arose, from the living or quite recent examples of many species of reptiles, fish, and the lower animals, the true characters of which, in many cases, were but imperfectly known, from their having been described from often badly-preserved specimens.

The value of such a work will be readily granted, and the energy of the Victorian Government will be duly appreciated by those of us in the mother country who know the difficulty there would be in our obtaining Government sanction for the publication of like descriptions of the animal inhabitants of these islands.

Of all the forms described and figured in these decades, the originals are preserved in the National Museum at Victoria. The first volume was completed with the tenth decade in 1885, and it forms a large octavo volume of 100 plates and over 200 pages, with a classified index. Since then, Decades 11 to 15 have been published, bringing the date to last year.

On this important work, which we fear is not so well known in this country as it ought to be, we venture to make the following remarks. Of the century of plates forming Vol. I., fifty-four are illustrative of vertebrate forms, and forty-six of invertebrate ones. Of these latter no less than twenty-eight are exclusively of Polyzoa, which seems to us a somewhat unfair treatment of the other groups. We cannot object to it on the score of the advancement of science, but we think we justly may, so far as the usefulness and interest of these decades are for the public. Another criticism, and we have done: the references to where the species have been described are for the most part useless. For example, to the species figured on the 100th plate, *Goniocidaris tubaria* (Lam.), where we find "*Cidarites tubaria* (Lamk.), Anim. sans Vert.," there is not another word added, and this reference is not only defective but erroneous. This is a subject that ought to be attended to: we do not demand a full and detailed synonymy, but would, in such a publication, be content with just such information as would enable a student to see where the generic and the specific names adopted by the author were to be found first described; and to give this, few would be better qualified than Prof. McCoy.

With scarcely an exception, the plates have been exceedingly well executed; those on insects by A. Bartholomew demand a special word of praise, and the same artist has also done full justice to the fishes and the Mollusca, the plates representing the "tuberculated argonaut" being nearly perfect. Another artist whose work we may allude to is Dr. Wild, well known in connection with the *Challenger* Expedition; among the drawings executed by him, that of the Australian fur seal, a group with the adult male, female, and a cub, is worthy of praise.

The descriptive details vary, as might be expected, in interest; sometimes we have most interesting and full accounts of the life-history of the species, as notably in the cases of the fur seals just referred to, of the case moths (Metura), the bell frog, the great cicada, and others too numerous to mention; and were our space unlimited we would gladly show how all-sided is the information to be gained from these decades. The following will serve as an example. A common moth, first described from New South Wales by Lewin as *Phalænoides glycine*, from the larvæ feeding on the leaves of a leguminous plant (*Glycine bimaculata*), is equally common in the colony o Victoria, but there the larvæ fed on *Gnaphalium luteo-album*, a common weed. Since the planting of vineyards this moth has increased in enormous numbers, and the larvæ have completely abandoned their original food, and now devour only the leaves of the grape vine, on which the moth multiplies beyond measure. It is a puzzle how the female moth was guided to deposit her eggs on a plant of so different a character from that which she had been accustomed to, and which must have been to her unknown. The injury done to the vineyards of Victoria by this insect is enormous, and would seem, in spite of many remedies, to be increasing. Insectivorous birds will not eat the marauding larvæ; and children, who might keep down the plague by hand picking, must, by law, attend their schools.

We hope to again notice these decades on the completion of the second volume. In the meanwhile we have said enough to call our readers' attention to the value and interest of the information which they contain; and we congratulate Prof. McCoy and the Victorian Government on their publication. E. P. W.

OUR BOOK SHELF.

Technological Dictionary. In 3 vols. English-German-French, French-German-English, German-French-English. Third Edition. (London: Trübner and Co., 1888.)

THE inventions and discoveries of the present century have introduced a very considerable number of new words into the various languages of the world, but more especially into the European languages. As these words do not occur in ordinary dictionaries, special dictionaries embodying them are necessary to a great number of persons. Thus, to facilitate communication in commercial transactions between one country and another, and to enable students of science and technology to profitably consult works written in languages other than their own, they are indispensable. As regards the three principal languages of Europe, this want is supplied by the work before us, the third edition of which has recently been completed by the publication of French-German-English, and German-French-English volumes. The third edition of the English-German-French volume was published in 1878. The first edition dates as far back as 1852, and since then the work has been thoroughly revised and new matter added.

The work embraces the terms employed in the arts and sciences, engineering, architecture of every description, navigation, astronomy, meteorology, mining, artillery, &c. In addition to the terms relating to the various appliances, processes, and substances, there are also those applied to the different orders of people concerned with them, from the "doffer" of the spinning mill to an "Admiral of the Fleet." Teachers of scientific and technological subjects will also find the equivalents of the great majority of the terms they find it necessary to employ, the names of chemicals and minerals included. The work is wonderfully comprehensive, and the arrangement is all that could be desired.

The best authorities have been consulted, and tedious processes adopted, with the view of obtaining indisputable accuracy, and this has practically been accomplished. No effort has been spared to make the work deserving of the important place in literature which it should naturally occupy, and no recommendation of ours is necessary. It certainly ought to be available for reference in all libraries of any importance. A. F.

Transactions of the Sanitary Institute of Great Britain. York Congress, 1886.

THE valuable work done by the Sanitary Institute cannot be altogether gauged by the annual volumes of Transactions, one of which now lies before us. It must be remembered that, besides the reading of papers and holding of discussions on subjects of sanitary interest, the Sanitary Institute endeavours, by means of its Congresses and annual Exhibitions, to arouse the interest of the inhabitants no less than of Town Councils and municipal authorities in the health and well-being of the towns visited. That such visitations have a beneficial influence, by awakening public interest in measures of sanitary reform, both local and general, can hardly be doubted; and, as pointed out by Sir Spencer Wells in his Presidential Address, if further legislation on sanitary matters is not to be ridiculous, it must be accompanied by increased knowledge on the part both of the persons charged with administering the Sanitary Acts as well as of the public themselves.

The modern science of hygiene is hybrid, embracing as it does special branches of most of the leading sciences—medicine, engineering, architecture, geology, chemistry, meteorology, &c. The subjects treated of by means of papers in such a Congress must be very varied, and such we find to be the case; but as far as possible the papers are relegated to one of three sections, where their merits will be best understood and most adequately discussed. The standard of the papers submitted to the York Congress is fully up to the average, many of them treating of subjects of wide interest, or having important bearings on the prevention of disease and maintenance of the public health.

Science Sketches. By David Starr Jordan. (Chicago: A. C. McClurg and Co., 1888.)

IN this neat and handy little volume we have a very interesting and intellectual collection of sketches and addresses more or less scientific. Some of the articles, which, as the author tells us, have been published before, have been freely retouched or re-written; but the papers on "The Dispersion of Fresh-water Fishes," "The Evolution of the College Curriculum," and the address on "Darwin" appear for the first time. The subjects treated are of various kinds, so that anyone who takes up the book will be sure to find in it something that will interest him. The appendix contains a list of the scientific papers of the author, and we hope it will not be long before we are favoured with another such book as the above.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

"Coral Formations."

SINCE writing the letter published in NATURE, March 22 (p. 488), I have checked Mr. Ross's figures. The result is somewhat surprising. Instead of 8400 tons of carbonate of lime removed from $12\frac{1}{2}$ square miles of lagoon representing a sheet half an inch thick, it really only amounts to a film of that area $\frac{1}{232}$ of an inch thick.

At this rate per annum it would in round figures take eighteen thousand years to dissolve out a lagoon a fathom deep, or a *million* years for the creation of a lagoon 60 fathoms deep. When we consider that this could only happen on the impossible assumption of the atoll remaining stationary for a million years, while no accumulation of coral sediment or organic calcareous growth took place in the lagoon, it is at once seen, on the showing of its own supporters, how impotent is the solution theory to account for the formation of lagoons in atolls.

To represent the figures in a familiar way, I may point out that the film removed annually would be a little less in thickness than one of the pages of "Prestwich's Geology." A volume of 36,000 pages (18,000 leaves), minus covers and well pressed, would be a fathom thick. No one acquainted with my geological work will accuse me of being parsimonious of geological time, but this is really beyond my mark altogether.

Mr. Irvine asks (NATURE, March 29, p. 509): "Can Mr. Reade give any observations or figures in support of his view of the rate of accumulation of oceanic calcareous deposits?"

If Mr. Irvine will refer to Mr. Murray's paper (NATURE, vol. xxii. p. 352), he will see that the pelagic life in a square mile of ocean water 100 fathoms deep is estimated by him to represent sixteen tons of carbonate of lime.

I am not aware of the length of life of such organisms, but if they lived on an average *only one day*, and the whole of their tests were rained down on to a submarine peak at the rate of sixteen tons per diem, *and none were dissolved by sea-water*, it would take twenty-nine years to accumulate 1 inch in thickness of solid carbonate of lime in this pelagic cemetery. In this way, if anything so improbable were to happen, a submarine peak half a mile below the range of coral growth might be levelled up into a suitable platform in 900,000 years. I could add much more, but respect for your valuable space bids me conclude.

T. MELLARD READE.

Park Corner, Blundellsands, April 3.

"The Dispersion of Seeds and Plants."

IN support of the views expressed in Mr. D. Morris's interesting article on the above subject (NATURE, March 15, p. 466), I beg to be allowed to state the following facts. In the Island of Porto Rico, the *Panicum barbinode*, called there "malojilla," has been cultivated for many years in the low humid lands, and it is a current opinion among farmers that it is reproduced by means of the animals feeding on it. Some fruit-bearing trees and shrubs, which are a favourite food for the wild *Columba leucocephala* and *Columba corensis*—among them the *Solanum stramonifolium*, the *Bucida Buceras*, the wild coffee, *Coffea occidentalis*, the palm-tree, *Oredoxa regia*—appear in some mountains and regions where they were formerly unknown, and there is no doubt that they have sprung from fruits and seeds transported by these pigeons. The *Anona muricata* (soursop), the *Anona reticulata* (custard apple), the *Carica papaya* (papaw tree), whose hard seeds are sometimes uninjured by the processes of mastication and digestion, are also believed to be planted accidentally by birds, and sometimes by hogs, horses, and other Mammalia. They grow all about in pastures where these animals are fed. The statement made about the orange-tree in Jamaica also holds good for Porto Rico. Very few orange-trees were planted in the interior of the country, and the tree is now wild in all that zone by the agency of birds in great part. There is no doubt, as Mr. Morris says, that birds and cattle have been the means of distributing plants all over the island.

ANTONIO J. AMADEO.

"Balbin's Quaternions."

NATURE of December 15, 1887 (p. 145), which has lately reached me, contains a notice of a treatise on Quaternions, by Prof. Valentin Balbin, in which the reviewer alludes to the "slight alterations" introduced into the notation of quaternions by Messrs. Houel and Laisant, and apparently visits them all with equal condemnation.

To me it appears that a distinction should be made between the two points in which the French notation differs from the English. The use of letters in different type to denote different kinds of quantities, the same type being always reserved for the same kind, seems to render the processes sometimes clearer and the results more immediately and easily available for students. In spite, therefore, of the ugliness of the black-letter symbols, it would not perhaps be altogether a loss if English mathematicians would adopt this part of the French scheme.

The other change introduced by M. Houel, that of the order of the factors, writing $q\,q'$ where Hamilton writes $q'\,q$, seems, on the contrary, to be an entirely retrograde step. That, as a rule, the symbol for the operator should be written before that of the operand, is a necessity in all modern symbolic processes. The alteration can only lead to confusion. In my "Text-book of Algebra" I have suggested that while the symbol $a \times b$

should be read, *a* multiplied by *b*, the symbol *a.b* or *ab* should mean *a* multiplied into *b*, so that $a \times b$ and *b.a* or *ab* are identical. Perhaps a compromise might be effected on this basis in the notation of quaternion multiplication.

The "unnamed French mathematician" who is quoted in the notice in question as asserting that quaternions have no sense in them, is stated by M. Laisant to have been M. Prouhet, and to have expressed this opinion in the *Nouvelles Annales de Mathématique* (1863, p. 333), in reviewing the first work published in French on quaternions, the author of which was M. Allégret. W. STEADMAN ALDIS.

Auckland, New Zealand, February 20.

Mr. Crookes and the Transformation of Heat-Radiations into Matter.

PROF. CLIFFORD, in the *Fortnightly Review*, June 1875, wrote as follows:—"But if the ether did absorb light, what would this mean? Vibratory motion of solids, which is really a molecular disturbance, is absorbed by being transformed into other kinds of molecular motion, and so may finally be transformed to the ether. There is no reason why the vibratory motion of the ether should not be transformed into other kinds of ethereal motion; in fact, there is no reason why it should not go to the making of atoms" ("Lectures and Essays," by W. K. Clifford, vol. i. p. 246).

Mr. Crookes, in his Presidential Address to the Chemical Society, March 28, brought forward a somewhat similar hypothesis, for he says:—"If we may hazard any conjecture as to the source of energy embodied in a chemical atom, we may, I think, premise that the heat-radiations, propagated outwards through the ether from the ponderable matter of the universe, by some process of Nature not yet known to us, are transformed *at the confines of the universe* into the primary—the essential—motions of chemical atoms, which, the instant they are formed, gravitate inwards, and thus restore to the universe the energy which otherwise would be lost to it through radiant heat."

The hypotheses will be seen to be exactly alike, except for the speculation introduced by Mr. Crookes of the transformation taking place "at the confines of the universe." What do we know of the confines of the universe? Nothing. Are we *now* to begin building up hypotheses on such foundations—foundations concerning which we know nothing, and are not likely to know anything *for some time*? HUGH GORDON.

Royal Institution, March 31.

Green Colouring-matter of Decaying Wood.

MR. IRVING writes (p. 511): "After an examination of thin sections" of the decaying wood "with the microscope, I am unable to trace this to any saprophytic organism."

I have at the present time a coccus, I suppose, growing on the surface of nutrient gelatin, which is stained a beautiful green, highly fluorescent, by the colouring-matter absorbed by it from the micro-organisms. The cultivation is in a test-tube of nutrient gelatin inoculated by scratching the surface of the gelatin with a needle which had been rubbed on a colony, isolated by plate-cultivation, and obtained from a bad water.

The growth, a greenish-white, is entirely on the surface—so entirely that the scratches made in inoculating the gelatin are still visible, three weeks after the inoculation, and the gelatin is perfectly transparent.

Under these circumstances it is quite certain if I made sections of the green gelatin no micro-organisms would be found in them.

It may be that the decaying wood is stained in the same way by colouring-matter absorbed by the sap or the moisture of the wood by micro-organisms growing on its surface.

It is a fact, I believe, that the colouring-matter formed by chromo-genic micro-organisms does not reside in their structures but in the interspaces between them, so it would naturally be absorbed by any solvent they were in contact with, while the organisms themselves might remain entirely on the surface, as they do in the case of my gelatin.

This may explain why Mr. Irving has failed to find micro-organisms in the sections he made. Further, if the colour of his green wood is caused by the same micro-organism which stains my gelatin green, it is a very small one, so small that, with a 1/15-inch oil-immersion object-glass, and a No. 12 compensating eye-piece of Zeiss, I find it very difficult to decide what shape it is, but I think it is not spherical.

I think Mr. Irving will find references to the literature of chromo-genic micro-organisms in Crookshank's "Manual of Bacteriology." HENRY ROBINSON.

The University Chemical Laboratory, Cambridge.

Comet *a* 1888 (Sawerthal).

I SAW comet Sawerthal to-day at 3.40 a.m., with power 20 on a 4¼-inch refractor. It was about 50′ immediately below θ Pegasi, and had a bright broad tail, which I could only distinguish to a length of 65′, on account of the twilight, moonlight, and the comet's low altitude. I thought the tail was slightly curved, concave to south; it pointed on the average to a little above ν Pegasi, or at a position-angle of about 260°. The total light of the head was considerably fainter than θ Pegasi, and considerably brighter than ν, so that it would be from 4 to 4½ mag.; but owing to the unfavourable conditions I could not see it with the naked eye. T. W. BACKHOUSE.

Sunderland, April 3.

THE HITTITES, WITH SPECIAL REFERENCE TO VERY RECENT DISCOVERIES.[1]

II.

THE monuments at Boghaz-Keui and Eyuk are on the east of the River Halys; and it seems doubtful whether there is evidence that the country inhabited by the Hittites extended much, if at all, beyond a line drawn from Sinope on the Euxine to the most westerly bend of the Halys, and continued through the peninsula to the Mediterranean. No doubt sculptures with Hittite characteristics have been found further to the west, as at Giaour-kalessi, in Phrygia, and at Karabel, near to Smyrna and to the coast of the Ægean; but as yet it does not appear certain that these sculptures denote permanent occupation, or that they are more than monuments of successful military expeditions. The Euphrates may be taken as marking vaguely the eastern boundary of the Hittite land. To the south, in Syria, the Hittite country certainly extended as far as Kadesh, a site on or near the present Lake of Homs.

It is with the inscriptions and the engraved seals found in, or connected with, the district I have indicated that Hittite researches are mainly concerned. The few characters on the monument at Karabel are too far obliterated to be, for the present, of much importance. In 1812, Burckhardt visited Hamah, the ancient Hamath, in Syria. He saw in the corner of a house in the bazaar "a stone with a number of small figures and signs, which appear to be a kind of hieroglyphical writing, though it does not resemble that of Egypt" ("Travels in Syria," Lond., 1822, p. 147). But, as Dr. Wright remarks, "so little interest was taken in his discovery, even by professional explorers, that Porter, in Murray's 'Hand-book,' so late as 1868, declares 'there are no antiquities in Hamah'" ("Empire of the Hittites," 2nd ed., p. 1). There were, however, other inscriptions at Hamah besides that noticed by Burckhardt, and the stone bearing one of these was supposed to possess mysterious properties, efficacious for the cure of spinal disease, so that "deformed persons were willing to pay for the privilege of lying upon it, in the hope of a speedy cure" (Burton and Drake, "Unexplored Syria"). After sixty years, or nearly so, from the time of Burckhardt's discovery, attention was called to the Hamath inscriptions, first by Mr. J. A. Johnson, United States Consul at Beyrout, and subsequently (1872) by Capt. R. F. Burton and the late C. F. Tyrwhitt Drake, in the work just quoted. In 1872, however, Dr. Wright was successful in obtaining casts of the Hamath inscriptions, while the originals were trans-

[1] Based on Lectures delivered by Mr. Thomas Tyler at the British Museum in January 1888. Continued from p. 514.

mitted in safe custody to Constantinople. The arrival of Dr. Wright's casts in this country was naturally followed by attempts at the decipherment of the hieroglyphics, though some of those who made these attempts had previously concerned themselves with the imperfect representations given by Burton and Drake in the work already mentioned. About the same time (1872) attention was called to the inscription then existing at Aleppo, but since unfortunately destroyed. Not very long afterwards an interesting bas-relief at Ibreez, in Lycaonia, accompanied by an inscription, was brought anew under notice by the Rev. E. J. Davis; and in 1876 Prof. Sayce observed with reference to this inscription, "The Hamathite hieroglyphics appear to have been an invention of an early population of Northern Syrians. Their occurrence in Lycaonia is probably due to Syrian conquest." Still later, and in view of the sculptures of Boghaz-Keui and Karabel, together with other monuments, Prof. Sayce took a much wider view, extending Hittite presence and influence through Asia Minor. Not long after taking this more extended view of the Hittites, the same scholar made a discovery of no small importance with regard to the decipherment of the inscriptions: I allude to the discovery that certain characters on the seal of Tarkutimme were Hittite hieroglyphics (*Academy*, August 21, 1880). The true nature of these hieroglyphics had not been previously seen, though, together with the cuneiform inscription round the circumference, they had been discussed by the late Dr. Mordtmann.

The history of this now celebrated seal is certainly remarkable. About the year 1860, a convex silver plate bearing the inscriptions just alluded to was presented for sale at the British Museum. Doubt was entertained concerning the genuineness of this silver plate as an antiquity, and the purchase was declined, though an electrotype copy was made and preserved. On account of the prolonged interval which has elapsed, the precise ground of doubt is not now altogether clear. It seems not unlikely, however, that the decision as to the spuriousness of the plate was arrived at after several considerations had been duly weighed. The silver of the plate may have seemed too well preserved for an object of so great antiquity, unless, indeed, it had been in some special manner sealed up and protected in a vase or other receptacle. Then the character of the engraving was probably regarded as inconsistent with the idea of its having been cut originally in silver, and especially in a comparatively thin silver plate, the engraving being rather that of stone, on which material, indeed, a seal was much more likely to be engraved. And another important fact, as agreeing with this view, is a flaw which appears on the right hand of the central figure, and which suggests the fracture or chipping of stone rather than the abrasion of metal. On these grounds, probably, the conclusion was arrived at that the plate was not a genuine antiquity.[1] Most likely it was a cast or electrotype from an ancient stone seal, this seal having been retained by the discoverer—whoever he may have been—with the view of obtaining eventually a larger profit by its sale. Proceedings of this kind are not unknown at the Museum. But where the original seal then was, or now is, has never been known; and the silver plate offered at the Museum has likewise disappeared from view. But this disappearance is of little importance to science, if the genuineness of the inscriptions can be fully proved.

In favour of this genuineness it must be urged as improbable that any from among the few Assyriologists who were to be found in Europe nearly thirty years ago would have co-operated in forging the seal. Moreover, there are two difficulties in the way of believing in such a forgery. First, the cuneiform legend has peculiarities which distinguish it from any other known type of cuneiform writing, as was observed by Dr. Mordtmann. Then there is an interspace over the head of the standing figure, which might seem, at first sight, to be interposed between the beginning and end of the cuneiform legend. It occurs, however, in the middle of a word. For this interspace a possible reason may be derived from the recently-discovered Yuzgât seal; but its occurrence does not suggest the idea of forgery by a scholar conversant with the cuneiform characters. Supposing, however, that these difficulties are put aside, there remains the much stronger argument furnished by the characters in the central space, which are certainly Hittite. Now, and for some time past, great interest has been displayed in relation to Hittite inscriptions; but in and about the year 1860 the case was far otherwise. There was then no temptation to forge these Hittite inscriptions on the seal, even if it had been possible to do so. But it may be doubted whether at the time in question it would have been possible to find and bring together the various Hittite characters. Besides, it is not difficult to discern a concinnity and agreement between the cuneiform and Hittite adverse to the idea of forgery, and consistent only with the opinion that the seal is, with its inscriptions, a veritable bilingual.

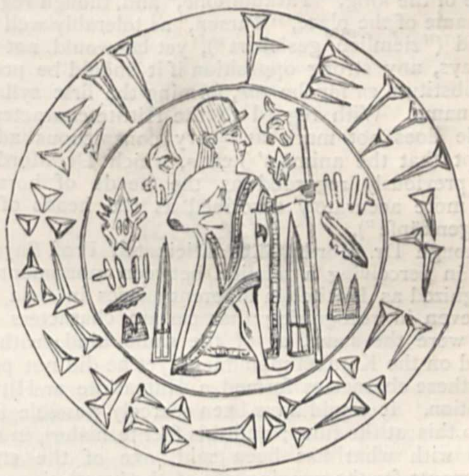

FIG. D.—Bilingual seal of Tarkutimme (enlarged).

About the time already mentioned (1860), Dr. Mordtmann examined at Constantinople a convex silver plate, then in the possession of M. Jovanoff, probably the identical plate which was offered at the British Museum. Concerning this plate, Dr. Mordtmann wrote, with date "Constantinople, December 6, 1861," a contribution to Grote's "Münzstudien," entitled "Sceau de Tarkoumdimmi, roi de Tarsous"; the designation "Tarkoumdimmi, roi de Tarsous," being Dr. Mordtmann's reading at that time of the cuneiform inscription on the seal. He noticed also, very appropriately, the resemblance of the name on the seal to the names Tarcondimotus, Ταρκονδίμοτος, as found in Tacitus, Strabo, and Dio Cassius, names employed to denote a father and son, Cilician kings who reigned in the time of Augustus. Dr. Mordtmann mentioned, also, that Plutarch gives, instead of the longer form, the shorter name Ταρκόνδημος, a name approaching still closer to that on the seal, expressing, however, at the same time the opinion that the king to whom the seal belonged was of much earlier date.[1] As to the name of the place mentioned, Dr.

[1] The decision arrived at was probably in accordance with the view of Mr. Ready, who then was, as he still is, at the Museum. What has been said as to the style of engraving and the fracture was, most likely, suggested by him at the time, though he cannot now recollect the details of the matter.

[1] Prof. Sayce has called the seal "The Boss of Tarkondemos." But I do not see how in any way the seal can be suitably designated a "boss." And, even if it be conceded as certain that "Tarcondemos" represents the name given on the seal, still it is a Græcized form which cannot be used with propriety to denote a king who, according to Prof. Sayce's view, probably lived some 700 years B.C.

Mordtmann seems to have been first inclined to give *Zousous*, but, as no other authority for such a name could be found, he changed this conjecturally for *Tarsus*.

The Hittite characters Dr. Mordtmann regarded as, on the whole, emblems of the country, with its productions, over which the king ruled, and not as forming inscriptions, or an inscription. He made, however, some important observations with regard to the relation of these characters, as well as the figure and equipment of the king, with what was to be seen on other monuments. The boots with turned-up toes were found also at Boghaz-Keui, Eyuk, and Eregli, in Cappadocia ("Les Monuments d'Uyuk, de Bogaz-keuy, et d'Éregli, en Cappodoce"), as well as on the monument at Karabel, near Smyrna. The dagger was to be seen at Boghaz-Keui, and the spear at Karabel. The figure at Karabel, also, was without a beard, like that on the seal. At Karabel, too, were the same characters found between the head and the spear.[1] The accoutrements of the king were like those of the Cilician soldiers in the army of Xerxes, as described by Herodotus (lib. vii. ch. 91).

About ten or eleven years later, Dr. Mordtmann returned to the seal, and discussed it in the Journal of the German Oriental Society (*Zeitschr. d. deutsch. morgenländ. Gesellsch.*, vol. xxvi. p. 625). He then gave, as the name of the king, "Tarkudimme," and, though regarding the name of the place, "Tarsun," as tolerably well ascertained ("ziemlich gesichert"), yet he would not make, he says, any strong opposition if it should be preferred to substitute *zu* for the *tar*, forming the first syllable of this name. With regard to the Hittite characters, this article does not mark any very conspicuous advance, except that the animals' heads, which Dr. Mordtmann had previously regarded as the heads of horses, he now more accurately described as the heads of goats "Ziegenköpfe").

Though Dr. Mordtmann anticipated Prof. Sayce, not only in perceiving a relation between monuments (now recognized as Hittite) in different places in Asia Minor, but even in recognizing that certain characters on the seal were the same, or of the same kind, with those found on the Karabel monument, yet he did not perceive that these characters formed a Hamathite or Hittite inscription. It would have been scarcely possible for him to do this at the time; and this fact furnishes, in accordance with what has been said, one of the strongest arguments for the genuineness of the inscriptions on the seal. It was reserved for Prof. Sayce to detect that the seal presented a true bilingual, Assyrian and Hittite (*Academy*, August 21, 1880).

Although, as already stated, the Assyrian characters have peculiarities which distinguish them from any type of cuneiform writing otherwise known, nevertheless, with the exception of one important character, there is a tolerable agreement as to the way in which the Assyrian inscription is to be transcribed and read. If we begin with the first character after the vacant space over the king's head, this inscription, it seems to me, may be read thus:—

-me-e ▌ *Tar-ku-u-tim-me sar mat Zu-*

But if we begin, as we certainly ought to do, with the vertical wedge standing before the king's name, and denoting that the name of a man follows—represented here by a vertical black line—we have:

▌ *Tar-ku-u-tim-me sar mat Zu-me-e.*
"Tarkutimme king of the country of Zume."

The precise pronunciation of the second dental in the royal name it is impossible to determine with certainty. Some might prefer to read "Tarkudimme." But this is not of very much consequence. The difficulty to which I have adverted relates to the first character in the name of the country—the character immediately before the vacant space over the king's head. Prof. Sayce reads this as *er*, and gives as the name of the country *Er-me-e*, "Erme." To me the probability has seemed that the character should be read *su* or *zu*, the alternative reading which had been suggested by Dr. Mordtmann.[1] Certainly, with the reading *su* or *zu*, a symmetrical rendering of the Hittite inscription can be given, but with *er* this seems scarcely possible.

On comparing the spaces on the one and the other side of the figure of the king—for certainly this figure must be intended as a portrait of King Tarkutimme—it will be seen that the characters are repeated, though apparently with some variations in size and in the order of sequence. But these variations may be accounted for, if the exigencies of the space at the engraver's disposal are considered. On the left side of the king there is the greater space, and a division is effected by the king's arm and staff or spear. Consequently, in decipherment, the order observed on this side would seem to furnish the more satisfactory guidance. We may reasonably begin at the top, with the two characters above the king's arm; and these, it can scarcely be doubtful, represent the royal name Tarkutimme, inclosed and shut off as they are from the rest. How the name is to be divided between the two characters may seem not quite clear. Does the upper one denote *Tarku* and the lower *timme*, or should we divide *Tar-kutimme?* There are grounds on which the latter view seems the more probable. The Hittite hieroglyphics may possibly have been used by non-Semitic peoples, but at present the balance of evidence seems to be in favour of a Semitism more or less pure. On the Semitic hypothesis, and with the unequal division last given, both elements of the name admit of tolerably easy explanation. The first character seems certainly to be the head of a goat. There is little difficulty, in accordance with well-known vocal changes, including the substitution in Aramaic of *t* for *s*, in understanding how *tar* may represent the Hebrew *se'ar*, *sa'ir*;[2] and the second character likewise may be reasonably explained.[3] Beneath the arm is a tall cone which must certainly represent "king." This may be argued from the character being placed close to the king on both sides, as well as from its position on his left side immediately under the characters representing the royal name. It

[1] "Les mêmes caractères verticaux entre la tête et la lance que nous voyons figurés sur le sceau près de la main qui tient la lance et de l'autre côté près du grand obélisque." If anything more was intended than *characters of the same kind*, there seems to be a mistake.

[1] This conclusion was arrived at when, in 1880, my attention was first directed to the seal; and I then consulted three well-known Assyriologists. One of these was Dr. Strassmaier, who still adheres to the opinion then expressed. The very large number of texts which he has examined in the interval, while preparing his laborious and comprehensive contributions to Delitzsch and Haupt's Assyriological Library, gives his opinion the greater weight. He bases his opinion on the convergence of the two smaller wedges towards the larger horizontal wedge: strict parallelism would have been required to give the value *er*. Dr. Haupt, now Professor of Semitic Languages at the Johns Hopkins University, gave, if I recollect rightly, the value *su* rather than *zu*. Mr. S. A. Smith, who is editing and translating the Assurbanipal texts, also gives his opinion in favour of *su*.

[2] We ought also to remember in this connection that Tarsus was the chief city of Cilicia. According to the oldest authority which we have for the name (the black obelisk of Shalmaneser), the city was called *Tar-zi*. That this city should be called after the goat can scarcely seem unlikely, if we recollect how famous Cilicia was for its goats with thick and long hair, out of which Cilician cloth was made—a cloth of which, according to some, St. Paul was a weaver.

[3] In his contribution to the "Münzstudien," Dr. Mordtmann spoke of this character as "un objet difficile à reconnaitre, mais qui ressemble au *pudendum muliebre*." And afterwards, in the *Z.D.M.G.*, he used similar language: "ein schwer zu bestimmendes Symbol, vermuthlich ein pudendum muliebre." Supposing this to be the object intended, there is no difficulty in understanding its bearing in a Semitic dialect the name *kutimme*. First, there is the Assyrian *katamu*, with the Arabic *katama*, "to conceal," connected with which the word would have a sense nearly equivalent to *pudendum*. But, having regard to what has been said on *tar*, it may seem that we ought to look to the Aramæan; and here we have *ketham*, "signavit," with a derivative, "*kuthema*," nearly identical in form with *kutimme*. In Gal. vi. 17 (Pesh.), *kuthema* is used in the plural of the στίγματα, which the apostle says he bore in his body. The transition from this sense is not difficult. Dr. Mordtmann's is the only probable explanation of the symbol. Special and local causes may account for its forming part even of a king's name.

may here be observed that there was at Aleppo a Hittite inscription which unfortunately has been destroyed, and which, though it had evidently suffered from the weather and time, was in several respects of great interest. From drawings which were made from it, especially by the late George Smith, we are able, however, to form a good estimate of its evidence with regard to the king-symbol. It presented a figure—no doubt of the person celebrated in the inscription—with a symbol similarly formed and similarly marked to that in the Tarkutimme seal.

The question here presents itself: In what order are the characters outside the staff or spear to be taken? Now in the Hittite inscriptions the *boustrophedon* manner of writing is observed. A line having been written from left to right, in the next the direction is reversed, and the writing goes back from right to left. This fact could not have been known to a forger in 1860, yet it is in accordance with this principle that our inscription is engraved. Having therefore read from top to bottom, we must go back, and read from the bottom towards the top. Accordingly we shall have to take next after the tall cone denoting "king" the smaller double cone. Prof. Sayce (apparently under the influence of Dr. Mordtmann's idea that the "deux petits obélisques réunis" owe their origin to the remarkable conformation of a certain district of Asia Minor) regards the double cone as denoting "country." But Dr. Mordtmann grouped these and the taller cone together, regarding all as of similar import. And, so far as their being of similar import is concerned, the conclusion seems to me inevitable. If, however, the

FIG. E.—"King"-symbol on Aleppo inscription.

taller cone denotes "king," the smaller cones, being of similar import, must denote "men." The tallness of the single cone is in accordance with the well-known ancient practice of denoting the greatness of a king by the greatly increased size of the figure representing him. It is true that, in accordance with Assyrian custom, the cuneiform legend gives "country." But whether a monarch is called king of a country or of the people inhabiting that country depends on local usage. "Queen of Great Britain" and "King of the French" are familiar contiguous examples in recent times. We may regard, then, the double cone as denoting "people," plurality being expressed by doubling the cone, and intensified probably by the numerous transverse marks.[1]

The symbol next above the double cone is, I believe, unique, no other example being found, so far as I am aware, on any of the inscriptions. To me it seems clear that this symbol is an ideograph of the country *Zume*. There are, it will be seen, on the lower side of the lower limb three projections, which may be reasonably regarded as representing mountains. The number *three* probably denotes a good many mountains. We may take it that Zume lay along the banks of a river or estuary with mountains on one side. A remarkable analogy is presented by one of the monuments in the British Museum from Jerablûs. We have here again the oval ideograph of "city,"[2] already mentioned in connection with the Boghaz-Keui bas-reliefs. Here again, as on the Tarkutimme seal, we have the three mountains, occurring in this case on both sides. The intention is, to indicate a city located in, or at the head of, a valley lying between mountains.[1] The name of the city is in all probability denoted by the other characters, to the reader's left, the doubled curve (the doubling denoting plurality) and what is probably intended for a tree beneath.[2] This twofold indication of the name, for the sake of clearness, is entirely in accordance with the usage of both the Assyrian and Egyptian monuments. And similar evidence might be adduced from more remote sources.

Thus a twofold indication of the name Zume in the Hittite inscription on the seal must be regarded as altogether probable; and it seems to me beyond reasonable doubt that the last characters, the four nearly vertical strokes, with one horizontal, express the name Zume phonetically. Dr. Mordtmann observed, with reference to these strokes, that it would be difficult to give them a phonetic value without regarding them as numerals, but that so to regard them would be fruitless in result. In this last remark he was, I think, in error. They are, in my judgment, numerals, though here used, not with reference to their numerical value, but merely as phonetic signs; and to show that they are to be so taken, the engraver has placed them at an angle, or, so to speak, tilted them up. The last character, the two vertical strokes with one horizontal, gives precisely the Assyrian symbol for 100, but written after the archaic manner, before the wedge-writing was introduced. *Me*, the Assyrian for "a hundred," is, moreover, precisely the value that we require here. *Zu* or *su* will then be the name for 2, the first character.

FIG. F.—Symbols from Jerablûs monument in the British Museum.

There is no great difficulty in connecting this with the Assyrian *sanu* 2, or *sunnu* ½, supposing that the *n* was slurred over in pronunciation and eventually dropped. And it must be remembered that, if those who made this seal spoke a Semitic dialect, there is no reason to suppose that this dialect was absolutely identical with any of the Semitic dialects otherwise known to us.[3]

It will be thus, I think, seen that there is a reasonable correspondence between this Hittite inscription and the cuneiform inscription round the circumference of the seal. It should be observed, too, that both with regard to the king and the country the phonetic designation is supplementary—in the first case to the portrait of the king, and in the second to the ideograph of the country. The inscription is mainly ideographic. It is important that this fact should be kept in view in the decipherment of other inscriptions.

With regard to the characters behind the king, or on his right side, it should be observed not only that the engraver had on this side a smaller space at his disposal, but also that he probably thought it necessary or desirable to place close to the figure the tall cone denoting "king."

[1] I have no hesitation in referring these cones to a phallic origin. This in early times would be regarded as a very natural way of representing "man"; and, like other designations of men, cones might easily come to denote both sexes, and a people generally.

[2] The ideograph is slightly broken on the monument.

[1] Dr. E. B. Tylor observes, "Map-making is a branch of picture-writing with which the savage is quite familiar, and he is often more skilful in it than the majority of civilized men" ("Early History of Mankind," p. 89). But of course the authors of these monuments were by no means savages.

[2] Having regard to the position of Jerablûs, where the monument was found, and to some other facts in relation thereto, I read the name conjecturally *Bamoth-elah*—that is, "Bamoth of the Terebinth."

[3] The two strokes similarly tilted up, and repeated occur on the monument in the British Museum mentioned just above (see Fig. F). With the same value as on the seal we should have *Su su*, or *Zu-zu*, a reading by no means improbable; but I cannot in this place discuss the matter further. Cf. Zuzim, Gen. xiv. 5, and Zamzummim, Deut. ii. 20.

That the two signs for the royal name are not engraved immediately above the cone may have resulted from the space above the king's right arm being too contracted. There is another change in the characters on the king's right side which is noteworthy. It will be seen that both the ideograph of the country and the numerals giving the name are inverted. On the left side of the king the characters were to be read from left to right of the reader, but on the right side they are to be read from right to left. This change is in accordance with the ***boustrophedon*** manner of writing previously mentioned, but it is a change which seems totally incompatible with the idea of forgery.

(*To be continued.*)

ELEMENTS AND META-ELEMENTS.

THE President of the Chemical Society, in his address at the anniversary meeting, has further developed views which he had already propounded in his address to Section B of the British Association at Birmingham, and in a subsequent Friday evening lecture at the Royal Institution. He would have us believe that the atoms of an element are not all precisely of one absolute pattern; that atomic weights, in fact, are not constants, as generally supposed; but that we must regard each element as a species of which many varieties exist almost infinitely more like unto each other than to the atoms of any other approximating species of element; and that what we term the atomic weight is but a mean value around which the actual weights of the individual atoms of the species range within certain limits. Could we separate atom from atom, we should find them varying in weight within very narrow limits on each side of the mean.

Mr. Crookes supports his arguments by a wealth of illustration culled chiefly from his own unique experience; and, whatever the ultimate intrinsic value to science of his hypothesis, there cannot be a question that the study of the transcendent problem of the nature of the elements will have gained greatly in fascination by its promulgation; that lines on which such study may be carried on will have been indicated; and that he will have lightened the inexpressibly wearisome labours of fractionation by casting around them the poetic play of fancy. The subject is of such importance that it appears desirable to consider the position which chemists may fairly take up, and from which it is permissible to criticize the arguments that have led to the suggestion of the existence of meta-elements.

Apart from the higher interest which Mr. Crookes has now infused into them, his researches on the rare earths will ever excite admiration in all who study them, as models of scientific investigation; and they will afford undying testimony to his determination and patience in search of truth, as well as to the incomparable fertility of resource in experimenting of which he is possessed. Among the individual observations are many of a most suggestive and striking character which, sooner or later, must claim attention; but it cannot be denied that the data are as yet insufficient for their exact interpretation. This is true also of Krüss and Nilson's remarkable observations; indeed, it may be questioned whether their results all admit of the absolute interpretation which they are inclined to put upon them. In the paper in which the omnipresence of samarium is demonstrated, in giving an account of the many anomalies which he encountered in his search for *x*—the substance characterized by an orange-coloured band in the phosphorescent spectrum, and which subsequently turned out to be samarium—Mr. Crookes tells us how he came to the conclusion that samaria (*x*), which of itself gave little or no phosphorescent spectrum in the radiant-matter tube, became immediately endowed with this property by admixture with certain other substances—lime, for example—which substances likewise of themselves had no power of phosphorescing with a discontinuous spectrum. Many substances were found effective; and there was a general resemblance between the spectra, but nearly all of them differed from one another in detail. Mixtures of samaria and yttria gave spectra differing to a very marked extent according to the proportions in which the two substances were present. All who take note of these observations must agree that they are of a most remarkable and significant character: they certainly leave no room for doubt as to the necessity of exercising the utmost caution in inferring the absence or presence of particular substances from spectral appearances and changes. Judging from Mr. Crookes's observations, and from our general knowledge of the rare earths, it would almost appear that they have the power to form double oxides akin to double salts, and the effect on the spectrum produced by associating one oxide with another may be compared with the somewhat similar effect of a solvent on the spectrum of a coloured substance. The part that such double oxides perhaps play appears as yet to have been left out of consideration. It is desirable also to take into account the possible presence of double salts, and of their influence on the spectrum, before deciding as to the bearing of Krüss and Nilson's observations.

Reference is made by the President of the Chemical Society in his address to Carl Auer's investigation of didymium. Now the differences between Auer's neo- and praseodymium—the reputed constituents of didymium—are very marked; but as yet unfortunately we have no information respecting their atomic weights. This is true also of the various reputed constituents of the rare earths studied by Mr. Crookes and Krüss and Nilson. Until such information be forthcoming, the suggestion that what is commonly regarded as the atomic weight of an element is but an average value, therefore, can only serve to direct attention anew to the extreme importance of the most exact and exhaustive study of atomic weights.

What is called yttria, according to Mr. Crookes (Proc. R.S., xl. 506) is a highly complex substance capable of being separated into several simpler substances, each of which gives a phosphorescent spectrum of great simplicity, consisting for the most part of only one line. Now, supposing that the several constituent meta-elements of ordinary yttria be found when isolated to differ almost imperceptibly from each other both in chemical properties and in weight, yet the spectral differences will admittedly be very marked—as marked perhaps as are the differences between elements which exhibit very diverse chemical properties and atomic weights; and it will be illogical to deny to these meta-elements the right to rank as elements proper—as distinct species, not mere varieties.

Why, then, does Mr. Crookes think it inadmissible in the elementary examination to open the doors so wide that the number of admissions will be limited only by the number of applicants? It is because he thinks that the periodic system of classifying the elements offers an insuperable barrier to this course. Undoubtedly, if this were granted, there would be little choice left us; but can it be granted? We think not. The scheme at present accepted is after all but a very imperfect and provisional classification. The successional order of the elements in the horizontal series is indeed determined in all cases in which the atomic weight is known with a sufficient approximation to truth; and in certain cases where the properties are clearly marked it is possible to assign the true position in the order of succession to an element even when the atomic weight is very inexactly ascertained; tellurium is an example, having been placed before iodine long ere its atomic weight was ascertained to be lower and not higher than that of iodine. But in arranging the elements in vertical series we have often great difficulty in determining which are true homologues: we have no difficulty in grouping the alkali metals, the halogens, or sulphur, selenium and tellurium, but how are we to place copper, silver and gold, for example? Are we justified in regarding them as true homologues, and in inserting them as intermediate terms in the group of the alkali metals? Ought we not rather to look upon them as but pseudo-homologues, and ought we not to place them apart from the alkali metals, and apart even from each other in vertical succession? This would lead us, instead of classifying the elements in linear vertical series, to arrange them in pyramidal groups, of which the elements of lowest weight form the summits. In fact, there is no justification whatever for the conclusion that the elements belong to only eight families; the most illiberal treatment leads us to recognize at least twelve, and there is no reason to accept this as the limit. We can thus foresee the possible existence of a far larger number of elements than is at present known, differing probably from each other to a marked extent both in atomic weight and properties. But even then the limit is not reached. Those who have classified the elements according to the periodic system, after all—consciously or unconsciously—have but followed the practice adopted in classifying carbon compounds; and if we consider the results arrived at by the study of hydrocarbons, and apply the conclusions to the elements, there appears to be no difficulty in finding place for a far larger number of meta-elements than even Krüss and Nilson would require to accommodate their host of new claimants for elemental rank. If we arrange homologous hydrocarbons side by side in the order of molecular weight, a scheme corresponding to that devised for the elements will result; but, if molecular weight only be considered, the existence of isomeric hydrocarbons escapes notice: if, however, isomers are included, each simple vertical group at once assumes a pyramidal form. In like manner, if the possible existence of isomeric elements be granted, the periodic scheme would admit without difficulty of the existence of a still larger number of elements even than was above indicated.

Nickel and cobalt have often been supposed to be isomeric elements. According to the most recent determinations of their atomic weights, however, cobalt has a higher weight (58·74) than nickel (58·56); but this result is discredited by the fact that cobalt is usually placed before nickel in the periodic scheme, and should therefore have the lower weight, unless the two elements are isomeric.

Whether among the meta-elements of the rare earths there are not numerous cases of isomerism, remains for the future to determine. Unless, however, some new mode of discriminating other than that involved in determining the atomic weight be introduced, the problem is one which appears beyond our present powers, as experimental error cannot be entirely eliminated. But it is perhaps of all the problems in chemistry the most important to solve, on account of its bearing on the higher problem whether the elements are simple or compound substances. So many converging lines of evidence now render it probable that the elements are compounds that the discovery of isomeric elements would probably suffice to carry conviction to the minds of all who are open to argument on this question. H. E. A.

THE DURATION OF LIFE.[1]

JOHANNES MÜLLER, the celebrated German zoologist, said: "All organic beings are transitory; life passes from individual to individual with the appearance of immortality, but the individuals themselves perish." This proposition is perhaps not so true as it seems to be. Nevertheless, it is certainly true that life has its natural limits, at least in all those animals and plants that ordinarily come under the notice of the layman. But the duration of life is very different in different animals, and it would be interesting to know the reason of this. Differences in length of life have been thought to depend on differences in structure and composition. Obviously the size of an animal will fix a certain minimum of time required for growth: owing to the relation between increase of bulk and increase of absorbent surface, pointed out by Leuckhart and Spencer, a larger animal will require a longer time to secure the surplus of nutriment required for reproduction. The degree of structural complication will also fix a minimum time: the activity of the vital processes, the rate of metabolism,—*because it influences the time at which reproductive power, the goal of individual life, is reached*—will influence the total duration of life. But these inner conditions do not fix the duration of life. Birds, whose vital processes are so rapid, may far surpass in age the sluggish Amphibia. Among ants, the males, females, and workers are practically identical in size, complication of structure, or rate of metabolism; yet the females and workers live several years, the males only a few weeks.

We must seek in the environment for the forces finally determining the duration of life. We find the length of life to be in each case an adaptation arranged by natural selection in the interests of the species. So soon as an individual has produced young enough to fill up the gaps caused by death, it ceases to be of use for the species. Where fostering of the brood obtains—be it uterine or post-uterine—we expect and find a longer duration.

The apparently accidental causes of death remove far more individuals than natural death. The longer an individual lives the more chances of accident does it undergo; *and so selection, acting in the interests of the species, rather than prolonging the life, hurries on the time of reproduction.* At first, it seems impossible that the great age reached by many birds (Raptores may survive their century) is the shortest possible. But the enemies of the eggs and of the young of birds are very numerous. The death-rate is enormously greater than in the case of mammalian embryos developing within the parent. Adaptation to rapid flight precludes great fertility. Bad fliers like the *Phasianidæ* lay many more eggs in a season and live through far fewer seasons.

The adaptation is very clear in the case of the larval life of insects. The larvæ of bees and of many ichneumons placed in the midst of an abundant food supply become pupæ in a few days. The larval stage of predacious larvæ which have to waste time and energy in securing their prey, and of vegetable-feeding larvæ, on account of the less nutritious nature of their food, lasts very much longer. The usually short life of the imago bears no relation to the length or shortness of the larval life, but is directly adapted to its own purposes. In the simplest case, where copulation takes place as soon as the wings are dried, and where the eggs are deposited rapidly and carelessly, the whole adult life lasts but a few hours. Where the mate has to be sought, or the eggs deposited in special conditions, or where active habits preclude simultaneous maturation of eggs, the duration of life is prolonged in correspondence with the special requirements. Adult insects are perhaps the most hunted of animals, and in them is found the extreme case of adaptive shortening.

The inner changes on which natural death depends are not very clear. They can hardly depend on cell destruction; for it is upon that that the processes of life are based. More probably they depend on a failure to produce new generations of cells to replace the cells broken down in the vital processes.

The occurrence of death at all is a provision to secure

[1] "Ueber die Dauer des Lebens." Von Dr. August Weismann. (Jena, 1882.)

the greatest possible number of contemporary individuals of full strength. Contact with the world wastes away individuals with here an accident to-day, there an accident to-morrow. The possession of immortality by the individual, while a doubtful boon to it, would be a harmful luxury to the speies. Death makes room for new, complete individuals. Death is, however, by no means a universal attribute of organisms. In unicellular organisms the single cell is at once somatic and reproductive, and, while liable to accidental destruction, is potentially immortal. The Protozoon divides without a remainder; and the life of each Protozoon alive to-day has descended in direct continuity from the life of the primordial Protozoon.

In the Metazoa a division of labour has separated reproductive cells from somatic, and their complexity, by admitting of mutilations short of destruction, has rendered them mortal. The reproductive cells had to remain capable of an indefinite number of generations lest extinction of the race occurred; but when the somatic cells became specialized, there at once arose the possibility and the necessity of a limit to the number of generations.

It is clear that the size of an individual is an inherited property. Conditions of nutrition can only negatively determine growth. No superfluity of nutrition could build up the framework of a dwarf into a giant. Natural selection acting on variations has fixed the average size of individuals. It has in fact fixed the space limits of cell reproduction, and could have equally well fixed the limits in time—the duration of life—of individuals. There is a continuity of life from organism to organism through the divisions of the immortal germ-cells. The somatic cells arising from the germ-cell in each generation possess a limited reproductive capacity, and the limits are fixed by natural selection for each species so as to maintain the greatest possible number of contemporary individuals of full vigour.

P. CHALMERS MITCHELL.

NOTES.

THE French Association for the Advancement of Science has had a successful meeting at Oran, in Algeria. M. Laussedat, the President, chose as the subject of his address the civilizing influence of the sciences. This was the second meeting of the Association in Algeria, the first having been held in 1881.

THE nineteenth annual Conference of the National Union of Elementary Teachers was opened at Cheltenham on Monday. The President, Mr. Pope, in his inaugural address, spoke bitterly of the existing system of elementary education, which he denounced as a "failure." On Tuesday, the same tone was adopted by the Rev. E. M. M'Carthy, of King Edward's School, Birmingham, who read a paper to show that the system violates two of the fundamental principles of true education. Those principles are: (1) that the course of studies laid down for each stage should be in harmony with, and adapted to, the natural development of the individual child's mind and body; and (2) that all educational processes should develop faculties so as to produce habits of ready and accurate thinking, besides furnishing the mind with knowledge for use and imparting mechanical skill in the use of it.

PROF. KIEPERT, of Berlin, will start immediately on a journey of research in Western Asia Minor. He will be accompanied by Dr. E. Fabricius, the archæologist. The journey will last three months.

ON Easter Monday, 12,374 persons visited the Natural History Museum, South Kensington. The number of visitors on the corresponding day last year was 6570.

THE Report of the Meteorological Council for the year ending March 31, 1887, which has recently been issued, shows that at that date observations were being taken for the Office on 143 ships, exclusive of the vessels of the Royal Navy, all of which are supplied by the Council with instruments, although the keeping of a special meteorological log is optional. The work in hand by the marine branch is: (1) the completion of the synchronous charts of the North Atlantic; (2) a discussion of the meteorology of the Red Sea; (3) current charts for the Atlantic, Pacific, and Indian Oceans; (4) charts of the Aden cyclone of June 1885. In order to discover the cause of this storm and of its unusual course across the Arabian Sea, synchronous charts of the North Indian Ocean for the month of June are being prepared. In the weather branch, forecasts are drawn three times a day. A comparison of the results of the 8 p.m. forecasts gives 81 as the total percentage of success. Hay harvest forecasts were issued to some selected stations, as in previous years. Storm-warning telegrams are issued to 141 stations; the trans-Atlantic messages appear to have been of no practical value for the purpose of these warnings—rather the contrary, as they have occasionally caused the premature issue of warnings to our coasts when no storms followed. The principal changes in the climatological branch have been the erection of self-recording anemometers at Fleetwood and North Shields, and of an electric anemometer at Valentia Island, but unforeseen difficulties have hitherto prevented this from being brought into operation. The Report contains a table showing the distribution of gales round the coasts of the British Islands during each month for the fifteen years 1871–85.

M. L. CRULS, the Director of the Imperial Observatory at Rio de Janeiro, has made an appeal to all meteorological observers for assistance in the compilation of a "Universal Climatological Dictionary," which is intended to comprise, in a methodical form, the principal meteorological elements from as many stations as possible over the whole globe. The data asked for are the mean monthly and yearly temperatures, together with the monthly maxima and minima, and the dates of the yearly absolute extremes; the relative humidity, amount of cloud, rainfall, number of days of rain, thunderstorms, and frost, and the prevalent wind, in each month; the mean annual height of the barometer, and its mean annual oscillation. The work proposed by M. Cruls would be very useful, as, although information already exists for a great number of stations, it is dispersed in many different publications, and is expressed in different measures, so that comparisons are difficult. Details relating to the meteorological elements of his own country especially are much wanted.

IN the *Annales du Bureau central météorologique* of Paris for 1885, vol. i., M. Renou has discussed the rainfall of Paris for the last 200 years. The observations were begun in 1688 by Lahire. At that time the Observatory was outside Paris, some distance to the south, but it is now in the midst of a district surrounded by high buildings. It is a curious fact that soon after Leverrier assumed the directorship he planted some trees near the rain-gauge, which in time affected its readings; these trees were afterwards cut down by Admiral Mouchez. The rainfall seems to have undergone some changes in this long period. At the time of Lahire there was a marked maximum in July; now there are two less marked maxima in June and September. The number of rainy days amounts on an average to 169. Snow occurs very irregularly, but it is never entirely absent in any winter. The heaviest rainfall in a short period was on the 9th of September, 1865, which yielded over 2 inches on the terrace of the Observatory in 2¼ hours; the gauge on the ground overflowed.

WHILE studying the laws of dissolution of salts, M. Umoff came to the following correlation, which seems not to have been yet remarked, and which he communicated in a paper in the Memoirs of the Odessa Society of Naturalists (vol. xii. 1). For potassium chloride, bromide, and iodide, as also for natrium iodide, the weights of salt necessary to saturate a given amount of water at 100° C. are proportionate to the cubes of densities of the respective anhydride salts; while for sodium chloride the same law is true with regard to the saturation weights of water at 0°. The saturation-weights of potassium chloride and natrium iodide at 100° being the double of what they are at zero, they belong simultaneously to both groups.

M. LINDELÖF has contributed to the Proceedings of the Scientific Society of Finland (tome xvi.), a paper on the trajectory of a body moving over the earth's surface under the influence of terrestrial rotation. The author considers that the explanation of the movements of atmospheric currents, for instance, as generally given, is far from sufficient, and leads to inexact ideas. The paper is divided into four parts: the first three deal with the equations of the different movements of a body, and with the forms taken by the trajectory; in the fourth part the theory is applied to the calculation of the passage of the atmospheric wave observed after the Krakatão eruption in August 1883.

PROF. W. BRÖGGER lately submitted to the Swedish Geological Society an account of the work done by the Committee appointed for the purpose of obtaining reports on earthquakes occurring in Sweden. It was decided that trustworthy reporters should be appointed in all parts of the country, and that a number of inexpensive seismographs should be purchased. At the same meeting Baron Nordenskiöld exhibited a new silicate of lead from the Harstigs Mine, in Värmland. Among recent papers of special interest published by the Society is one on the meteors observed in Sweden in 1887, by Dr. Svedmark.

AT a recent meeting of the Seismological Society of Japan, reported in the *Japan Weekly Mail* of February 4, Prof. Milne read a paper on earthquake sounds. These frequently precede the shock, are often heard during its progress, and sometimes have been heard after the earthquake proper has ceased. Their character is very varied, from a low, barely audible rumbling, to a loud rattling, like a cart on a stony street, or a volley of musketry. They are heard better in some districts than in others; better probably where the earth's structure is hard and solid than where it is loose and soft. After discussing some of the explanations that have been given, Prof. Milne suggested that there is a close connection between these sounds and the smaller vibrations which invariably precede the shock proper. He had counted as many as seven per second of these sinuosities, and we are warranted in assuming the existence of still smaller and quicker vibrations preceding even these. With more delicate seismographs we might be able to catch the very early infinitesimal movements that herald the approach of an earthquake. With thirty or forty vibrations per second we should have an audible note of very low pitch. It was suggested in the subsequent discussion that as seismographs show a tail-end of sinuosities very similar to the initial ones, we should expect to hear sounds succeeding as often as preceding an earthquake.

THE Report of Mr. Cautley, the Acting-Consul at Trieste, on the forests of Austria, just issued by the Foreign Office, says that perhaps Austria has a larger proportion of forest in comparison with its area than has any other country. The woods cover about 3,500,000 acres, of which 80 per cent. is timber forest, and the remainder of young growth. The Government and the large land-owners own 69 per cent. of the total forest area, the parish authorities 20 per cent., the clergy 5½ per cent., and peasants about 1½ per cent. The forests are, in fact, the principal source of wealth to Austria, and, calculating the cubic contents of all the timber, and reckoning each cubic foot at nine-tenths of a penny, the wealth of the whole country in this respect may be set down at close on £40,000,000 sterling. The yearly increase in the value of the forests is said to be over half a million sterling.

IN the *Zoologist* for April, Mr. Postlethwaite, of Hallthwaites, Cumberland, states that, last autumn, while netting for salmon in the Duddon Estuary, fishermen brought to the surface some massive horns of the red deer. One pair, with the skull attached, must have had at least fifteen points; the length of one horn is 40 inches; the distance apart at the top of the horns, 42 inches; the circumference of the burr, 11 inches. In another case, a skull was recovered with only a portion of one antler attached; and of a greater size than in the previous example. The horn is broken just above the third tine, the length from the base being 14 inches; the length of one tine, 13½ inches; and the circumference of the burr, 10½ inches. A scapula was dredged up and brought to shore at the same time. The weight of each of these specimens was great, the first-named being as much as a man could comfortably carry. Similar horns were found some years ago, and in the neighbouring estuary of the Esk at various times many such antlers have been discovered, most of which are preserved at Muncaster Castle. Mr. Postlethwaite adds that the channel of the Duddon is shifting and running close into the sides of an old peat moss, from which it seems not unlikely that the horns have been washed. In an editorial note appended to this interesting communication it is suggested that the animals which possessed these fine horns may have been wanderers from the great forest of Bowland, in Lancashire, where red-deer lingered until the early part of the present century; and that they may have roamed over Martindale Fell, in Westmoreland, "where a few of their descendants are still preserved, a pleasing link of association with the past."

THE whale fishery in the Greenland seas and Davis Straits was very unprofitable in 1887. In an article on the subject in the current number of the *Zoologist*, Mr. Southwell says that whales are by no means exterminated. Capt. Gray saw fourteen of them in Greenland, and Capt. Adams is reported to have seen seventeen in Davis Straits; but, from long persecution, they are now "simply unapproachable."

THE French Consul at Bilbao states in a recent report that the pilchard or sardine fishery on the Atlantic shores of the northern portion of Spain proved in 1887 a most disastrous failure. During the three months of June, July, and August, which are generally the most abundant in the year, nothing was caught but sardines far too large for the boxes commonly used in the trade. The amount taken in 1886 was 1650 tons, and during the corresponding months in 1887, it was only 790 tons. This large falling off is supposed to be due to the fact that the fish do not find the food they require on this coast, formerly one of their favourite habitats. Perhaps in a large measure it is owing to their having been driven away by the reckless system of fishing which has been adopted in the past.

THE Report of the Mason Science College, Birmingham, for the year ending February 23, 1888, has just been issued. The Chairman of the Academic Board testifies that, although the year was not marked by any new or striking developments in the educational policy of the College, or by any special additions to the existing curriculum of the subjects taught, the general progress of the College upon the lines laid down in previous years was eminently satisfactory. Not only was the total number of day students larger than in any previous year, but the increase affected, in varying proportions, nearly all the different departments. The year was also characterized by a marked increase in the number of systematic students. By "systematic" students are meant those who enter the College with the object of preparing for the various University or medical examinations, for technical diplomas, or for the Associateship of the College, or who are studying some definite subject with the view of teaching, or original research, or with regard to its practical application to manufacturing industries.

WE have received the Proceedings of the Royal Physical Society, Edinburgh, for the session 1886-87. Among the contents is an interesting Presidential Address, by Mr. John A. Harvie-Brown, on the faunal importance of the Isle of May, purely from an ornithological point of view.

WE have received the first part of what promises to be an admirable work—"An Illustrated Manual of British Birds," by Mr. Howard Saunders. The book will be completed in about twenty monthly parts. It is being issued by Messrs. Gurney and Jackson.

A TWELFTH edition of the late Dr. David Page's "Introductory Text-book of Geology" (Blackwood) has been issued. It has been edited by Prof. Charles Lapworth, who, in order to bring all the departments up to date, has found it necessary to recast or re-write almost the whole of the work, with the exception of the introductory and concluding chapters.

MR. HALY, Director of the Colombo Museum, has published a first Report on the Collection of Birds in that institution. It fills about eighty pages demy octavo.

THE new number (the third) of the American periodical—the *Technology Quarterly*—opens with a valuable account, by Mr. W. O. Crosby, of the methods of instruction in mineralogy and structural geology in the Massachusetts Institute of Technology. Mr. S. W. Hunt continues his discussion of the precision of measurements; and Mr. F. W. Clark contributes notes on the assaying of lead, silver, and gold.

THE Johns Hopkins University, Baltimore, has received from the Maryland Academy of Sciences a considerable portion of its scientific collection. Among the specimens is the skeleton of a young fin-back whale captured in the lower part of Chesapeake Bay. Stumps of cycads, which were presented to the Academy by Mr. P. T. Tyson, are also greatly valued. They were taken from the Upper Jurassic clays of Maryland.

ACCORDING to a communication by M. A. Pavloff to the Moscow Society of Naturalists, the meteorite which fell in August last at Okhansk, in Perm, is one of the largest yet known. Its weight, before it was broken, was about 1100 lbs. It belongs to the group of stony meteorites. As it contains particles of unoxidized nickel iron, it must be classified with the sporado-siderites. Its spherical mineral aggregates bring it under the heading of chondrites.

THE following extract from a private letter by a British officer, dated Sittang, Upper Chindwin, February 4, 1888, may be of interest to anthropologists:—"We have arrived here after eight days of hill-marching with very many ups and downs—the highest point just over 5000 feet. We are now completely out of Burma—the hills were sparsely inhabited by uncivilized Chins and Nagas—and are now in a small State, a plateau in the mountains at a level of nearly 3000 feet. The ruler and his people are Hindus by conversion or adoption some hundred years or less ago—the only example I know of Hindu proselytes. The Burmans are tattooed from waist to knee with a fine pattern in blue, looking as if dressed in short dark tights. They wear the hair long, rolled on the top of the head, and covered with a bright-coloured silk kerchief, put on somewhat as one sees in pictures of Negro women of the Southern States in America. The Shans, who were our neighbours in the hills near the Ruby Mines, wear very baggy trousers, like the Chinese, of coarse blue cotton stuff, have uncut hair, and for a head-covering a hat, either of straw or a coarser kind of wicker, of colossal circumference. This hat is as big as an ordinary silk umbrella, but flat except in the middle, which is conical for the reception of the top-knot, and as this might sometimes prove an insecure hold they often wear a fastening under the jaw. They tattoo more extensively than the Burmans, and sometimes stow away jewels under the skin. I have seen lumps which may have been so caused, from their appearance, but I never had the chance of proving their secretion by enucleation. The Nagas, whom we have used in the last few days as carriers, do not tattoo, and wear a skimpy kilt. The hair is uncut and coiled on the front of the head, the lump or coil of hair secured by a band round the base; the band often made of strings of blue beads or a tape of leather, on which two or three rows of small white shells are sewn. A silver or other metal skewer, about ten inches long, is often stuck through the hair, like the arrows worn by some belles of the West—whether only for adornment, or used as a fork or harpoon, I know not. All these savages have the ears pierced. The Naga carries his snuff in a bit of bamboo thicker than an ordinary lead-pencil; and the Burman, who smokes eternally, sticks his cigar *in* his ear-lobe—and his cigar is about the size of that Mr. Verdant Green was induced to smoke, of such calibre that it would not pass through a Colt's revolver barrel. The Nagas here are not tall, but their calves and thighs would attract attention even at a Highland gathering at Athol or Braemar. Their loads they carry with a neatly made neck-and-shoulder yoke. From the yoke in front is a brow-band, while behind a rope-loop passes under the load."

THE Students' Engineering Society of the University College, Bristol, concluded the winter session, on March 26, with a public disputation on the gas-engine *v.* the steam-engine, and on March 27 gave a *conversazione.* The electrical and engineering exhibits attracted much attention, and a highly appreciated concert was rendered by the students and their friends.

THE additions to the Zoological Society's Gardens during the past week include a Gannet (*Sula bassana*), a Greater Black-backed Gull (*Larus marinus*), British, presented by Mrs. Rickards; a Hawfinch (*Coccothraustes vulgaris*), British, presented by Mr. Chas. Faulkner; a Common Swan (*Cygnus olor*), British, a —— Penguin (*Eudyptes pachyrhynchus*, from New Zealand, deposited.

OUR ASTRONOMICAL COLUMN.

THE PERIOD OF ALGOL.—Mr. S. C. Chandler publishes, in Nos. 165, 166, and 167 of *Gould's Astronomical Journal*, a careful and thorough discussion of the period of this interesting variable. Starting with the observations of Goodricke in 1782, he had at his disposal the times of nearly 700 minima as observed by about fifty astronomers, spread over a little more than a century. His first task was to reduce these observations to a common system—an operation the more necessary, since, in the present low state of our knowledge, differences in the processes of reduction are more important in their effect, if they do not completely overshadow personal differences in observation. Mr. Chandler decided, therefore, to abandon the use of the minimum phase as a reference-point, and re-reduced the entire mass of observations on a method the essential principle of which consisted in taking, as the reference-point, the mean between the times of equal brightness on the descending and ascending branches of the light curve. This involved the abandonment of 199 minima, for which sufficient details could not be procured, but left 496 to be employed in the investigation. Unfortunately these are not by any means evenly distributed as to time, and in the earlier part of the present century satisfactory observations are very scarce.

That the period of Algol was itself subject to change was suspected by Wurm and proved by Argelander, but the formulæ deduced by the latter have not represented later observations. Mr. Chandler has succeeded, however, in reducing its apparently highly complicated anomalies to a comparatively simple law.

This law comprises two inequalities, with the periods respectively of 141·3 years and 37·7, and coefficients of 173·3 and 18·0 minutes of time. A third period of 17 years, with a coefficient of 3·5 minutes, was suspected, but the coefficient is so small as to bring it almost within the limit of errors of observation. The resulting elements are as follow: 1888 January 3, 7h. 21m. 29·23s. (G.M.T.) + 2d. 20h. 48m. 55·425s. E′ + 173·3m. sin. ($\frac{1}{50}$ E′ + 202° 30′) + 18·0m. sin ($\frac{3}{40}$ E′ + 203° 15′) + 3·5m. sin ($\frac{1}{6}$ E′ + 90° 20′); where E′ = E (Schonfeld) − 11210. The interpretation of the theory is as follows:—The period at the time of Goodricke's discovery of the character of the variation was 2d. 20h. 48m. 58·0s., lengthening to 59·8s. in 1798, diminishing again in the next ten years to 57·2s., and then again lengthening irregularly to 59·2s. in 1830. A rapid diminution shortly followed, and the rate was reduced to 54·0s. in 1843. After a halt a further but less rapid diminution set in, and in 1858 the period was 52·8s. The following six years saw an increase of 1·6s., followed by another shortening, until in 1877 the period had fallen to 51·1s., from which time it has remained nearly constant; but should the theory be correct, a period of increase must shortly set in, which, with halts and retrogressions, will attain a maximum somewhat late in the coming century.

The paper concludes with a table of heliocentric times of minima up to August 1898.

M. Oudemans, Director of the Utrecht Observatory, is likewise preparing a work on this variable, and requests observers to transmit to him copies of their notes on all observed minima since 1883.

OBSERVATIONS OF VARIABLE STARS.—Mr. Edwin Sawyer has given, in Nos. 164 and 165 of *Gould's Journal*, his observations of several variable stars made during the year 1886. The following table will show how some of these compare with the ephemerides given week by week in NATURE.

Star.	Phase.	Observed.	Calculated.
V Cancri ...	*M* ...	1886 March 29 ...	April 12
R Ursæ Majoris	*M* ...	1886 April 29 ...	May 12
R Virginis ...	*M* ...	1886 April 8 ...	April 10
S Coronæ ...	*M* ...	1886 May 10 ...	April 10
R Scuti	*m* ...	1886 July 21 ...	June 27
	M ...	1886 Sept. 12 ...	Aug. 1
	m ...	1886 Dec. 2 ...	Nov. 17

Mira Ceti was observed at maximum 1886 January 9; *g* (30) Herculis at minimum June 14, and at maximum September 20; and W Cygni at three epochs, viz. *m* July 8, *M* September 10, and *m* November 5.

Gore's new variable near χ_1 Orionis, to which Mr. Sawyer gives the lettering U Orionis, but which other astronomers have generally designated T, attained a maximum about 1887 December 14. The maximum was only a feeble one, − 7·5 mag. The light remained almost stationary from 1887 November 29 to 1888 January 2, a period of thirty-four days. The period of the star must be almost exactly a year.

The variable Lal. 40083, discovered by Mr. S. C. Chandler (see NATURE, vol. xxxv. p. 282), and to which he has given the name X Cygni, has shown from further observation that its light-curve is not constant in different periods, the minimum brightness being especially variable, but since the bright and faint minima do not alternate regularly the star does not belong to the β Lyræ class. Mr. Chandler's revised elements for the star are as follow: 1886 October 13, 14h. 20m. G.M.T. + 15d. 14h. 24m. E. Approximate duration of increase 5·6 days, of decrease 10·0 days. The maximum brilliancy is generally about 6·4m.; the minimum ranges from 7·2m. to 7·7m.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *APRIL* 8–14.

(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 April 8

Sun rises, 5h. 20m.; souths, 12h. 1m. 43·3s.; sets, 18h. 43m.: right asc. on meridian, 1h. 10·4m.; decl. 7° 29′ N. Sidereal Time at Sunset, 7h. 53m.

Moon (New on April 11, 9h.) rises, 4h. 46m.; souths, 10h. 6m.; sets, 15h. 35m.: right asc. on meridian, 23h. 14·6m.; decl. 8° 21′ S.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.	
	h. m.	h. m.	h. m.	h. m.	° ′
Mercury..	4 52 ...	10 29 ...	16 6 ...	23 37·0 ...	5 8 S.
Venus ...	4 47 ...	10 32 ...	16 17 ...	23 40·9 ...	3 40 S.
Mars ...	18 53*...	0 22 ...	5 51 ...	13 28·6 ...	6 48 S.
Jupiter ...	22 57*...	3 10 ...	7 23 ..	16 16·9 ...	20 19 S.
Saturn ...	10 59 ...	18 58 ...	2 57*...	8 7·8 ...	20 48 N.
Uranus ...	18 9 ...	23 46 ...	5 23*...	12 56·4 ...	5 17 S.
Neptune..	6 56 ...	14 37 ...	22 18 ...	3 45·7 ...	18 11 N.

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

April.	h.	
8 ...	23 ...	Mercury in conjunction with and 1° 16′ north of the Moon.
9 ...	1 ...	Venus in conjunction with and 2° 24′ north of the Moon.
11 ...	6 ...	Mars in opposition to the Sun.
14 ...	4 ...	Mercury in conjunction with and 1° 10′ south of Venus.

Variable Stars.

Star.	R.A.	Decl.			
	h. m.	° ′			h. m.
U Cephei	0 52·4 ...	81 16 N. ...	Apr.	12,	4 2 *m*
Algol	3 0·9 ...	40 31 N. ...	,,	13,	3 26 *m*
R Canis Majoris...	7 14·5 ...	16 12 S. ...	,,	11,	20 7 *m*
U Monocerotis ...	7 25·5 ...	9 33 S. ...	,,	12,	*m*
S Cancri	8 37·5 ...	19 26 N. ...	,,	13,	19 30 *m*
δ Libræ	14 55·0 ...	8 4 S. ...	,,	10,	22 56 *m*
U Ophiuchi... ...	17 10·9 ...	1 20 N. ...	,,	11,	2 57 *m*
			,,	11,	23 5 *m*
W Sagittarii ...	17 57·9 ...	29 35 S. ...	,,	9,	4 0 *m*
Z Sagittarii... ...	18 14·8 ...	18 55 S. ...	,,	11,	1 0 *M*
U Sagittarii	18 25·3 ...	19 12 S. ...	,,	10,	3 0 *m*
			,,	13,	2 0 *M*
η Aquilæ	19 46·8 ...	0 43 N. ...	,,	14,	2 0 *m*
T Vulpeculæ ...	20 46·7 ...	27 50 N. ...	,,	13,	4 0 *M*
R Vulpeculæ ...	20 59·4 ...	23 23 N. ...	,,	13,	*M*
δ Cephei	22 25·0 ...	57 51 N. ...	,,	12,	3 0 *m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near α Ursæ Majoris ...	163° ...	60° N. ...	April 10 and 11.
,, 42 Herculis... ...	248 ...	50 N. ...	,, ,,

GEOGRAPHICAL NOTES.

A SHORT excursion into the almost unknown interior of San Domingo was made last summer by Baron H. Eggers, in the course of which he explored the mountainous district, and made a complete study of the vegetation of this elevated region; he further discovered a route along which the exploration of this little-known mountain region may be carried out with facility. The following details are taken from the traveller's own account of his journey, published in *Petermann's Mitteilungen* (Part 2, 1888). He left Puerto Plata, on the north coast, on May 2 last, and about the middle of the same month found himself at Jarabacoa on the Rio Yagin, having passed through Santiago on his way. While at Jarabacoa he ascended Monte Barrero (4100 feet) in the vicinity of the town. The steep slopes of this peak are covered with lofty pine woods. In the small ravines and between rocks the traveller observed many interesting plants, *e.g.* the dark red *Fuchsia triphylla*, a bright red *Siphocampylos*, a large *Pentarhaphia*, and a beautiful *Cyathea*; he also found a large number of hitherto unnoticed plants, including an ilex, several Compositæ, Labiatæ, &c. The animal life in these pine forests appears to be very poor: there are scarcely any insects, and a species of crow is the only bird seen. At the end of May the traveller with a small party of blacks set out in a due southerly direction for the Valle de Constanza. The valley is well watered, and its height above the sea is 3840 feet. Its inhabitants, numbering 100, are engaged in cattle-rearing, and the cultivation of beans, maize, cassava, tobacco, &c. The climate is cool, and from November to March dry; during the rest of the year it rains. The thermometer at 6 o'clock in the morning of May 28 stood at 59° F. The higher part of the surrounding mountains, which almost everywhere contain gold, though in small quantities, are quite unexplored. From the Valle de Constanza the traveller made a further excursion to the south-east to a savanna region, situated in a depression among the mountains, and called by the natives "Valle Nuevo." The path led over forest clad mountains with intervening gorges, and formed a continual ascent till the Valle Nuevo was reached, which is 7450 feet above the sea. One of the forest tracts which the traveller traversed was especially dense and almost impassable; beautiful mosses, ferns, orchids, lycopods, and other epiphytes were growing on the trees. The Valle Nuevo is surrounded by low hills, which form the culminating points of the range; the highest of these, viz. Pico del Valle Nuevo (8630 feet above the sea-level) was ascended by the traveller.

DR. RINK contributes to the current number of *Petermann's Mitteilungen* an account of the results of the recent journeys made by Lieuts. Ryder and Block along the coast of Greenland to the north of Upernivik in 1887. By accurate measurements made in the ice-fiords of Angpadlar Fok, &c., both in April and August, some interesting and important results have been secured as regards the physical geography of this region. Some of the ice-fiords are very prolific in ice-bergs, notably that of Giesecke, where the edge of the permanent ice has retreated considerably within recent years. The results show not only the extraordinary rapidity, but the great variableness in the movements of the ice, apart apparently from the temperature of the time of year. The average temperature of the air during the measurements from April 20 to 24, was from $-9°$ F. to $-15°$. On January 28 the water temperature, at a point where the ice-fiord was 512 fathoms in depth, was as follows: at the surface 27°·7 F., at 50 fathoms 28°·9, at 200 fathoms 32°, and at 287 fathoms 32°·2. The question of the limit and movements of the inland ice of Greenland, to which the attention of recent Danish explorations has been directed, and towards the solution of which the results obtained by Lieuts. Ryder and Block have materially contributed, is discussed by Herr Rink in his paper, which also gives some interesting notes on the botany, geology, and ethnography of the country.

IN the April number of the Proceedings of the Royal Geographical Society there is an excellent new map of Siam, based on the surveys of Mr. James McCarthy. There also will be found the second and third of General Strachey's Cambridge geographical lectures.

AT the last meeting of the Royal Geographical Society a paper of unusual interest and originality, on the Solomon Islands, was read by Mr. C. M. Woodford, who spent several months in the group in 1886-87. Mr. Woodford's attention was mainly directed to Treasury Island, his head-quarters for some months being at Alu, on that island. He made many journeys into the interior, and was so successful that he obtained nearly 17,000 specimens in natural history, which, so far as they have been examined, have been found to comprise three new genera, and eight new species of mammals, fifteen new species of birds, six new species of reptiles, and over a hundred new species of Lepidoptera. Mr. Woodford visited, besides Treasury Island, the islands of Fauro, New Georgia, Guadalcanar, and others, exploring their interiors as far as possible, and in the case of Guadalcanar attempting to ascend Mount Lamma (8000 feet), without, however, succeeding. He followed the Bokokembo River as far as possible, finding the vegetation most luxuriant, and composed of large Ficus and other forest trees, with occasional clumps of sago and areca palms, but few coco-nuts. The coast natives are greatly afraid to venture into the interior, partly through fear of the bush-folk who live in the mountains, and partly through superstition. Mr. Woodford's observations on the natives are of great value; he had unusual opportunities of observing their modes of life. They are mostly inveterate head-hunters and cannibals. Natives of different parts of the group differ considerably from one another, but they belong to the Melanesian or Papuan type. Mr. Woodford believes, however, that on the island of Ysabel there is a strong infusion of Polynesian blood from Ongtong Java, or Lord Howe's Group, as canoes are known to have been driven in bad weather from that group, and to have arrived on the coast of Ysabel. The natives of Bouka and Bougainville, and of the islands of Bougainville Straits and of Choiseul, are intensely black in colour, but as one journeys eastward the colour changes to a dark brown. They have woolly hair, but occasionally natives are met with wavy, and in some cases straight hair. Mr. Woodford attributes this fact to an infusion of Polynesian blood, and has noticed it in natives from Ysabel, also at Fauro.

THE Royal Geographical Society of Sweden has awarded the *Vega* Gold Medal—instituted in honour of Nordenskiöld's voyage—to Dr. Wilhelm Junker, the celebrated African traveller. The medal, which has not been awarded since 1884, has hitherto had only four recipients, viz. Nordenskiöld, Palander, Prejevalsky, and Stanley.

THE ATOLL OF DIEGO GARCIA AND THE CORAL FORMATIONS OF THE INDIAN OCEAN.[1]

DIEGO GARCIA is a typical atoll; a narrow strip of land varying in width from a mile to 30 yards, nearly completely encircles a lagoon of irregular shape. The lagoon is open to the ocean towards the north-west, its mouth being divided by three small islets into four channels, of which three are sufficiently deep to allow ships to enter the lagoon. The whole of the land composing the atoll is very low; the highest point in the island is not more than 30 feet above the level of high tide, and this height, which is quite exceptional, is due to the accumulation of great heaps of sand through the action of the south-east trade winds which blow with considerable strength for more than one-half of the year. Diego Garcia is the southernmost atoll of the Chagos Group; it lies in S. lat. 7° 26′, E. long. 72° 23′, and forms the last of the great chain of coral formations reaching from the Laccadive Islands, through the Maldives to the Chagos Group. To its south-west lie the submerged atoll-shaped reefs known as Pitt's Bank and Centurion's Bank, to its north lies the huge submerged atoll known as the Great Chagos Bank. It is an interesting fact that throughout the Laccadive, Maldive, and Chagos Groups there is no instance of a fringing or of a barrier reef; nothing but coral structure rises above the waves; all the islands are atolls; none of these are upraised, but there are several submerged banks. The existence of this long line of atolls seemed to be one of the strongest arguments in favour of Darwin's theory of the formation of coral reefs.

In Diego Garcia the nature of the soil varies considerably from place to place. In some localities it consists of nothing else than bare coral rock upon the surface of which coral boulders are scattered about; in other places it is composed wholly of calcareous sand, and one may dig down for 6 or 8 feet without finding coral rock. It is obvious after a short examination that some parts of the land are older than others, and that the great strip of land was formerly a series of disconnected islets which have since been joined together by the accumulation of sand and coral *débris* between them. In the older parts of the island, which have apparently been covered with vegetation for a considerable period, a thick peaty mould has been formed by the decay of fallen leaves and stems of trees and shrubs.

Throughout the island the outer or seaward shore is higher than the inner or lagoonward shore, owing to the pile of coral boulders thrown up in the form of a low rampart along the former by the action of the waves. In most places a flat reef extends fully 60 yards seaward of the rampart; and this reef is just uncovered at low spring tides. As a rule the inner shore slopes gently down into the lagoon for some distance, and then pitches down rather suddenly to a depth of 10 or 12 fathoms, but in some places there is a depth of 6 or 8 fathoms close up to the inner shores. Marshy pools of fresh or brackish water are found in the centre of the strip of land on the south-east and west sides of the island; into these the sea enters in many cases during the highest spring tides, and at the south-east and south ends of the island it has established permanent breaches into some of these pools, through which the tide runs in and out regularly from the lagoon. Thus there are formed sheets of water like secondary lagoons within the strip of land; these are known on the island by the name of *barachois,* and they are of some importance when one comes to consider the amount of change which is continually going on in the island.

Externally the shores slope away very rapidly to considerable depths, the sounding-line giving depths of 250 fathoms and upwards at a distance of a few hundred yards from the edge of the reef, excepting at Horsburgh Point at the south-east side, where a depth of 45 fathoms is found at a distance of 1 mile from the shore. After a stay of two or three months on the island one cannot fail to be impressed with the immense amount of

[1] By G. C. Bourne, B.A., F.L.S., Fellow of New College and Assistant to the Linacre Professor in the University of Oxford. Communicated to the Royal Society by Prof. E. Ray Lankester, F.R.S.

change which is continually in progress. Large masses of sand are in the space of a month deposited in one spot to be swept away during the next month and deposited in another. Everywhere there is evidence that the sea has encroached upon the land, or that the land has in its turn gained upon the sea. In one place numerous dead and fallen cocoa-nut palms show where old-established land has been carried away; in an adjoining spot tracts of sand, either bare or covered with a scanty growth of young shrubs, show where the combined action of wind and waves has added a new piece to the island. Within the lagoon the currents are constantly changing in force and direction, and their every change affects the growth of coral in their track. In estimating the structure of the atoll these changes should be kept in mind, although their complexity makes it far more difficult to arrive at a correct conclusion.

In the course of my investigations I learnt to distinguish the following kinds of coral rock formed by the action of the waves or wind, or both combined.

Firstly, *reef rock*, a tolerably homogeneous mass of compacted coral *débris*, the component parts of which are so thoroughly infiltrated with carbonate of lime held in solution in the sea-water that the masses of fragments of coral composing the rock are rarely distinguished from one another. This form of rock exhibits a fine horizontal stratification; it is invariably formed under the sea or between tide marks.

Secondly, *boulder rock*, formed just above high-tide mark by means of the masses of coral which are transported across the reefs by the waves and are piled up to form the low rampart already alluded to. The interstices of the boulders are soon filled up with coral *débris* and sand, and are cemented together by the spray. Such rock is only formed on the seaward shores, and invariably shows a stratification dipping downwards towards the sea.

Thirdly, *shingle rock*, which may be of two kinds. The first kind is horizontally stratified, and is scarcely distinguishable from reef rock, except in its finer texture; it is formed below water or between tide marks by the agglomeration of small pieces of broken coral, among which are included numerous shells of mollusks, remains of Crustacea, Echinoderms, &c., and in the more sheltered parts of the lagoon it may include considerable masses of dead Madrepores embedded in their natural position in the rock. This rock is of a looser texture than the reef rock. The second kind of shingle rock is formed above high-water mark by the action of the waves. It is entirely composed of small fragments, and exhibits a fine stratification dipping seawards at an angle.

Lastly, there is the *sand rock*, formed above water by the action of the wind. Wherever masses of fine sand are piled up within reach of the spray they are gradually compacted, and form a friable rock, the stratification of which dips seaward.

In many parts of the island I observed that the land was composed of stratified reef or shingle rock, the strata of which were perfectly horizontal, and did not dip down towards either shore. Having observed the manner in which the different kinds of coral rock were formed, I was at a loss to understand how such horizontally stratified masses could have been formed in their present position above high-water mark, and could only believe that they were originally formed as reef or shingle rock below high-water mark, and had been subsequently raised to their present position. I was thus led to believe that a slight elevation had taken place, and this belief was strengthened by a study of the formation of East Islet. This islet is about 800 yards long, and nearly 100 yards broad; its westermost extremity is composed of masses of sand piled up on the underlying reef rock, and in this place there is a clump of high trees (*Hernandia peltata*). The eastern and by far the larger part of the islet is of different formation. The even surface of the soil is covered with a low scrub, but bears no trees nor cocoa-nut palms. It forms a low plateau, the surface of which does not slope down towards the lagoon, but is perfectly horizontal, and stands 4 feet above the very highest spring tides. The shore on the lagoonward side shows an abrupt fall of 6 feet to the reef, which in this place extends for a distance of 50 yards towards the lagoon, and is only left uncovered at the lowest spring tides. At the eastern extremity of the island there is no reef, but from 1½ to 2 fathoms of water are found within a few yards of the shore. This point is exposed to the ocean, and a strong and constant current sets against it, so that it is undergoing a considerable amount of erosion. On the north or seaward side the reef again extends outwards from the shore, the latter differing from the inner shore in the presence of a talus of large boulders which have been thrown up against it by the waves. Wells have been sunk in numerous parts of the island, though, for some reason which I cannot explain, water is only found in one of them. Numerous pits, some of which are 9 feet deep, have also been dug for the purpose of planting cocoanuts. These pits and wells expose the interesting structure of the superficial part of the island. Beneath a thin surface layer of sand and mould lies a horizontal layer of stratified shingle rock, in which large embedded coral masses may occasionally be distinguished; this layer is about 2½ feet thick. Beneath is a layer of loose coral sand about 18 inches thick, and beneath that is another layer of coral rock of the same character as the first, and about 3 feet thick. Beneath this is another layer of friable sand lying on the solid reef rock into which the excavations did not penetrate. These layers lie perfectly horizontally, and do not dip in any direction. They crop out above the reef on the steep eastern and southern shores, and as the loose sand is washed out by the waves the overhanging layer of rock breaks off and falls down in large masses. The central parts of this area are absolutely beyond the reach of any waves at the present time, and as the strata of rock and sand run evenly through it there is no evidence of its having been formed by successive additions of material through the action of the waves. Nor can it possibly have been formed under the surface of the water unless it has since been raised to its present position, for, as I have said, its upper surface is 4 feet above the level of high spring tides. On one occasion when the tide rose to an abnormal height and invaded several parts of the main island, I saw that the water reached to within 3 feet of the top of the shore, but even then the whole of the upper stratum of coral rock was well above the waves. It is scarcely credible that an even layer of shingle rock could have been formed above the highest high-water mark.

My belief in elevation is further strengthened by the following facts, communicated to me by M. Spurs, a resident for twenty-five years at Diego, an ardent naturalist, and much interested in coral formations.

A small shore crab of the genus *Ocypus* is always to be found on the sandy flats between high and low water marks. These crabs, as is well known, form numerous galleries in the fine muddy sand, which they line with seaweed, &c., to prevent their falling in. These galleries open to the surface by short passages placed perpendicularly, the mouths of which open only a few inches above the level of low tide. This crab is only found on the shore between tide marks; on the dry land its place is taken by *Gearcinus*, another genus of crab, which forms different burrows. In the west part of East Islet there is an aggregate of friable, scarcely compacted sand, which has somewhat the appearance of half-dried clay. It lies 5 feet above high-water mark, and was found by M. Spurs, during some excavations which he had to make for the purpose of constructing a slip for boats, to be riddled with the seaweed-lined galleries of *Ocypus*, evidently long since disused and empty.

Having made this observation on East Island, M. Spurs made a search in similar formations on the main island, and found, he tells me, precisely the same facts in several instances, aggregates of sand lying at some distance above high-water mark, riddled with the abandoned burrows of *Ocypus*. Now, since the burrows of *Ocypus* are quite characteristic, and could not have been mistaken by so good an observer as M. Spurs for those of another species, and since they are in the present day only found between tide marks, these observations afford a further presumption in favour of a slight elevation having recently taken place. In any case they preclude the idea of any subsidence being in progress, as Mr. Darwin fancied to be the case in the Keeling atoll. M. Spurs further informs me that, during the time that he was superintendent of the oil company's estate, he caused more than 30,000 pits to be dug on the main island for the purpose of planting cocoa-nut palms, and that he frequently observed in different localities the same alternate layers of sand and rock that I have described as existing on East Island. These alternations of sand and rock would suggest alternations of very slight subsidence with very slight elevation, rather than a single movement of upheaval, yet on the supposition that all the layers were formed beneath the water, as their horizontal stratification leads me to believe, I can venture on the following explanation. The mass of rock which forms the base upon which the islets and other dry land rests is solid reef rock, and the whole floor of the lagoon is similarly formed.

The latter is covered at depths of 3 or 4 fathoms and upwards by a layer of fine sand, which may attain a thickness of 2 or 3 feet. In protected parts of the lagoon and in spots where the changeable currents have ceased to deposit any quantity of sand, corals will grow in considerable quantities, chiefly those wide-spreading ing species of Madrepora which cannot find a lodging on the exterior of the reef, where they would be dashed to pieces by the waves. By the continual growth of new colonies on the top of the old ones which have died, a layer of solid rock of considerable thickness may be formed. Whilst diving for corals at the lower part of the lagoon, I often noticed such layers of half-formed rock on which living coral was growing or not, according as the constantly changing currents were at that time throwing up sand in the locality or not. Thus on the west side of the lagoon, off Point Marianne, there are large tracts of recently formed coral rock, on which no living corals are to be seen, whilst on the east side of the lagoon, exactly opposite to Point Marianne, a similar basis of rock is luxuriantly covered with growing coral.

Now, as the currents are constantly changing, and as the changes may, as I saw, affect an area some miles in extent, one may suppose that an area was first covered with corals growing on the sand, which everywhere covers the reef rock, when the latter lies more than a fathom below the surface. A change in the currents brought abundant sand to the spot, killed the corals, and deposited an even layer of sand of some little thickness over the rock formed by the skeletons of the dead corals. A further change in the currents would again render the spot suitable for coral growth, and a new layer of rock would be formed over the last layer of sand. I have seen quite analogous formations in progress in a fathom of water a little way above Point Marianne. Raise the formation to the surface, and you get that stratification which occurs in so many parts of the island, a stratification which cannot be explained on any theory of subsidence, and is scarcely less difficult to explain on the supposition of rest. At first I had some hesitation in extending to an island on the borders of the lagoon, as is East Island, a view of the formation of layers of sand and rock derived from an inspection of the interior of the lagoon, but afterwards I saw that similar layers were being formed just within the large reef known as Spur's Reef, west of Middle Island, so that no objection can be raised on that score. The whole character of the Chagos Group is very much opposed to the theory that atolls and barrier reefs are formed during subsidence. There are several atolls rising above the waves, that of Peros Banhos being 55 miles in circuit, and composed of numerous small islets placed upon a ring-shaped reef through which there are several large and deep channels. Egmont or Six Islands is an instance of an atoll in which the encircling reef is perfect and unbroken by any channels, the land consisting of six islets placed for the most part on the southern and western sides of the reef. There are several submerged banks, nearly all of which have an atoll form. Of these the best known is the Great Chagos Bank, a huge submerged atoll 95 miles long and 65 miles broad, having a depth of 4 to 10 fathoms over a narrow rim around its periphery, and a central lagoon of a depth varying up to 45 fathoms. South-west of the Great Chagos Bank, distant less than 15 miles, lies the atoll of Six Islands, and on the other side of these, scarcely 12 miles distant, lies another submerged atoll, known as Pitt's Bank. South-west of Pitt's Bank are two smaller banks, Ganges and Centurion's Banks. Darwin considered that the Great Chagos Bank afforded particularly good evidence of the truth of the subsidence theory. He regarded it as an atoll carried down by a too rapid subsidence below the depth at which reef-building corals flourish. The same would be the case for Pitt's Bank and the two others just mentioned. A more intimate knowledge of the Great Chagos Bank, and of the relations of it and other submerged banks of existing land, shows this view to be untenable. In the first place, the rim of the Great Chagos Bank is on an average not more than 6 fathoms below the surface, and therefore situated in a depth eminently favourable for coral growth, and there are actually six islets on the northern and western edges rising above the water, and some of them inhabited. Secondly, any such rapid subsidence could not have affected areas only 30 miles apart without involving the Six Islands atoll lying directly between them. A similar argument might be extended to the more northern islands of the Chagos Group, and even to Diego Garcia itself, although it lies somewhat apart from the rest of the group. Again, if atolls and barrier reefs are formed around subsiding peaks, it is at least curious that throughout the Laccadive, Maldive, and Chagos Groups there are no instances of high islands surrounded by barrier reefs, marking the last remnants of pre-existing land. In the more western parts of the Indian Ocean, between Madagascar and the Seychelles, there are numerous atoll islands, and in long. 60° E. there lie the submerged Saya de Malha Bank and the reef known as Cargados Carajos. Between these two lies the extensive Nazareth Bank, having over it depths of from 14 to 45 fathoms. The Saya de Malha Bank appears to have the characters of a submerged atoll, having a central depression of 65 fathoms, surrounded by a rim which has only 8 to 16 fathoms on its eastern side, but 22 fathoms on the western. Some of the groups north of Madagascar afford very good evidence of upheaval. Aldabra Island, situated in lat. 9° 22′ S., long. 46° 14′ E., is a perfect instance of an upraised atoll. Captain Wharton describes the external shores as consisting of low coral cliffs, about 20 feet high, the surface of the land being composed of jagged coral rock. The lagoon is entered by a passage varying from 11 to 5 fathoms in depth, but its internal portions are either very shallow or partly dry at low water. Not far distant is the Cosmo Ledo Group, a perfect atoll, with a lagoon some 4 fathoms deep, or less. There are ten islets of various sizes on the reef, and all of them appear to have been elevated some 10 feet. There are some hills 40 and 50 feet high on the two largest islands, but these appear, according to Captain Wharton, to be formed of blown sand. The Farquhar Group and Assumption Island, situated within the same area, have been raised, according to the same authority, some 10 feet. Providence Island, in lat. 9° 14′ S., long. 51° 2′ E., appears to be a low island situated upon the edge of the atoll-shaped Providence Reef. At a distance of 19 miles from Providence Island is the island of St. Pierre, which has no fringing reef. It is particularly interesting, for although it is in close proximity to the low Providence atoll, it has been raised about 40 feet above high water, and in the absence of a fringing reef the sea breaks with great violence against a low cliffy coast, hollowing out a number of caverns which, from the description given in the sailing directions for Mauritus and its islands, appear to open inshore by "blow-holes." [1]

Near and among these raised coral formations are several submerged banks, the most important of which is the McLeod Bank, situated in lat. 9° 57′ S., long. 50° 20′ E., between Providence Island and the Cosmo Ledo Group. The details show that there is a group of coral formations, situated in lat. 10° S., north of Madagascar, in which are found raised atolls—atolls whose dry land just rises above the waves and submerged banks. There can be no clearer proof that atolls are formed in areas of elevation, and, if the facts which I have already stated concerning Diego Garcia are of any weight, it would seem that most of the coral formations of the Indian Ocean mark areas of elevation rather than of rest, certainly they are not evidence of subsidence.

Those who have felt that the evidence brought against Darwin's subsidence theory is too strong to be resisted, must often have felt that no satisfactory explanation of the lagoons of atolls or the lagoon channels of barrier reefs has been given in its place. Semper was the first to suggest that the lagoon was formed by a solution of the interior parts of the reef, and more recently this view has been urged with great force by Murray, who points out, in addition, that corals on the periphery of a reef must, from their position, get the advantage over those more interiorly situated, being more directly in the track of food-bearing currents. Neither of these explanations has completely satisfied me. That sea-water exercises a solvent action upon carbonate of lime does not admit of doubt, and that the scour of tides, combined with this solvent action of the water, does affect the extent and depth of a lagoon is obvious. But I challenge the statement that the destructive agencies within an atoll or a submerged bank are in excess of the construction. It would be nearer the mark to say that they nearly balance one another. In the first place, the carbonate of lime held in solution by sea-water is deposited as crystalline limestone in the interstices of dead corals or coral *débris*. Anyone who is acquainted with the structure of coralline rock knows how such a porous mass as a Mæandrina head becomes perfectly solid by the deposition of lime within its mass. This deposition can only be effected by the infiltration of sea-water. In reckoning the solvent action of sea-water, therefore, account must be taken of the fact that a not inconsiderable proportion of the carbonate of lime held in solution is redeposited in the form of crystalline limestone. Of

[1] For the information on the islands north of Madgascar I am indebted to the courtesy of Captain W. J. L. Wharton, R.N., F.R.S.

this, it seems, Mr. Murray has not taken sufficient account, and has, therefore, overstated the destructive agency of the sea. Secondly, the growth of corals, and the consequent formation of coral rock within the lagoon, is generally overlooked.

Whilst diving for corals at Diego Garcia, I had abundant opportunities of studying the formation of coral rock within the lagoon, in depths under 2 fathoms. The layers of tolerably compact rock thus formed are of no mean extent or thickness; they soon become covered with sand, and are thus protected from the solvent action of the water. I have found it impossible to reconcile Mr. Murray's views with what I saw of coral growth within a lagoon. Not only do the more delicate branching species of the Madreporaria flourish in considerable numbers, but true reef-building species—Porites, Mæandrina, Pocillopora, and various stout species of Madrepora—are found there. It is a mistake to suppose that certain species of corals are restricted to the external shores, others to the lagoon. My collections proved that many of the species growing in the lagoon at distances of 5 miles and upwards from its outlet are identical with those growing on the outer reef. In addition to them are numerous species, such as *Seriatopora stricta*, *Mussa corymbosa*, *Favia lobata*, *Fungia dentata*, and many others that are not found on the outside. The reason is that the last-named are either free forms, such as Fungia, or are attached by such slender and fragile stems to their supports that they could not possibly obtain a foothold and maintain themselves among the powerful currents and waves of the open ocean.

These various species, numbers of which grow close together, form knolls and patches within the lagoon, and it cannot be doubted that their tendency is to fill it up.

These considerations have led me to discredit the solution theory as an explanation of lagoons and lagoon channels, and other objections have been lately urged with great force by Captain Wharton. The conclusion which I reached, after carefully considering the conditions of submerged lakes of atoll form, is that the ring-shape of the outer reef is to be explained by the peculiarly favourable conditions for coral growth found on the external slopes. Although corals may, and do, flourish in lagoons, they are only found in knolls and patches, and are always liable to be smothered, when, by a change in the tidal currents, sand is thrown down upon the place where they are growing. On the external slopes, however, corals grow in extraordinary abundance, and chiefly those massive forms whose skeletons take so conspicuous a share in the formation of coral rock. If once it is admitted that the periphery of the reef offers peculiarly favourable conditions to the growth of reef-forming corals, it follows that, as the reef rises to the surface, its external parts will outstrip the more internal, and will reach the surface first, forming a rim around a central depression or lagoon. This elevated ring will be as marked a feature in submerged as in complete atolls.

Corals are always thickest along the slopes around a coral reef, and the reef tends to increase at its periphery, growing upwards there, whilst it tends at the same time to spread outwards. These principles hold good in the case of a submerged bank as well as in the case of a reef that is awash, and a submerged bank must tend in the course of time to reach the surface in its circumferential portions, and form an atoll-shaped reef, on the rim of which detritus may be heaped from place to place, forming shingle cays or islets which may temporarily form dry land. In atolls where storms are of frequent occurrence, regular storm-beaches may be formed, till the fragments piled high upon one another may form low islets standing some 6 or 10 feet above high-water mark, upon which vegetation may subsequently find a footing. Atolls are often formed in this way, without any elevation taking place, and such has undoubtedly been the case in the Florida reefs, where atolls (the Tortugas) and barrier reefs and islands have been formed in an area of complete rest. No one who has read the admirable work of Alex. Agassiz on the Florida reefs can fail to agree with the author's conclusion that the islets there have been formed by the action of the wind and waves alone, without any assistance from the upheaval of the bed of the sea. But I am not satisfied that this has been the case in the Chagos Group. Storms are of very infrequent occurrence there, and the horizontal masses of reef rock standing above high-water mark cannot be attributed to the normal action of the prevailing winds and currents.

In the Florida reefs the nature of the soil betrays its origin—its strata slope towards the sea on every side, and the lamination of the rocks attests the long-continued action of waves and spray. But the alternate horizontal layers of sand and rock occurring so abundantly at Diego Garcia are quite different; they do not dip seawards, their composition differs from the rocks of the Florida reefs, and their edges, instead of showing signs of accumulation of fresh material, are often bluff, and show that the sea is gradually eating them away. It is difficult to explain these appearances except on the hypothesis of slight elevation. It might be objected that if any upheaval had taken place, the banks lying at various depths below the surface would have been raised to different heights, and that it would be in the highest degree unlikely that so many would be raised some 4 or 5 feet above high-water mark and no more, throughout so large areas as the Laccadive, Maldive, and Chagos Islands, and the various low groups in the Pacific. The force of the objection must be admitted, but it may be observed that atolls raised from 10 to 40 feet above the waves are not so uncommon as has been hitherto supposed, and that the numerous submerged banks lying at very various depths show that all the reefs have not been raised to one height in a single area of elevation. The uniform level of many atolls and barrier reefs admits of a further explanation. A reef raised some few feet above the sea-level is at once attacked by the waves, and as the rim is very narrow, it must soon be worn away till the whole of the land is eaten away, and its surface is brought awash once more. Thus every slight movement of elevation would soon be compensated by the denuding action of the waves. The island of St. Pierre, already described, is a good instance of this process of erosion. It cannot be doubted that this island, which has recently been raised 40 feet, is undergoing rapid waste, and must soon be reduced to the level of the sea. At Diego Garcia I was astonished at the rapid destruction of dry land which is in progress, on the outside as well as the inside of the lagoon. The destruction is not so great on the outside as on the inside as a rule, for in the former case the rampart of coral boulders thrown up by the waves compensates in many places for their erosive action. But in the bay above Horsburgh Point, exposed to the full strength of the south-east trades, the destruction is very great. M. Spurs, an old resident of the island, writes to me on this subject: "Cette destruction est très rapide; Diego perd en moyenne un pied de terrain par an, tant intérieurement qu'extérieurement, excepté aux pointes nord-est et nord-ouest, où une partie des sables, entrainés du fond de la baie par les vents de sud-est, conservent à ces deux pointes leur largeur première."

M. Spurs has over-estimated the rate of destruction, but there can be no doubt that it is very considerable. It is most conspicuous along the shores bordering the lagoon. The stumps of cocoa-nut palms, the newly-made breaches into the land, forming shallow inland lagoons, the vertical faces of old banks of half-consolidated sand, all attest it. Just above Point Marianne is a road running along the lagoonward shore, which when I left the island had been narrowed by the action of the sea to a mere path, and was in some places almost impassable, as the sea had made clean breaches across it, and found its way into some shallow fresh-water lagoons lying on the other side of the road. I was assured that this road had been over 12 feet wide some years previously, and that it was formerly separated from the lagoon by a narrow strip of land of an equal width. Perhaps the best evidence of the destruction of land is afforded by the "barachois" at the southern extremity of the island. These barachois are inland lagoons connected with the main lagoon by a narrow outlet some 2 fathoms deep or more. They are filled and emptied every tide, and their floor is intersected by numerous small channels running in every direction. No corals grow within the barachois, and a slight study convinces the observer that the daily scour of the tides is denuding their shores and floors very considerably.

Barachois are formed in the following way:—During unusually high tides, when the waters of the lagoon are dammed back by a north-westerly wind of unusual violence, the water rises to great heights and invades the land in several places. In some instances it actually makes a breach in the lagoonward shore, and fills up the shallow depressions which are often found in the middle of the strip of land. A pool of salt water is thus formed, which kills the cocoa palms and other vegetation growing in its bed, and, as this process is repeated again and again, in the course of a few years a channel is cut out between the pool and the lagoon, which finally becomes so deep that spring tides, and finally even neap tides, run in and out of the pool regularly. As soon as these conditions are established, the channel is scoured out and deepened, and the daily tides scour out the bed of the pool, forming a complete barachois.

It is not easy for one who has not seen it to understand how much of the loose soil of a coral islet can be moved by a single tidal encroachment. It happened that I was riding past the very thin strip of land between Minni Minny and Barton Point the day after an abnormally high tide. The strip of land here is not more than 30 yards across, and the sea had washed right over it on the previous day, clearing away an amount of soil which was almost incredible. My companion, M. Casimir Leconte, told me that the sea had not been known to wash over this place before. It was apparent that, after a few more of such high tides as I had witnessed, a permanent breach would be made at this spot, and another lagoon outlet would be formed, which would be continually deepened as the tide set through it. At the south-eastern side of the island I noticed that the land was being rapidly destroyed on the outer shores just opposite to a half-formed barachois, whose margins are situated not 60 yards from the outer shore. If the same process of external destruction continues, whilst the barachois is deepened and scooped out from within, it will not be many years before the ocean makes a new channel into the lagoon at this point. Thus the continuous strip of land which now nearly encircles the lagoon of Diego Garcia is tending to be split up again into a series of islets. At the points where the breaches are made the tides and ocean currents will rush with great force into the lagoon, and will scour out deep channels similar to that now existing between Middle and East Islets.

These facts taken together show how the normal action of tides, winds, and waves is constantly tending to lower to the sea-level any dry land that may have been formed by elevation or otherwise. It does not seem to me to be surprising that the majority of atolls and barrier reefs are, under such circumstances, only just able to maintain their surfaces above the sea-level.

No explanation of atoll formation would be complete if it did not include an explanation of the Maldive atolls. This has been felt by Darwin, who has explained the formation according to his theory. Without attempting to enter into a lengthy discussion, I will give my own explanation of the atoll. Tilla-dou-Matte atoll is, as is well known, a huge atoll composed of atolls. The islets forming the rim of the main atoll are themselves atolls with their own lagoons; the main lagoon contains a few secondary atolls corresponding to the coral patches in an ordinary atoll. It will be generally admitted that coral reefs are constantly increasing to seaward because of the excessive growth of coral on their external slopes.[1] As the inward shores of an atoll are constantly being removed, and an atoll if completely formed tends to be broken up again into small islets when it has reached a certain size, and as the channels between the islets must be continually deepened by the scour of the tides until deep passages are formed, an atoll like Diego Garcia may be expected to reach in time a condition like that of Peros Banhos. It is probable that a large bank like the Great Chagos Bank, when it reaches the surface, can never give rise to a continuous strip of land, but must consist of a chain of islets separated by channels of some depth and by tracts of submerged reefs. The islets and tracts of reef in either case would be bounded by deeper channels, and these channels, swept by strong currents, would become wider and deeper, for corals could not thrive in them. After a time the islets would become so far isolated, and the entries into the lagoon would become so large and numerous, that oceanic conditions would prevail in the lagoon, and then there would be around each separate islet or piece of reef all the necessary conditions for the formation of a new atoll. The currents would impinge upon one side of the islet or reef, sweep round it, and give a backwash at the further side; the corals would flourish in the circumferential parts of the reef surrounding the islet, and new atolls with shallow lagoons would be formed.

In Tilla-dou-Matte the lagoons of the secondary atolls are tolerably deep. In this case they must have been formed before any land reached the surface. Applying the same reasoning as in the former case, it can readily be understood how in the case of the Great Chagos Bank, which has wide and deep breaches in many places, the isolated reefs as they grow to the surface must tend to assume an atoll form. An examination of the chart shows that this is the case. The Great Chagos Bank in the course of time will rise to the surface as an atoll composed of secondary atolls or atollons, similar to, but on a smaller scale than, the Tilla-dou-Matte atoll. The explanation of atollons in the centre of a large lagoon in which oceanic conditions have been established, is quite obvious.

[1] This statement may at first sight seem at variance with what I have just said about the rapid destruction of land on the outer and inner shores of an atoll; but in the latter case it is *land above water* that is destroyed. Coincidently with this process the reef rock below water is constantly tending to raise itself and to spread in all directions, owing to the perpetual growth of corals and the accumulation of their skeletons.

THE ROYAL HORTICULTURAL SOCIETY.

On Tuesday, March 27, the Scientific Committee of the Royal Horticultural Society met in the Committee-room of the Drill Hall. Among the numerous subjects brought forward were the following:—

Dispersal of the Seed in Pinus insignis.—Dr. Masters, alluding to the great differences that exist in the species of *Pinus*, as to the time at which the constituent scales of the cone separate in order to liberate the seed, showed a series of cones of *Pinus insignis*, the oldest of which bore the date 1864. In this all the scales were widely separate. The most recent cones dated from 1877, and in them the scales were not at all separated. Between these two extremes, cones were shown exhibiting almost every intermediate stage of separation. It is to be remarked that the separation begins generally just above the centre of the pendulous cone on the side furthest away from the branch, at the place where the excentricity of the cone, due to the free exposure to light and air, and the absence of obstacles afforded by the branch was greatest, and that it follows a spiral course towards the base of the cone. The scales separate in successive spiral coils, till, at length, all except a few at the base and apex respectively, and which are probably sterile, are separated one from the other.

Semi-double and other Orchids.—Dr. Masters explained the construction of numerous malformed orchids which were interesting as throwing light on the morphology of the order. Some extraordinary malformations of Fuchsias were shown, and a drawing was exhibited of a magnificent new Anthurium, which had appeared accidentally with an importation of *Cattleya Gaskelliana*, in the garden of the Right Hon. J. Chamberlain. The heart-shaped leaves are of gigantic size, and the large boat-shaped spathe is of the richest crimson colour.

Eucalyptus urnigera.—Dr. Masters showed specimens of this Tasmanian species in flower and fruit. They had been received from Whittinghame Gardens, Prestonkirk, near Edinburgh, not far from the sea, and where the tree is perfectly hardy.

Daffodil with Crested Corona.—Rev. E. C. Gabbett sent through Dr. Masters two flowers of a curious Daffodil from plants growing on his lawn in Co. Limerick. The "frill," or outgrowth, is produced from the outer surface of the corona, which has thus a very peculiar appearance.

Douglasia lævigata.—Mr. G. F. Wilson alluded to this plant as having been shown for the first time. It is a low-growing Primulaceous plant, with tufted leaves and lilac flowers, like those of an Androsace, but larger, and with the tube of the corolla longer than the calyx, and with only two seeds to the capsule. The species are the natives of North-Western America, the first known species having been collected by Douglas not far from the sources of the Columbia River, and named in his honour by Dr. Lindley.

Araucaria imbricata Timber.—Mr. Ford, gr., Leonardslee, exhibited slabs of wood cut from a tree of this species, and which at 6 feet from the ground girthed 26 inches, the tree being 35 feet in height. The wood was yellow, soft, evenly grained, and, judging by the distance between the rings, quickly grown.

Numerous other plants and objects of interest were exhibited and commented on.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 15.—"A Class of Functional Invariants." By Mr. A. R. Forsyth, F.R.S.

The memoir is occupied with the investigation of a class of functional invariants, constituted by combinations of the partial differential coefficients of a dependent variable, z, with regard to two independent variables, x and y. The definition of the invariant is given by the property that, when the independent variables are transformed to X and Y, and the same combination as before is formed with regard to these new variables, the equation

$$\Phi = \left\{ \frac{\delta(x, y)}{\delta(X, Y)} \right\}^m \phi$$

is satisfied.

The transformations for which any detailed results are given are of the general homographic type. The characteristic properties of such invariants are :—

(i.) Every invariant is explicitly free from the variables, but necessarily contains both the differential coefficients p and q of the first order.

(ii.) It is homogeneous in the differential coefficients, and is of uniform and the same grade in differentiations with regard to each of the independent variables.

(iii.) It is symmetric or skew symmetric with regard to these differentiations.

(iv.) It satisfies four differential form-equations and two index-equations, all linear and partial of the first order.

An invariant is said to be proper to the rank n, when the highest differential coefficient of z which occurs in it is of order n. By means of the solutions of the form-equations, the following propositions relating to irreducible invariants in a single dependent variable, z, are established :—

Invariants can be ranged in sets, each set being proper to a particular rank.

There is no invariant proper to the rank 1; there is one proper to the rank 2; there are three invariants proper to the rank 3.

For every value of n greater than 3 there are $n + 1$ invariants proper to the rank n, which can be chosen so as to be linear in the partial differential coefficients of order n.

Every invariant can be expressed in terms of this aggregate of irreducible invariants; and the expression involves invariants proper to rank no higher than the order of the highest differential coefficient which occurs in that invariant.

Some of the properties of the irreducible invariants involving differential coefficients of two dependent variables are obtained, and, in particular, it is shown that there is a single irreducible simultaneous invariant proper to the rank 1, and that there are four such invariants proper to the rank 2.

The theory of eduction is next considered, with some examples. Finally, it is shown that the theory of binary forms can be partly connected with functional invariants.

March 22.—"Second Preliminary Note on the Development of *Apteryx*." By T. Jeffery Parker, B.Sc., C.M.Z.S., Professor of Biology in the University of Otago. Communicated by W. K. Parker, F.R.S.

Chemical Society, March 15.—Mr. W. Crookes, F.R.S., in the chair.—The following papers were read :—The nature of solutions as elucidated by the heat evolved on their dilution; Part 1, calcium chloride, by Mr. S. U. Pickering. To determine the nature of the action which takes place on diluting aqueous solutions, the author has examined calcium chloride, and, in a series of elaborate experiments, has obtained results which form a curve of great regularity. This regularity, however, is only apparent, since on differentiation a number of independent curves are obtained, each of which on further differentiation gives a straight line. The points at which these lines meet, when produced, indicate percentages of water corresponding to distinct hydrates of the salt, and moreover coincide in every case, within the limits of experimental error, with the points obtained by treating in a similar manner the curve expressing the densities of the various solutions. The author contends that these results, taken in conjunction with the fact that the variation in the electrical conductivity and the density of sulphuric acid on diluting with water also point to the existence of certain hydrates in solution, make it no longer reasonable to doubt that solutions do in reality consist of such hydrates, and is of opinion that any theory of the nature of solutions which ignores their existence must be rejected absolutely and for ever. A new form of mixing calorimeter, devised for these experiments, was exhibited.—The action of thiocyanates on aldehyde-ammonias, by Dr. A. E. Dixon.—Carboxy-derivatives of quinone, by Dr. J. U. Nef. Ethylic paradiketohexamethylenecarboxylate, obtained by the reduction of ethylic quinonetetracarboxylate with zinc dust, exists apparently in three distinct modifications, only two of which, however, have been studied—the one modification is green and crystallizes in needles, the other is yellow and crystallizes in plates; after fusion, the former appears dark yellow and the latter bright yellow. If either modification be separately dissolved in carbon bisulphide, a solution is obtained from which the two substances crystallize out together; the solution also has the same colour and the same absorption spectrum whichever modification be dissolved. The author calls attention in the paper to a number of similar cases of dimorphism.—The action of acetone on ammonium salts of fatty acids in the presence of dehydrating agents, by Dr. S. Ruhemann and Mr. D. J. Carnegie.—A method of estimating nitrites either alone or in presence of nitrates and chlorides, by Mr. T. C. Day.

PARIS.

Academy of Sciences, March 26.—M. Janssen in the chair.—New theory of the equatorial *coudé* and of equatorials in general (continued), by MM. Lœwy and P. Puiseux. Here are given the general formulas promised in the previous communication, together with the terms depending on the position of the outer glass.—On the relations of atmospheric nitrogen with vegetable humus, by M. Th. Schlœsing. A detailed account is given of the experiments carried out according to the already described method for the purpose of ascertaining whether gaseous nitrogen is fixed by vegetable soil. The disappearance of the oxygen shows in six different cases that the combustion of the organic substances takes place in various degrees depending on the quantity and nature of such substances. During this combustion nitric acid is formed with disappearance of the ammonia. The volume of gaseous nitrogen contained in the soil does not perceptibly vary.—On the absorption of saline substances by plants (continued), by MM. Berthelot and G. André. The experiments here described deal with the acetate of potassa, an organic salt analogous to those present or produced in the plants; also with the nitrate of potassa, the formation or accumulation of which is characteristic of certain species, especially of the Amaranthus group. This accumulation is shown to depend rather on the period of vegetation than on the proportion of the salt in the ground.—New nebulæ of a remarkable character discovered in the Pleiades, by means of photography, by MM. Henry, and described by M. Mouchez. Besides a new nebula round Maia in the Pleiades, the more recent researches of MM. Henry have revealed a great mass of cosmic matter covering a large part of this constellation. But the most remarkable discovery, and one of an absolutely unique character, is a rectilinear thread of nebular matter projected from the central mass nearly in the direction from east to west for a distance of 35′ to 40′ of arc, but with a thickness of no more than 3″ to 4″. This thread crosses on its path seven stars, which it seems to string together like the beads on a rosary, and slightly changes its direction at the point where it meets the largest of these stars. A second streak, somewhat similar, but shorter, is perceptible in the middle of the nebular mass.—Preliminary work for the execution of the photographic chart of the firmament, by M. Mouchez. Reference is made to the publication of a *Bulletin* specially devoted to this object. Two more Observatories, those of Potsdam and Oxford, are announced as intending to take part in this great work, making thirteen stations altogether. These, it is stated, are already sufficient to secure the completion of the undertaking in the course of four or five years.—Treatment of auriferous sands by amalgamation, in ancient times, by M. Berthelot. The second part, just published, of the already noticed "Collection des Alchimistes grecs," contains the works of Zosimus, a writer of the third century of the new era, dealing with the extraction of gold by means of its natural ores treated with mercury. This process appears to have been substituted for a still more ancient method, in which the ore was fused with lead, salt, a little tin, and barley bran, and submitted to a genuine process of refining.—Observations of the Comet 1888*a*, made at the Paris Observatory with the equatorial of the West Tower, by M. G. Bigourdan. The observation here recorded was taken on March 25, when the comet, discovered at the Cape, on February 18, by M. Sawerthal, was approaching the northern hemisphere.—On a new mercury-bath for the observation of the nadir, by M. Périgaud. This valuable appliance at last gives the long-sought solution of the problem, how to employ the mercury-bath for determining the vertical, and for taking observations by reflection in all states of the weather, and on ground subject to the constant vibrations produced by carriage traffic, as in large towns.

BERLIN.

Meteorological Society, March 6.—Dr. Vettin, President, in the chair.—Dr. Zenker gave an account of his work, which has been awarded a prize by the Paris Academy, on the distribution of heat over the surface of the earth. When considering the total heat which reaches the earth's surface, it is of course dependent upon the distance of the sun, and is greater at perihelion than at aphelion in the ratio of the inverse square of the sun's distance. The varying ellipticity in outline of the earth in its various positions has no influence on the heat received owing to the extremely slight difference thus produced. If any one point of the earth's surface is alone considered, then the heat received is determined by the sine of the sun's altitude or the cosine of its zenith distance, for which the speaker gave an equation expressed in terms of amplitude and declination. From the above relationships it follows, leaving the air out of account, as has usually been the case, that the heat received by the Pole on a summer day is greater than that which falls on a point at the equator. Thus taking as unit the heat received during twenty-four hours by a place at which the sun is in the zenith, the North Pole receives an amount of heat represented by 0·397, and a point on the equator an amount represented by 0·292. But the air absorbs a large part of the sun's heat. The speaker considered it unreliable to estimate the height of the atmosphere from the amount of heat-absorption, as is frequently done, inasmuch as the chief absorption takes place in the deeper layers of the air. For the determination of the coefficient of absorption Dr. Zenker accepts the values obtained by Langley from his bolometric experiments, with a reservation, however, as regards the absorption which takes place in its highest layers, which he did not admit. One factor of great importance is the diffusion of heat, already described by Clausius, from the small particles of water, dust, and air in the atmosphere, which are calculated under other definite assumptions. Another factor which must not be lost sight of is the reflection of heat at the earth's surface; this is calculated for the three cases of a surface of water, land, and snow. Special tables are given of the heat reflected from these three kinds of earth-surface for separate places per day and per year. The application of this theoretical part of the research to the climatology of the earth's surface, the speaker intends to lay before the Society at some future time.—Dr. Less drew attention to the meteorological conditions of the past few days. A minimum temperature on March 1 was succeeded by a thaw on the evening of the 2nd, which was followed by a second very low temperature which again gave way to a thaw on the 6th. The rise and fall of the barometer corresponded to the above: the very considerable double variation in atmospheric pressure was caused by a minimum passing through South-West Sweden across the East Sea to Russia, which was succeeded by a partial minimum following the same course. Exactly similar meteorological conditions were in existence from February 4, and were caused by a minimum with its succeeding partial minimum following the same course as above. Such an exact similarity of path and action of two minima is of very rare occurrence, and deserves to be carefully studied; on both occasions, in February and March, very wintry weather was observed.—Dr. Hellman drew attention to the unusually heavy snow-fall of the past winter. As yet the maximum number of days on which snow falls in Berlin has been fifty, but this year up to the present time it has already fallen on fifty-eight days; in the same way, until this year never more than eight consecutive days of snow-fall have been observed, but this winter there has been one period of sixteen consecutive days on which snow has fallen.

STOCKHOLM.

Royal Academy of Sciences, March 14.—Studies on the Characeæ and Violæ of the Isles of Gotland and Oeland, by Dr. Wahlstedt.—Studies on the geographical distribution of the plants in the province of Wermland, by Dr. Ringius.—On the currents of disjunction, by Dr. Mebius.—On the institution of pendulum observations in Sweden, by Prof. Rosén.—A review of the Orthoptera of Scandinavia, with descriptions, by Dr. Haij.—Analyses of gadolinite and hornilite, by Dr. W. Pettersson.—On the production of nitro-cymol and its products of oxidation, by Prof. Widman and Dr. Söderbaum.—On the occurrences of *Limnadia lenticularis* on the Isle of Nordkoster in the province of Bohus, by Hr. Hanson.—A thunderstorm combined with water-spouts near Upsala, by Hr. Th. Wigertz.—On fossil wood from Egypt and Eastern Asia, by Prof. Schenk, of Leipzig.—Volcanoes in the interior of the north-eastern parts of Iceland, by Hr. Thoroddsen, of Reykjavik.—On the determination of the constants in the diurnal rotation, by Dr. Bohlin.

AMSTERDAM.

Royal Academy of Sciences, February 25.—M. Martin exhibited a geological chart of the course of the River Surinam, appending the communication that, during his stay in the West Indies, he succeeded in discovering the geological formation in which the gold occurring in those parts, and long since known as wash-gold, was originally deposited. This formation is the crystalline schist, a stratum in which, in Brazil also, most of the gold is met with. The speaker urged that Brazil and Surinam offer striking points of resemblance both in the order and nature of their stratifications.—M. de Vries made a communication on his determination of the molecular weight of raffinose. His results, based upon physiological methods, tended to support the formula of Loiseau and Scheibler,

$$C_{18}H_{32}O_{16} + 5H_2O.$$

—M. Hubrecht described the early stages in the development of the blastodermic vesicle of the hedgehog. He claimed that the stages observed and described by him go a long way towards explaining the questionable points in the early stages of the human blastodermic vesicles that have yet been noticed.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Fundamental Principles of Chemistry: R. Galloway (Longmans).—Reminiscences of Foreign Travel: R. Crawford (Longmans).—An Examination of the Theory of Evolution: G. Gresswell (Williams and Norgate).—Johnston's Botany Plates, II. (Johnston).—Key to the Volapük Grammar: A. Kirchhoff (Sonnenschein).—Specimens of Papers set at the Army Preliminary Examinations, 1882-87 (Macmillan).—Companion to the Weekly Problem Papers: Rev. J. J. Milne (Macmillan).—An Indictment of Darwin: O. Dawson (Freethought Publishing Company).—An Increase in the Produce of the Soil through the Rational Use of Nitrogenous Manure: P. Wagner; translated by G. G. Henderson (Whittaker).—Smoke in Relation to Fogs in London: Hon. Rollo Russell.

CONTENTS.