THURSDAY, APRIL 26, 1877

THE GEOLOGY OF THE LAKE COUNTRY

The Geology of the Northern Part of the English Lake District. Memoirs of the Geological Survey of England and Wales. By J. C. Ward, F.G.S. (London: Longmans, 1876.)

WHEN the staff of the Government Geological Survey first entered upon their labours, the Director, Sir H. de la Beche, saw very clearly that the work with which he was entrusted would be very imperfectly performed if he limited himself to the publication of geological maps and sections alone. He therefore gave orders that whenever from time to time sufficient portions of the country had been examined, descriptions of their geology should be issued, in which such details as could not be inserted on the maps should be recorded, and questions of theoretical and practical interest should be discussed. The Memoirs published in compliance with this regulation by Sir Henry himself and his coadjutors Phillips, Ramsay, Forbes, Hooker, Playfair, and others, are lasting witnesses both of the wisdom of the regulation itself and of the skill and energy with which the work of the Survey was carried on.

Then there came a time when the publication of explanatory memoirs was for a while dropped altogether, and so it happens that in many districts of the highest interest and importance, as for instance the Dorsetshire Coast, the Carboniferous Limestone country of Derbyshire, and the great coalfields of Derbyshire and North Staffordshire, we miss those descriptions which are elsewhere such a boon to the geological student, and the work of the Survey becomes shorn of half its usefulness.

When the publication of descriptive memoirs was resumed they took the form of small pamphlets, good as far as they went, but of the slenderest dimensions and almost niggardly in their details, in which for instance the geology of Charnwood Forest is dismissed in three pages, and eighteen pages are considered enough for the illustration of the important coalfield of Wigan and St. Helens. It is impossible to avoid contrasting these scanty bundles of notes with the exhaustive detail and broad scientific treatment that characterise the earlier publications of the Survey.

Of late years, however, there has been a welcome return to the old traditions which has resulted in the production of the admirable monographs on the Geology of Rutland, the Weald of Kent and Sussex, and the London Basin. The memoir now before us on the "Geology of the Northern Part of the English Lake District" is fully entitled to take rank with these latest productions of the Survey. It is curious, however, to find in it what looks like evidence of the existence in certain quarters of a sort of hankering after the vastly inferior class of memoirs which formed for a long time the staple of the Survey issues. In his Introductory Notice the Director, Mr. Bristow, thinks it necessary to apologise for the length to which the description has run, and to give a reason why the work "has been allowed to exceed the usual limits to which the explanations of such small areas as those comprised in quarter sheets have hitherto extended." We can assure the Director that he may make his mind easy on this point, for no one possessing even the most limited geological tastes and acquirements will find the book in any way too long; the only fear will be whether, from anxiety to cut down the memoir to regulation size, details and explanations that can be ill spared may not have been sacrificed. It will be an evil day for the Survey when it exchanges the scientific zeal which has hitherto so honourably distinguished its members, for a spirit in which devotion to official routine comes first and a desire for the spread of geological knowledge holds a subordinate place.

But *absit omen!* and a work like this furnishes good grounds for the hope that it never will be so. It might have been thought that the labours of Sedgwick and other eminent geologists had left little for their successors to do among the mountains and dells of Cumbria, but Mr. Ward has shown that there are many points yet remaining to be cleared up, and he has brought to bear on their elucidation the more refined methods and superior accuracy of the geology of the present day. He has investigated and admirably illustrated the microscopic character of many of the rocks; and though it is scarcely possible in the present state of our knowledge to determine exactly the geological bearing and value of some of his results, there are others whose great importance is even now obvious. In the case, for example, of some rocks which the naked eye cannot distinguish in hand specimens from flinty traps, microscopic examination confirms the conclusion arrived at on broad geological grounds that they are highly altered volcanic ashes. The descriptions of other altered rocks throw great light on the difficult question of metamorphism. The Skiddaw district is peculiarly interesting on account of the close parallel which its rocks present to the metamorphic beds of the Pyrenees so admirably worked out by Fuchs. We cannot but regret, however, that the papers which Mr. Ward has contributed on this subject to the Geological Society have not been more fully embodied in the present volume; a Survey memoir should aim at being a complete *vade-mecum* for the local geologist, and it is not every one in the wilds of Cumberland who has access to the pages of the *Quarterly Journal* of the Society.

Perhaps the most generally interesting features in the work are the account of the volcanic products with the localisation of the vents from which they were discharged, and the description of the glacial phenomena of the district. The author has with great skill used his experience of modern volcanic countries to make the old ruined Cumbrian volcanoes tell the tale of their whereabouts and performances. The glacial phenomena are worked out with singular thoroughness, and strong evidence is brought forward in favour of the "great submergence" on which Mr. James Geikie has thrown such considerable doubt.

It is dangerous for an outsider to differ from an observer who has spent so much time and spent it so well in working out the geology of a particular district, but there are two points, and two points that to a certain extent hang together, on which we must confess we are not altogether satisfied. These are the absence of any unconformity

between the Skiddaw slate and the overlying Volcanic Series, and the existence of the chain of faults which everywhere separates the two groups. Mr. Ward relies on the fact that beds of volcanic ash occur on the upper part of the Skiddaw slate. This shows that volcanic activity began before the deposition of the Skiddaw slate was completed, but it scarcely proves that no upheaval and denudation attended the commencement of the volcanic outbursts. Volcanic activity and elevation are so intimately connected that it may well be that the early discharges were the heralds of an upward movement of the rocks. The author indeed admits thus much, and believes that slow upheaval did attend the advent of volcanic activity, and that the bulk of the volcanic products are terrestrial. We should be inclined to go further, and to suggest that a long period may have followed the first volcanic outbreaks, during which the Skiddaw Slate was crumpled up and brought within the range of atmospheric denudation. Any volcanic deposits formed during this interval would of course be removed by denudation. By the time the volcanoes had reached their full growth, a land-surface, diversified by hill and valley, may have been produced, and when the volcanic products were showered down on this uneven floor, heaps of ash and sheets of lava would every here and there abut against banks of Skiddaw Slate, in a manner that produces to us a deceptive appearance of faulting. We give this hint merely for what it is worth, and have no wish to throw any doubt on the possibility of the boundary being such as the map represents it to be; indeed, instances about which there can be little doubt might be quoted, where two groups of rocks are parted by just such a jagged line of faults as that which Mr. Ward has drawn in the present case.

The book is liberally illustrated by maps and sections, and the bibliographical list of works relating to the geology of the district is a most welcome addition.

We cannot but feel that a great mistake has been made in the map which the memoir is intended to illustrate. As a typographical piece of work it is unsurpassed, but it is its excellence in this respect that makes it unsuited for geological purposes. The reliefs of the surface are admirably brought out by the hill shading, but in order to produce the desired effect, the hatching has been made so dark that in many places it is difficult, if not impossible, to distinguish the geological colouring and signs. The Ordnance Survey issue in the northern counties another set of one-inch maps, with contour-lines in the place of hill-shading, and had one of these been employed to receive the geological colouring, the very serious difficulty just mentioned would not have arisen. We have no hesitation in saying from actual experience in the use of both classes of maps, that had plain copies been used, the value of the map would have been well-nigh doubled.

Before concluding we would remonstrate with the author on his italics; the book bristles with them, till it reminds one of a school-girl's letter. This indiscriminate use of emphasis destroys that repose which is one of the chief charms of style, and in a very large number of cases there is no necessity for it, for the meaning would be perfectly clear without the adventitious aid of a variation in the type.

A. H. G.

VENNOR'S "ACCIPITRES OF CANADA"

Our Birds of Prey; or, The Eagles, Hawks, and Owls of Canada. By Henry G. Vennor, F.G.S. With Thirty Photographic Illustrations by W. Notman. 4to, pp. i.–viii., 1–154, plates i.-xxx. (Montreal: Dawson Brothers; London: Sampson Low and Co., 1876.)

SO little is really known respecting the ornithology of Canada that one cannot but welcome with great satisfaction such a substantial addition to our knowledge as has been given by Mr. Vennor in the present work. As a geologist employed on the survey of Canada the author has enjoyed unrivalled opportunities for studying many of the birds in the field, and although the fulfilment of his duties has prevented him from devoting his entire attention to ornithology, yet he has evidently kept his eyes open, and the work before us embodies the result of thirteen years' observation. It is to be regretted that at present Mr. Vennor has only written on the birds of prey, and it is to be hoped that he will continue his labours on the rest of the birds of Canada. The species themselves included in the present work are twenty-seven in number, and on all these very complete information seems to be given respecting their distribution in the Canadian dominion, including not only a *résumé* of the hitherto published facts, but giving also a large amount of new information. Excellent accounts of the habits of the birds are added, chiefly from the personal observations of the author himself, and each article concludes with the description of the species in which the colours of the soft parts are always given; this is a feature often omitted by Messrs. Baird, Brewer, and Ridgway in their recently-published "History of North American Birds." Mr. Vennor does not include among the species fully treated of, the Common Turkey Buzzard (*Rhinogryphus aurea*), which hardly extends to Canada in its northern range, though it is a regular summer visitant to "the extensive flats near Chatham and Lake St. Clair," while further to the westward it occurs frequently on the line of the forty-ninth parallel. Of the Barn Owl (*Strix flammea*), Mr. Vennor says that there is no authentic record of its occurrence in Canada, but we notice in Mr. Bowdler Sharpe's paper on the "Geographical Distribution of Barn Owls," published in Mr. Rowley's *Ornithological Miscellany*, that the British Museum contains a specimen from the neighbourhood of Toronto, collected near that city by Mr. James Whitely, who has resided there for some years, and has sent many interesting birds to this country. Other small points might also be alluded to in which we think further consideration on the author's part desirable, such as the relations between *Falco candicans* and *F. labradorus*, *Circus cinereus* and *C. hudsonius*, &c. We are not disposed to quarrel with the photographic illustrations to the book, which are excellent specimens of photography, although this mode of illustrating scientific works does not commend itself to our fancy. At any rate, however, a good photograph is better than a bad plate, especially in a work like the present, where the author's chief aim has been to give such a figure as may render the identification of the species more easy to the student, his object being, in his own words, "a work of practical utility, not a mere exhibition of pretty photographs." As a new worker in the vast field

of ornithology we welcome Mr. Vennor, and only trust that many years will not elapse before he gives us a second instalment on the birds of Canada.

OUR BOOK SHELF

The Use of the Spectroscope in its Application to Scientific and Practical Medicine. By Emil Rosenberg, M.D. (New York: Putnam, 1876.)

THIS is an essay on the use of the spectroscope which obtained the Stevens triennial prize for 1876, awarded by the College of Physicians and Surgeons.

It treats mainly of the absorption spectra of blood in its normal state and after being acted upon by other substances. The first chapter gives a very short account of the optics of the spectroscope, which the author does not pretend to treat fully; then follows a short notice of the emission spectra of the metals. The absorption bands of oxyhæmoglobin (scarlet cruorine) and their change to the one reduction band of hæmoglobin (purple cruorine) by the abstraction of oxygen, discovered by Prof. Stokes, then comes in for recognition. The remainder of the book is chiefly on the absorption spectrum of blood with reference to forensic medicine and its spectrum after the introduction of foreign matters and gases.

It appears from the numerous references that the author has compiled this essay from books and papers rather than from observation, and the authors referred to are with few exceptions Germans. We think the book is well suited for the perusal and reference of the medical profession and others taking up this special subject.

Journey in the Caucasus, Persia, and Turkey-in-Asia. By Lieut. Baron Max von Thielmann. Translated by Charles Heneage, F.R.G.S. Two vols. Map and Woodcuts. (London, Murray).

BARON THIELMANN'S journey, which was made in the year 1872, embraced all the Caucasian region, much of the western shore of the Caspian Sea, with the long stretch of country between Tabrez, Hillah, and Beyrout. Though this is a region about which a good deal has been written, the Baron's narrative will be found to contain a considerable addition to our knowledge. His observations on the people and the antiquities of the countries traversed are especially valuable, while the work contains as well much interesting topographical and geographical information. The Baron is an exceedingly pleasant travelling companion, and as Mr. Heneage has made a thoroughly readable translation, the work will be found of value both to the stay-at-home reader and as a guide to the intending tourist.

LETTERS TO THE EDITOR

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

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

Structure and Origin of Meteorites

IN the abstract of Mr. H. C. Sorby's lecture "On the Structure and Origin of Meteorites," given in NATURE, vol. xv., p. 495, in reference to the subject of glass globules observed by the lecturer in certain meteorites, the condition in which glassy particles given off by terrestrial volcanoes occur, is contrasted with that produced artificially in furnace slag by the action of a strong blast of hot air or steam. In the furnace slag "pear-shaped globules, each having a long hair-like tail," are described as being formed, whereas in the case of volcanoes the glassy particles are said, when given off, to be immediately solidified on entering the atmosphere, and to remain as mere fibres, as Pele's hair, or more or less irregular laminæ, like pumice dust. In fact, the formations in the two instances are closely similar. In the crater of Kilauea, in the Island of Hawai, wherever the well-known Pele's hair is in process of formation, long-tailed pear-shaped globules are formed in abundance, and a large proportion of the "hairs" are to be found with larger or smaller globules in connection with their ends.

I saw the formation of Pele's hair in two places in the crater.

In the one instance the formation occurred at the margin of one of the small lakes of molten lava. The lake was inclosed by a range of low cliffs, against the bases of which the waves of the extraordinarily fluid lava were constantly surging, being kept in perpetual commotion by the violent discharge of gases from beneath. The waves splashed up against the cliffs and spray and large drops were thrown into the air, and on the leeward side of the lake were driven by the wind over the top of the cliff so as to fall on a level platform of rock which was even with its summit.

The platform appeared as if melted pitch had been splashed out all over it, and was covered with small masses of pitch-like looking lava. Those of the masses which had evidently completely solidified before reaching the platform in their fall were pear-shaped, whilst in other cases where hardening had not been complete, the elongate masses falling in the soft condition had become flattened into irregular shapes, which showed more or less evident traces of the coiling of the masses as they fell.

All the masses had tails, some short and spike-like, others long and hair-like, and there was every gradation between stiff fine rods of transparent lava and the perfectly elastic hair of which a handful could readily be raked together with the fingers on the platform in a very short time.

In the other instance, the Pele's hair was seen by me around one of the small hollow cones or lava fountains which are constantly formed in the crater. The cone was not active at the time I saw it. It was surrounded with the small lava masses thrown out by it and forming a deposit closely similar to that formed at the margin of the lake, except that numerous larger lumps occurred amongst the smaller ones.

Very striking objects in the crater are large bubbles which have been formed in the lava when molten by the escaping gases. The surfaces of the bubbles are composed of extremely thin transparent laminæ, which look just like thin green bottle glass. Such bubbles are encountered at almost every step on the floor of superficially solidified lava, on which the visitor walks in the crater.

A remarkable peculiarity of the Hawaian lava is its extreme fluidity when in the molten condition. This property has brought about the unusual form of the great mountains of the island composed of it, which have so gradual a slope that the observer can hardly credit their great height when viewing them from the sea.

H. N. MOSELEY

Exeter College, Oxford

On the Simplest Continuous Manifoldness of Two Dimensions and of Finite Extent

IT could hardly fail to be instructive if Mr. Frankland would explain the following obvious paradox in his theory (NATURE, vol. xv., p. 515). Let two "straight lines" XOX′, LOL′, make an angle XOL other than a right angle, and consider the shortest line PN from a moving point P in LL′ to XX′; from the assumptions, this is a "straight line" perpendicular to XX′. As P moves from O along OL, it will by and by, according to the theory, be at L′; that is, on the other side of XX′, if our "straight lines" are "of the same shape all along." Now, to put it algebraically, how does the perpendicular come to change sign? It does not pass through infinity, for the manifoldness is of finite extent: it does not vanish except when P is at O; and though it is conceivable in itself that N should travel to a maximum distance along OX and come back again while P moves on, yet this contradicts our principal assumption, for each perpendicular will then have two points in common with LL′. Is a door of escape to be found through any interpretation of "continuous"? Or, while "there is nothing self-contradictory in the definition," is there something in it contradictory of the superposition-principle by means of which its consequences are worked out?

The theory is partly exemplified upon the surface of revolution got by bending a hemisphere till it closes up. Correspondence is pretty close as to points in the equator and the simpler figures symmetrical to it.

C. J. MONRO

Hadley, Barnet

Non-Amphibious Batrachians

ON calling the attention of the Rev. L. Blomefield (formerly Jenyns) to the interesting article in NATURE (vol. xv. p. 491) of a tree-frog which produced its young without their passing through the tadpole stage, he has been good enough to allow me to quote a MS. note to his work, "Observations on Natural History," p. 203, which may be useful to persons interested in the matter. It refers to a colony of toads which lived in a cellar of Bottisham Hall, Cambs, and without access to water. It runs as follows:—

"See some remarks by Mr. Lowe in the *Annals and Magazine of Natural History* (No. 64, April, 1853, p. 341), tending to show that under certain circumstances where the parent animals have no access to water, the reproduction of the toad and frog takes place without the intermediate stage of tadpole. He mentions instances of their depositing spawn in cellars and young toads being afterwards observed. Such was probably the case with the toads in the cellars of Bottisham Hall, though I never observed the spawn myself." "See further remarks by myself on this subject in *Annals of Natural History*, vol. xi. 2nd series, p. 482. See also NATURE, vol. vii. p. 401, on 'The Adaptation of Animals to External Conditions.'"

The following passage occurs in the Rev. L. Jenyn's "Manual of British Vertebrate Animals," p. 304-5, and bears upon the same phenomenon.

"*Triton punctatus*, Common Eft.

"This species is subject to considerable variation. It is also found on land, a circumstance which tends in some degree to alter its characters. In such specimens the skin loses its softness becoming opaque, and somewhat corrugated. The membranes of the back and tail entirely disappear, causing this last to appear narrower and thicker in proportion to its depth. The toes from being flattened become rounded; the colours are also everywhere more obscure. In this state it is the *Lacerta vulgaris* of Sheppard and Turton, and considered as a distinct species by these and other authors. I am, however, perfectly satisfied that it is identical with the aquatic kind, and that all its peculiarities may be traced to the change of circumstances under which it is placed. . . . I suspect that the period of time during which this species remains in the larva state is subject to much variation, and that if anything occur to oblige the young to exchange their native element for another before they would attain their perfect form, the gills are cast prematurely to enable the animal to accommodate itself to its new circumstances. The fact of such small specimens as Sheppard has noticed being found on land is indisputable, but I think I have generally observed some traces of there having *been* gills at no very long period before."

GEORGE HENSLOW

Morphology of "Selaginella"

IN consequence of my not having expressed myself sufficiently fully, Prof. Thiselton Dyer somewhat misapprehends my remarks respecting Selaginella and Carex, to which he is good enough to reply in NATURE (vol. xv. p. 489); and I shall be glad of an opportunity of explaining the nature of the comparison that I drew between the reproductive organs in these two genera.

I purposely avoided asserting that the spike of the one was the "homologue" of that of the other; and I thought that my change of expression—"instead of regarding . . . as the homologue . . . we compare it"—would sufficiently indicate that I was not raising the question of exact homology at all; but merely comparing the male and female structures of Selaginella (each as a whole) with those of a unisexual-flowering plant. I regret that I did not state this in explicit terms.

Notwithstanding what has been written by Sachs and others, it appeared to me that the homology between the reproductive organs of Cryptogams and Phanerogams could not be regarded as yet so completely settled as to be past doubt; and I therefore wished to exclude, as not material to the line of argument I had in view, such questions as to homology as Prof. Thiselton Dyer brings forward. He considers that the ovule, and not the ovary, is the equivalent of the macrosporangium. I did not wish, even by implication, either to assert or to deny this fact, and it does not affect my comparison in the least, for the female structure of Carex comprises of course an ovule. He further considers that this leaves the ovary unaccounted for; and not only so, but the perigynium and seta also. The essential part of a female flower is the ovule, which may be naked as in Gymnosperms; and the surroundings, whether consisting of an open carpellary leaf, an ovary, hypogynous scales, corolla, calyx, perigynium, or seta are accessories, and any of them may be absent. A comparison may surely be made between the female flower of a conifer (as a whole) with the much more complex one of a diclinous polypetalous plant, without being vitiated by the fact that parts of the latter are unaccounted for; and I thought, and with due respect still venture to think, that the macrosporangium of Selaginella with its covering scale, and the female flower of Carex with its covering glume, may properly be regarded as comparable.

Prof. Thiselton Dyer had compared the sporangia of Selaginella with the male and female elements of a single hermaphrodite flower, reversing their relative position on the axis; and my object was to show that, as each sporangium had its own "lateral appendage," they might be equally compared with the male and female elements in the separate unisexual flowers of a diclinous plant, without reversing their position on the axis. It was quite unnecessary for me to discuss which particular parts of the phanerogamic flower were the exact homologues of the macro- or micro-sporangia of the cryptogam; and I did not intend to express any opinion on that subject.

I thank Prof. Thiselton Dyer for drawing my attention to his paper on *C. pulicaris*, which, however, I have already had the pleasure of perusing; for I read everything written by him to which I have access; and I can assure him that, as a non-professional myself, I always receive his opinions with the respect that is their due, although in the present instance I cannot adopt his view as to the hermaphroditism of the primordial flower. That subject is, I think, sufficiently important to be discussed by abler pens than mine; and it was in the hope that it would receive the attention that it deserves, that I ventured to point out the diametrically opposite views that had been expressed by high authorities.

THOMAS COMBER

Newton le Willows, April 11

The Rocks of Charnwood Forest

THE announcement by Messrs. Bonney and Hill (NATURE, vol. xv. p. 470), of their *discovery* of the *intrusive* character of the ridge of rock, stretching from Groby on the south-east to Bardon Hill on the north-west, is a surprise to local geologists, they having recognised its *intrusive* character for the last quarter of a century.

The rocks constituting the "ridge" are called by different names—sienite, sienitic greenstone, greenstone, &c., according to the greater or less degree of crystallisation of the components, and the abundance, or scarcity, of some of them. Its intrusive character is very obvious. First we have Cambrian Rocks on both sides (east and west) of the "ridge," and at places near Groby these Cambrian rocks are less than half a mile apart. Second, the *effect of the intrusion* in breaking up the formerly overlying beds, is well seen near Markfield, where there are several low hills called the "Alter Stones;" these consist almost entirely of broken up fragments of unaltered Cambrian rocks embedded in a grey, coarse, felspathic base, the *fragments* forming more than two-thirds of the mass; similar beds occur beyond Bardon Hill, but the quantity of embedded fragments is not so great, but pieces are found eight to ten inches square quite unaltered, and showing the "ribboned" structure, red, purple, and green bands, so characteristic of the Cambrian rock of this area. Over other parts of this "igneous ridge" the broken and disturbed beds have long since been removed by denudation, but the *débris* is found in the "drift," which stretches far and wide for miles over the surrounding country. I think both Mr. Howell of the "Survey," who plotted this district, and Prof. Hull who did the adjoining one, recognised the *intrusive* character of the igneous rocks on the west side of Charnwood Forest. Many other facts bearing on this subject are known, but cannot be described in this short note. Any *new* facts discovered by Messrs. Bonney and Hill, in illustration of this matter, will be gladly received by local geologists.

Leicester JAMES PLANT

Patenas of Ceylon

I DO not think Mr. Abbay's suggestion of a possible cause of the origin of the Ceylon patenas will be found to hold good to the extent he believes it will. On the Dimbula patenas rock of any kind is very scarce, even if you go several feet down, and where it does occur, it is, to the best of my recollection, almost always gneiss. On the patena on my property it is certainly so throughout. In part of the Ouvah patena district, mentioned by

Mr. Abbay, the rock is limestone, as is proved by its being largely quarried and burned. Moreover, the patena soil in Ouvah is not of the ordinary worthless quality, at any rate in the opinion of planters owning portions of it, as they frequently assert that it is as good as the jungle soil of Dimbula, and the neighbouring districts. What truth there is in this I cannot say.

Further, though cleared forest land when abandoned usually runs into "chena," I could show Mr. Abbay, if he were to return to Ceylon, as I wish he would, cases in which it has run into patena. The Dimbula cricket ground is a case in point.

Pendleton, Manchester, April 17 E. HEELIS

Cumming's Electricity

IN a passage from my "Introduction to the Theory of Electricity" which you quote in a review of the work in NATURE, vol. xv. p. 526, occurs a very unfortunate misprint of the word *of* for the word *on*, which seems to have misled your reviewer, and I therefore beg a few lines to correct it. The passage in question is the statement of Prop. 8, p. 203, which ought to have been written: "In computing the potential on any closed circuit we may substitute for it any closed circuit which is obtained by projecting the given circuit by means of lines of force."

In defence of this phrase I may perhaps be allowed to point out that the definition of potential quoted by the reviewer as that of Sir William Thomson is not the definition of potential but of *electrostatic potential at a point*, which is given at p. 45 of my book. The phrase potential on an electrified body in a field of electrical force is, I hold, perfectly legitimate, denoting the work done against electrical forces in moving the body (supposing all electrification undisturbed by the movement) to an infinite distance out of the field.

The case in point, however, refers to electro-magnetic potential and the potential on the closed circuit really represents the work done in carrying the circuit against magnetic forces out of the magnetic field.

The phrase suggested in your review—induction through the circuit—I had purposely avoided as liable to be confused with ordinary "magnetic induction" in a mass of magnetic iron, or with the "self-induction" of the circuit, or even with the induced current produced by the movement of the circuit, while the phrase potential on the circuit is at once suggestive of its own meaning and clear from any ambiguity.

Rugby, April 19 L. CUMMING

Remarkable Papuan Skull

I WISH to call your attention to a remarkable Papuan skull which Prof. Mantegazza showed at the last meeting of the Anthropological Society of Italy. The upper jaw contained very distinctly no less than four molars and two canine teeth on each side, all the molars being well developed.

Unfortunately the lower jaw is missing, but if it corresponded with the upper jaw, as we may justly presume—the whole skull not showing any abnormality of structure—the total number of teeth would amount to *forty*. There are cases recorded of negro-skulls showing three, four, and five supernumerary teeth, but *eight* is certainly an *extremely rare* occurrence.

It would be interesting to know whether museums or collections in England contain any similar specimens. J. E. Z.

Meteor

ABOUT 10.50 P.M. on the night of Monday, the 16th inst., the sky being cloudless and the young moon just setting, I observed a remarkable meteor in the northern heavens. It originated near to the star γ Cephei, and travelled towards the eastern horizon, its path forming an angle of about 35° with the perpendicular. The head, two or three times as large and bright as Venus, was bluish, and left a trail of yellowish light. I took it at first for a falling rocket, whose ascent I had not noticed; but its transient existence, its sudden extinction without noise or sparks, and the straightness of its path, with only a slight zig-zag, but no curve, preclude that explanation I think.

Leicester, April 17 F. T. MOTT

OUR ASTRONOMICAL COLUMN

THE U.S. NAVAL OBSERVATORY, WASHINGTON.—Under the title "Instruments and Publications of the United States Naval Observatory," the superintendent has circulated a series of photographs of the instruments at present in use in that noble astronomical institution. They are taken by the heliotype process, and comprise (1) the mural circle, mounted in 1844, aperture 4·1 inch; the transit instrument, 5·33 inch aperture, mounted in the same year, and placed in the same room beside the mural circle; the smaller equatorial, mounted in 1844, with which so much good work has been performed, aperture 9·62 inch; the transit-circle, by Pistor and Martins, Berlin, which was mounted in 1866, the aperture of the object-glass 8·52 inch, and the focal length 12 feet 1 inch; a general view of the grand 26-inch refractor, of 32 feet 5·8 inch focal length, mounted in 1873, and one of the most powerful telescopes in the world; the clock-work, &c., of this magnificent instrument is shown on a separate plate. Brief descriptions accompany these heliotypes, and in addition are drawings made with the 26-inch equatorial of the nebula in Orion, the omega nebula, the annular nebula in Lyra, and the planet Saturn. Some account of the foundation of the observatory and a list of its publications from 1845–76 precede the brief description of the instruments of which views are presented.

NEW VARIABLE STAR.—A recent number of M. Leverrier's *Bulletin International* contains a notice from MM. Henry respecting a variable star in Virgo, which they state has been under observation for some time. The period is about seven months, and the limits of variation 8m. to 14m.; at present it is near a maximum. The position for 1877·0 is in R.A. 12h. 27m. 32·2s., N.P.D. 93° 44′ 37″.

EARLY OBSERVATION OF SOLAR SPOTS.—In our popular astronomical works the Chinese are not usually credited with the observation of spots upon the sun at a distant date. Gaubil, however, records from the Chinese annals that on May 7, 826 black spots were seen on the sun's disc, and again on April 21, 832. There are, indeed, few phenomena which are not noted by this observant people, or rather by their watchful astronomers; yet, strange to say, the zodiacal light is amongst them. And it is singular that while Kepler's star of 1604 is duly recorded, the Chinese annals have no reference to the similar object in 1572, with which the name of Tycho Brahe is commonly associated.

COMET 1877 III.—The comet discovered by M. Borelly at Marseilles, on April 14, appears to have been detected three or four nights earlier by Mr. Lewis Swift, of Rochester, New York, who is already the independent discoverer of more than one of these bodies. We say three or four nights earlier, for although the telegram forwarded to Europe through the Smithsonian Institution dates the observation on the night of April 11, the rough place there assigned agrees more nearly with the computed position for the previous midnight. In circular No. xxv. of the Imperial Academy of Sciences at Vienna, are elements by Dr. Holetschek, from the first three nights' observations, which it is remarked have "a very great resemblance to those of the comet of the year 1762." The following orbit has been calculated by Mr. Hind from the first complete observation at Marseilles, on April 14, one at Mannheim by Prof. Schönfeld, on the 16th, and a third at the observatory of Mr. J. Gurney Barclay, at Leyton, on the 19th. For the sake of comparison the elements of the comet of 1762, calculated by Burckhardt, after a new reduction of the Paris observations, are annexed.

	Comet 1877 III.	Comet 1762.
Perihelion Passage (G.M.T.) ...	April 26·9501	May 28·3345
Long. of Perihelion	102 45 51	104 2 0
,, Ascending Node ...	345 53 18	348 33 5
Inclination	77 8 56	85 38 13
Perihelion Distance	1·01089	1·00905

The motion is direct. It will be remarked that the only material difference is in the inclination of the orbits to the ecliptic. The comet of 1762 was discovered in the Netherlands, by Klinken-

burg, on May 17, and was observed by Messier and Maraldi at Paris until July 2. When first seen it was just visible to the naked eye. The interval between the perihelion passages is 114·91 years, and with such period of revolution, with the other elements of 1762, the descending node would fall about 0·27 from the orbit of Mars and the ascending node at a radius-vector of 3·35, or in the region occupied by the minor planets; thus the difference of inclination will not be easily explained on the supposition of identity of the comets, though it must be remarked that elements of the present comet founded upon the first few days' observations may be open to more sensible correction than is usually the case.

"THE OBSERVATORY, A MONTHLY REVIEW OF ASTRONOMY."—There is ample room for the new astronomical periodical, which has been launched by Mr. Christie, the First Assistant of the Royal Observatory, Greenwich, under the above title, during the last week. Its aim is to present in a popular form a general survey of the progress of astronomy and to afford early intimation of recent advances. Such a publication ought to be well supported in this country, where astronomical amateurs are in great force. The first number holds out good augury for the future; amongst the contents are a report of the proceedings at the last meeting of the Royal Astronomical Society, proceedings which are not detailed in the *Monthly Notices*, where the discussions following the reading of papers are, as a rule, ignored, but which, as everyone knows who has been in the habit of attending the meetings of our scientific societies, are frequently the most interesting feature in the evening's proceedings; and we hope this point will not be lost sight of in the new periodical. There is an article on the photographic spectra of stars, a subject known to have lately much occupied the attention of the president, by whom it is furnished; the first part of a contribution from Mr. Gill, on the determination of the solar parallax; remarks on the nebular hypothesis, by Mr. Darwin, being an account of an inquiry intended to suggest a cause which may fill up a hiatus in the theory, and an outline of the results of Dr. von Asten's researches on the motion of Encke's Comet, recently communicated to the St. Petersburg Academy; also, ephemerides for physical observations of the moon and of Jupiter, by Mr. Marth, whose assistance in this direction deserves the high appreciation of observers. We will further express the hope that accuracy of typography may characterise the future numbers of Mr. Christie's publication; it is most important that this should be the case if the confidence of the practical astronomer is to be secured for it, and we are induced to offer this suggestion from remarking one or two inaccuracies in the first number, as on p. 4, where the search for an intra-mercurial planet by the Rev. S. J. Perry is dated in April instead of in March, and on p. 27, where Mr. Swift's discovery of the comet subsequently found by M. Borrelly, is erroneously referred to April 5, which was the date of discovery of the previous comet.

THE NEBULÆ—WHAT ARE THEY?[1]

BEFORE the announcement of Mr. Huggins's discovery of the presence of bright lines in the spectra of nebulæ, it was generally, if not universally, accepted as a fact that nebulæ were merely stellar clusters irresolvable on account of their great distances from us. This view had become impressed on the minds of many of our greatest observing astronomers in the progress of their work, and is one therefore which should not lightly be abandoned.

It appears to me that Mr. Huggins's observations instead of being inconsistent with the view formerly held by astronomers, are rather confirmatory of the correctness of that view.

[1] On a Cause for the Appearance of Bright Lines in the Spectra of Irresolvable Star Clusters. Paper read at the Royal Society by E. J. Stone, M.A., F.R.S., Her Majesty's Astronomer, Cape of Good Hope.

The sun is known to be surrounded by a gaseous envelope of very considerable extent. Similar envelopes must surround the stars generally. Conceive a close stellar cluster. Each star, if isolated, would be surrounded by its own gaseous envelope. These gaseous envelopes might, in the case of a cluster, form over the whole, or a part of the cluster, a continuous mass of gas. So long as such a cluster was within a certain distance from us the light from the stellar masses would predominate over that of the gaseous envelopes. The spectrum would therefore be an ordinary stellar spectrum. Suppose such a cluster to be removed further and further from us, the light from each star would be diminished in the proportion of the inverse square of the distance; but such would not be the case with the light from the enveloping surface formed by the gaseous envelopes. The light from this envelope received on a slit in the focus of an object-glass would be sensibly constant because the contributing area would be increased in the same proportion that the light received from each part is diminished. The result would be that at some definite distance, and all greater distances, the preponderating light received from such a cluster would be derived from the gaseous envelopes and not from the isolated stellar masses. The spectrum of the cluster would therefore become a linear one, like that from the gaseous surroundings of our own sun. The linear spectrum might, of course, under certain circumstances, be seen mixed up with a feeble continuous spectrum from the light of the stars themselves.

It should be noticed that, in this view of the subject, the linear spectrum can only appear when the resolvability of the cluster is at least injuriously affected by the light of the gaseous envelopes, becoming sensibly proportional to that from the stellar masses, and that in the great majority of such cases it would only be in the light from the irresolvable portions of the cluster that bright lines could be seen in the spectrum.

The changes in form which would be presented to us by such a nebula might be expected to be small. These changes would depend chiefly upon changes in the distribution of the stellar masses constituting the cluster. It has always appeared to me difficult to realise the conditions under which isolated irregular masses of gas, presenting to us sharp angular points, could exist uncontrolled by any central gravitational mass without showing larger changes in form than appear to have been the case with many of the nebulæ. In my view of the nature of nebulæ this difficulty no longer exists.

THE RACES AND TRIBES OF THE CHAD BASIN

ON this subject a most valuable paper has been contributed to the last number of the *Zeitschrift der Gesellschaft für Erdkunde* by Dr. G. Nachtigal, one of the few living writers entitled to speak with authority on the ethnography of Sudan. While the great problems now being rapidly solved in the portion of Africa lying south of the equator are almost exclusively of a strictly geographical nature, those still awaiting solution in the northern half of the Continent are on the contrary mainly of an ethnological character. The reason of this pointed difference is very obvious. Although there are vast regions south of the line still unexplored, enough is already known to warrant the conclusion that what remains to be there discovered is peopled by the same great race holding almost exclusive possession of the parts already opened up by the spirit of modern enterprise. With the sole exception of the extreme south-western corner, occupied by the Namaqua and Cape Hottentots, and of some districts also in the south still haunted by a few straggling Bushman tribes, the whole of Africa from the equator southwards would seem to be the domain of what is now conventionally known to philologists as the Bantu

family. Whatever be their origin, all the countless tribes here settled are now at least linguistically united into one group, all of them, with the exceptions already specified, apparently speaking dialects of some one common mother tongue now extinct. Hence however interesting the questions that still remain to be settled relating to the physical geography of Africa south of the equator, its ethnography, so far as that can be determined by the test of language, presents little or no further difficulty.

But north of the equator the case is completely reversed. Here there doubtless remain to be cleared up some few geographical points, such, for instance, as the water parting of the White Nile and Lake Chad, the course of the Upper Shari, and especially that of the Ogoway, so far as it may flow north of the line. But on the whole the main physical features of this half of the continent may be said to be at last fairly settled.

Its ethnology, on the contrary, only becomes all the more complicated in proportion as our knowledge of the land and its peoples increases.[1] No doubt we have here also one or two widespread linguistic groups, such as the Semitic, represented by two of its branches—the Arabic in the Barbary States and Egypt, and the Himyaritic (Lesana Gêz, Tigré, and Amharic) in Abyssinia. There is also the great Hamitic family, with its three distinct branches—Egyptian, Libyan, and Ethiopic—occupying more than one half of the Sahara, from about the 15° E. long. to the Atlantic seaboard, large tracts in the south of the Barbary States, parts of Egypt and Nubia, and the whole of the Galla country and Somaliland as far south as the River Dana or Pocomo, where it is met by the Waswahili and other Bantu tribes of the eastern seaboard.

But there still remains the pure negro race, properly so-called, occupying nearly the whole of the Sudan in its widest sense, the banks of the White Nile, and all its head streams, from Khartum to the Victoria Nile, and in all probability the still unexplored regions of the Ogoway, and of Central equatorial Africa generally, from Cape Lopez inland, to the Blue Mountains west of the Albert Nyanza, and from Lake Chad southwards to the equator. Here we find innumerable negro tribes, dwelling more especially in three great centres of population—the region between the Niger and the West Coast, the Basin of the Chad, and the Upper Nile, with all its head streams[2]—tribes generally speaking differing as much in speech as they would seem on the whole to resemble each other in their main physical features. Here live the Wolofs, the Veis, the numerous Mandenga and Haussa peoples, the Fulahs (who, however, are not Negroes), the Masa family, the Bagirmi, Babir, Nyamnyam, Shilluk, and many other Niger, Gambia, Chad, and Nilotic races, all speaking idioms seemingly in no way related to each other, and in fact possessing nothing in common with any known forms of speech beyond the general and somewhat vague feature of agglutination characteristic of most, if not of all, of them. Here, therefore, we have many linguistic and ethnological puzzles still awaiting solution, and forming, as stated, the counterpart of the topographical mysteries now being so successfully unveiled in the southern half of the continent.

The Basin of Lake Chad, situated in the very heart of this vast region, is peopled by such a bewildering number of races, as to have hitherto baffled all attempts at analysis, or any general classification based on recognised scientific principles. Here we find dwelling either separately or together, branches of the Semite, Hamite, Fulah, and Haussa races, though none of them, except the Semite Arabs, in any considerable numbers. Here is further represented every variety of the mysterious Tibu people, who elsewhere share the Great Desert with the Twareg (Tuareg) Berbers—Teda and Dasa, that is, northern and southern Tibus, Tibus pure and mixed, nomad and settled. Here also are the Kanembu,[1] or people of Kanem, who are Tibus one degree removed, and the Kanuri or Magomi, the ruling race in Bornu, who may be described as Tibus, or rather Kanembu, in the third and fourth degree, in other words, half-caste descendants of Kanembu and the Aboriginal Negro inhabitants of the land. Here are, moreover, the Margi, Mandara, Makari, Logon, and other members of the Masa or Mosgu family, in all probability akin to, if not the collateral descendants of, the So or Sou people, now either extinct or absorbed in the Tara, Manga, Ngalmaduko, Dalatoa, and other Kanuri tribes. Here, too, are the Bede, Babir, and some other independent or unclassified Negro peoples, fragments of the Kuka and Bulala from Lake Fittri, and lastly, the Bagirmi from the neighbourhood of the Middle Shari, and apparently connected with the Jur and Dor tribes on the western head waters of the White Nile, thus forming a sort of connecting link between the Nilotic Negro tribes, and those of Central Sudan.

All or most of these data were doubtless previously known, at least in a vague or general way; but thanks to Dr. Nachtigal's careful investigations on the spot, we are now for the first time enabled to form a clear idea of the various geographical, political, social, and linguistic relations of these different peoples, one to the other. Unfortunately in his elaborate monograph he treats the whole subject under the threefold division of races in Kanem, Bornu, and the lake islands, a political rather than an ethnographic distribution, which is all the more confusing that several Kanembu tribes, such as the Sugurti and Tomagheri, are now settled also in Bornu, while on the other hand several Bornu or Kanuri people, such as the Magomi of Fuli on the east coast, the Bulua, Malemia, and Ngalma Dukko, have found their way back to Kanem, whence their forefathers originally migrated westwards.

The inconvenience, however, arising out of this arrangement of the subject matter is largely obviated by the excellent coloured map accompanying the paper, without which it would in fact be scarcely intelligible to the ordinary reader. It will therefore be necessary in the subjoined *résumé* of Nachtigal's conclusions to depart somewhat from his triple division, and give a general classification of all the Chad races, based rather on their permanent linguistic and physical affinities than on their accidental political relations, while in all other respects closely adhering to the data supplied by him.

The map above referred to is shaded in ten different colours, corresponding to so many distinct peoples. But one of these colours comprises four not yet classified Negro tribes on the west and south-west frontier of Bornu, between that state and the adjoining Haussa states further west. On the other hand, the Bagirmi are not represented at all by any of these colours, so that four more shades would really be needed to embrace all the Chad races, while even then excluding such more remote peoples as the Adamawa on the south-west and the Fulahs on the west.

It thus appears that all the peoples dwelling either round about the Chad or on its numerous islands may be grouped under the subjoined fourteen main divisions:—(1) Tibus (Teda, Dasa, and Kojam); (2) Kanembu;

[1] A striking proof of this is afforded by the recent expedition of Dr. W. Junker along the Lower Sobat from its junction with the White Nile to Nasser, the most advanced Egyptian military station in that direction. He informs us that between these two points are spoken no less than five distinct idioms, some of which are now heard of for the first time. These would seem to be the Nuer, along the right bank of the Sobat, and the Shilluk, Janghey, Fallangh, and Nuiak on the left. And beyond Nasser he reports the existence of many other independent tribes on the Middle and Upper Sobat, such as the Bonjak, Jibbe, Kunkung, Nikuar, and Chai, all apparently speaking different languages.

[2] Reporting last year to the Egyptian Government on the White Nile between Duffli and Magungo, Gen. Gordon Pasha remarks: "Le pays est très peuplé; beaucoup plus qu'aucune autre partie de l'Afrique."

[1] The suffix *bu* is simply the plural of the personal suffix *ma*: *Kanemma* = a native of Kanem; *Kanembu* = the people of Kanem.

(3) Kanuri or Magomi; (4) Masa or Mosgu; (5) Yedina or Buduma and Kuri; (6) Bulala and Kuka; (7) Dana or Danawa; (8) Bede; (9) Ngisem; (10) Kerrikerri; (11) Babir; (12) Bagirmi; (13) Haussa; (14) Arabs.

1. TIBUS, of whom, as already stated, every variety is represented. They occupy the greater part of Kanem proper and are found on both banks of the Komodugu Yoobe in Bornu, between the 12° and 13° E. long. Principal pure nomad Tibu tribes: Gunda, Atereta, Worda, Juroa, or Osumma, Mada, Wandala, Dogorda, with a total population of 13,000. Principal pure settled Tibu tribes: Salemea, Beggaroa, Aborda, Nawarma, Oreddo, and Billea, numbering altogether 4,400. Mixed and doubtful Tibu tribes: Gadawa, Kumosoalla, Hawalla, or Famalla, Medolea, Jinoa or Mallemin, say 10,500, giving a total of 27,900 Tibus in the Chad district.

2. KANEMBU, dwell principally round the eastern, northern, and western shores of the lake, therefore, as already remarked, both in Kanem and Bornu. Their principal tribes are the Sugurti and the Tomaghera or Tomagheri, both in Kanem and Bornu; the Konku, Gallabu, Kuburi, Kunkinna, &c., with a total population of over 18,000.

3. KANURI, the ruling people of Bornu, and by far the most important nation in the Chad basin. Nachtigal proposes two derivations of the name: first from the Arabic نور=nūr=light, and the Kanuri prefix *Ka*, implying the concrete idea of "the people of light," as the first heralds of Islam in the Pagan lands occupied by them. But this mixture of elements from two radically distinct languages, though perhaps interesting to Mr. J. C. Clough and other advocates of mixed languages, can scarcely be meant seriously. It is as if the first English settlers in the Fiji Archipelago were to announce themselves as the "lumen-bearers," as the first messengers of the "lumen evangelii," or "light of the Gospel," to the natives of those islands. Second, and much more probably, a corruption of *Kanemri*, implying their Kanem origin, already referred to. Principal Kanuri tribes in Kanem: Bulua, Anjalibu, Rogodobu, Biradull, Biriwa, Melemia, Forebu, Ngalma Dukko, the Magomi of Fuli, and Dalatoa. These last, though claiming to be considered a Kanuri people, being really descended from slaves of other races subject to them. Principal tribes in Bornu: The Magomi or Kanuri proper, the Tura, Manga, Nguma, Kai, Ngallaga, Ngalmaduko, Ngomatibu, Ngasir, &c., with a total population of about 1,500,000.

4. MOSGU or MASA family occupies the region south of the Chad as far as Adamawa, and seems to belong to the same race as the extinct So and other autochthonous peoples of Bornu either extirpated by, or absorbed in, the Kanembu invaders of that region. Principal tribes: Margi, Mandara, Mekari or Kotoko, Logon, Gamergu, the unsettled Keribina, and the Mosgu or Masa proper. Masa is the name by which they call themselves. They may number altogether about one million.

5. YEDINA, or BUDUMA and KURI, are the two native lake tribes, the former dwelling on the great central group of islands, the latter on the Karka, or smaller South-eastern Archipelago. Yedina is the proper name of the first, Buduma being the name by which they are known to the Kanuri, from *Budu=hay*, and the suffix *ma* singular (for the plural *bu*), meaning the "hay-people." They are fierce and daring pirates; the terror of the surrounding nations. The Kuri, so called by the Arabs and others, call themselves *Kalea* or *Kaleama*, and are undoubtedly akin to the Yedina, though the two languages vary not a little. Principal Yedina tribes: Maijoja, Maibulua, Buja, Guria, Margauna, Jillna; numbering from 15,000 to 20,000 altogether. Principal Kuri tribes: Arigna, Media, Kadiwa, Toshea, Karawa, Kalea.

6. BULALA and KUKA, kindred tribes, originally from Lake Fittri, whither most of them seem to have returned. Some of the Bulala have withdrawn to a few of the islands in the lake, but the four following tribes are still in Kanem: Ngijem, Bedde, Sarabu, and Tirra, all off the south-east shore of the lake. The Kuka are now found only in Gujer, in the same neighbourhood. They jointly number about 5,800.

7. DANA or DANAWA, called by the Arabs *Haddad*, and by the Dasa or Southern Tibus *Azoa*, both terms meaning "Smiths," occupy a compact territory at the south-east corner of the lake opposite the Korio group of islands inhabited by the Kanembu. According to their tradition, the Danawa are half-caste Manga Tibus and Bulalas, but they now speak a Kanuri dialect.

8. BEDE, about 12° 30′ N. lat., 11° E. long.

9. NGISEM, 12° N. lat., 11° E. long.

10. KERRIKERRI, 11° 30′ N. lat., 11° E. long.

11. BABIR, 11° N. lat., 12° E. long.

Unclassified aboriginal Negro tribes on the west and south-west frontier of Bornu, confining westwards on the Haussa States, and southwards on Adamawa.

12. BAGIRMI, along the eastern or right bank of the Lower Shari, with undefined southern limits, and extending north-eastwards in the direction of Lake Fittri and Waday. Are closely related to the Sara tribes of the Middle Shari, and are also connected with the Jur and Dor dwelling on some of the head waters of the White Nile. Some of the Bagirmi are settled in Bornu, where they are called Karde, possibly through some confusion with their northern neighbours, the Kredas of the Bahr-el-Ghazal, who are Dasa or Southern Tibus akin to the Sakerda further up the bed of that now dried-up stream.

13. HAUSSA communities exist in one place only in Bornu, the district round about Gummel, on the 13° parallel and the 10° E. long. north-east of Kano.

14. ARAB TRIBES are found both in Kanem and Bornu. The principal Kanem tribes are the Tunjer, Uledsoliman (Wassili), and Mgharba, about 80,000 altogether. The principal Bornu tribes are the Auladhamed and Salamat, numbering perhaps 100,000. Many of them have become in some respects assimilated to the surrounding Kanuri people, but still hold tenaciously to their Semite speech. "I have met with Arabs settled in Bornu for a series of generations, near the centre of the kingdom, and who were still so little acquainted with the Kanuri language that I was obliged to act as their interpreter" (Nachtigal). These Bornu Arabs are called Shoa by the Kanuri, and are carefully to be distinguished from those Arabs who occasionally make their appearance in these regions, either as marauders or traders from the Barbary States.

Though mainly ethnological, Dr. Nachtigal's paper is introduced with a few geographical notes, which, however, present little or no novelty. The lake is described as about 27,000 square kilometres in superficial area, of a triangular shape, open and navigable in its western section, but along its eastern shores crowded by a large number of islands in many places separated only by narrow channels one from the other. The upper course of its one great affluent, the Shari, still remains to be determined, the writer merely remarking on that point that it flows "in two main streams apparently rising in the heathen lands to the south and south-east of Waday, receives a small portion of the rivers flowing down the western slopes of the Marra range, and throughout the whole year discharges a considerable volume of water into the lake." The Bahr-el-Ghazal, its former north-easterly outflow, has long been dried up, so that the Chad has now no outlet of any sort, its waters being kept by evaporation alone at their present variable levels.

But nothing could possibly be more thorough and satisfactory than Nachtigal's elucidation of the complicate ethnography of this region, which he has disentangled as successfully as Stanley has just solved the geographical problems connected with Lake Tanganyika.

A. H. KEANE

THE "LOST ATLANTIS" AND THE "CHALLENGER" SOUNDINGS[1]

IT may perhaps not be at first apparent what is the connection between those tubes and masses of metal and other apparatus on the right and these fossil leaves in the cases on the left. Those are some of the sounding apparatus used on board the *Challenger* in her four years' voyage. They have been brought from the galleries of the Loan Collection of Scientific Apparatus, where they are deposited by the Admiralty, into this theatre, in order to illustrate the method by which deep-sea soundings and temperatures are ascertained. It is the results obtained from soundings in the Atlantic Ocean alone that we shall consider this evening. While the working out of these results, as shown in the diagram, has been accomplished by the staff of the *Challenger*, there are some few other ships to which passing allusion will have to be made. These fossil leaves, deposited by Mr. J. Starkie Gardner, F.G.S., are also brought in from the Loan Collection. It is not these particular leaves we have to consider; these are all English: but we shall have to consider the teachings of collections of leaves similar as regards their manner of preservation, obtained from different parts of Europe and America. There are no specimens at present in the collection besides these, though until recently there was the small typical collection of the Baron von Ettingshausen. These English specimens will, however, serve our purpose very well as illustrations to convey an idea of what Tertiary fossil leaves look like.

The connection between these two subjects is here. We are going to consider certain past vegetations which are made known to us by their fossil remains. The study of some of them led Prof. Unger by a process of reasoning that will be presently indicated, to the belief that there existed in Tertiary times land between Europe and America by which the ancestors of the plants gradually travelled from America to Europe. It is now seventeen years ago that Prof. Unger proposed to call this hypothetical land the Island of Atlantis;—the sunken island or lost island of Atlantis. It was, no doubt, what our American cousins would call "a big thing" for a botanist to do, to "create" a former land in mid-ocean simply because he wanted it to account for the migration of the ancestors of fossil plants he had studied, and to do so without a particle of physical evidence. It was the first time in the history of geological science that so bold a step had been taken. The arguments by which Unger arrived at his conclusions were criticised at the time and another route for migration by the Pacific was suggested.[2] Whatever may be opinions as to the value of the evidence on which Prof. Unger based his "lost *Atlantis*," we now know from the *Challenger* working out of soundings that not only a "sunken island," but a ridge does lie in mid-Atlantic between the Old and New World.

Our subject groups itself into three divisions:—(1) Tertiary fossil plants; (2) Deep-sea soundings; (3) the "Atlantis ridge."

[The lecturer then turned to the fossil leaves, and described their manner of preservation and the conditions under which they are met with, and referring to diagrams and tables explained the meaning of the word Tertiary.]

No one now doubts these are really the remains of plants that grew and are not *lapides sui generis*. In comparing them with living plants and determining their affinities there are many difficulties to be encountered. The remains themselves are often fragmentary. Even when they are tolerably perfect the comparisons have to be made for the most part with specimens in herbaria, and the variations seen in the few leaves of a specimen often suggest that variations from different parts of the tree may be considerable. With fruits and with ferns preserving the fructification, the determination is safer, but with leaves alone, while in some well-marked cases there can be hardly a doubt, in a large proportion of cases the doubt is great. When the lecturer first paid attention to the Lower Bagshot flora, fourteen years ago, he thought, as many unacquainted with the subject might think, that with such herbaria as at Kew and the British Museum the work of comparison would be simple. The riches of these places will soon show, however, that a wide experience and a trained eye are needed to refer to all the species, frequently of orders and genera widely separated in the natural classification, whose leaves resemble a fossil leaf under consideration. Those who may try the work will more readily understand how it was that a few years ago not a single English botanist of note was willing to attach any importance to the determinations based on fossil leaves alone.

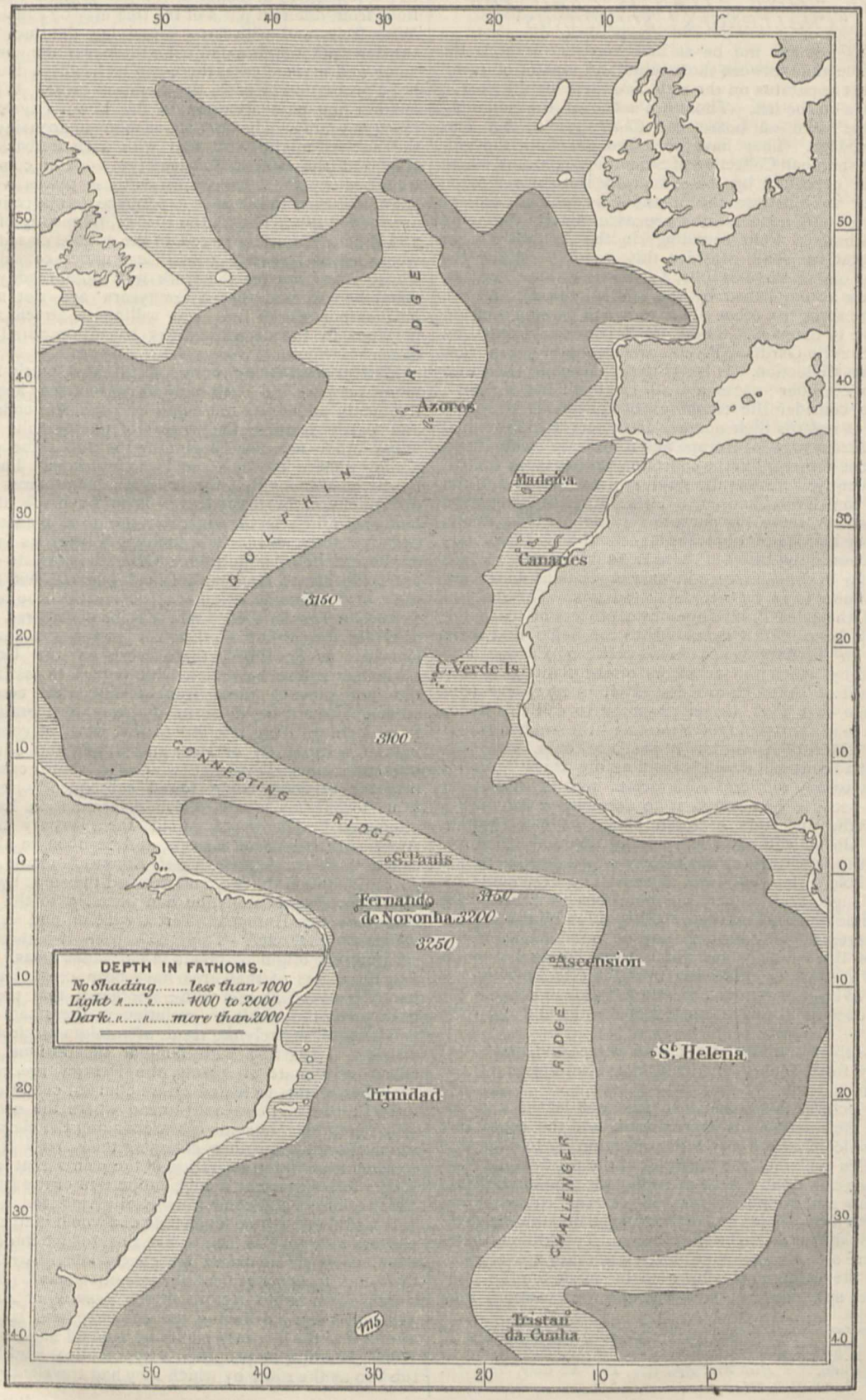
Matters are looking more hopeful now, partly because more perfect and well-marked specimens are being frequently added to museums and private collections, and partly because the writers of monographs on any living order are now beginning to adopt the plan of adding what is known about its fossil forms. There can hardly be a doubt that the solid reliable progress in the determination of fossil leaves is to be made alone by botanists who select a particular group of plants for exhaustive study, and include such fossil forms as they find no hesitation in admitting. General botanists of even great experience may make good guesses, but nothing short of the determination of a specialist can be regarded as absolutely safe, even if that may be considered so.

While the feeling of English botanists a few years ago was as described, there were on the Continent some few whose hesitation with regard to fossil leaves did not prevent them from trying what could and what could not be done in the way of identification. [The lecturer then referred to the work of continental botanists, especially of Heer and Unger, and alluded to the confirmatory evidence which in some cases had occurred of fruits being found subsequently from the same locality as leaves, whose determination had been attempted.] Unger compared the Tertiary flora of America with that of Europe, and in 1860, in a lecture called "Die versunkene Insel Atlantis," made a comparison between the two, and detailed the steps by which, after twenty years' study, he had been led to the conclusion that the European Tertiary flora had a North American character. There have been two theories respecting the origin of plants in particular areas. One is that the plants of that area have been created there as fully developed as met with; another is that they have been partly the result of evolution in the same district, and partly or entirely the result of immigration from other districts. [Starting with familiar illustrations of the effects of climate on plants, the lecturer proceeded to show how plants retreated before climatal conditions that were hostile to them and spread where the conditions were favourable, in some cases changing the elevation at which they grew, in others changing their area.] It was the consideration of the migration of the plants that led Prof. Unger to believe that a high proportion of the European Tertiary forms had come from North America.

It would occupy too much time and would fulfil no useful purpose in a popular lecture like this, to give in detail the data on which he based his conclusions. A *résumé* of them in a form convenient for reference may be found in a translation of his lecture in the *Journal of Botany* of January, 1865. Believing the evidence was sufficiently strong that the Tertiary plants he studied had come from North America, he proposed a hypothetical land between the two as the route by which they had travelled.

[1] Abstract of a lecture given in connection with the Loan Collection of Scientific Apparatus at South Kensington, March 31, 1877, by W. Stephen Mitchell, M.A., LL.B.

[2] Prof. Oliver, *Nat. Hist. Rev. Ap.*, 1862, Prof. Asa Gray, *Mem. Am. Acad.*, N. S., vol. vi. p. 377.


DOLPHIN RIDGE
Azores
Madeira
Canaries
3150
C. Verde Is.
3100
CONNECTING RIDGE
St. Pauls
Fernando de Noronha 3200
3750
3250
Ascension
St. Helena
Trinidad
CHALLENGER RIDGE
Tristan da Cunha
1715
DEPTH IN FATHOMS.
No Shading ..... less than 1000
Light ..... 1000 to 2000
Dark ..... more than 2000

He took the name of his hypothetical land from a legend met with in the "Timæus" of Plato. In a conversation between a priest of Saïs and Solon, when in Egypt, mention is made of a great island of Atlantis, situated beyond the pillars of Hercules, where lived a powerful nation that ruled over Libya as far as Egypt, and over Europe as far as Tyrrhenia. They tried to subjugate the Hellenes, but that heroic people defeated them. At a later period, during severe earthquakes and great floods, the island of Atlantis sank into the ocean. Such in brief outline is the legend. [The lecturer, alluding to the translations of Jowett and Whewell, referred to the puzzle this passage had been to students to know where an Egyptian priest could have known such a legend, or why (possibly) Plato had invented it, and alluded to one explanation that it was probably an exaggeration of some local phenomenon. In the *Journal of Botany* for January, 1865, a list of the literature of the subject is given.] This is as much as time will allow to be said to indicate the nature of the reasoning by which Unger, on the evidence of plant remains in Europe and America, conjectured former intervening land between the two, and why that hypothetical land was called "the sunken" or "the lost island of Atlantis."

We now turn to the *Challenger* soundings, and with these must be mentioned those of the United States ship *Dolphin*, the German frigate *Gazelle*, and the British ships *Hydra* and *Porcupine*. The generalisations of the soundings taken by these vessels, with inferences drawn from bottom temperatures, have been worked out by the staff of the *Challenger*, and a contour map has been prepared, of which the features which bear on our subject are reproduced in the diagram. Some of the most important soundings were taken from the *Challenger* herself, and as the working out of the whole results have been performed by the staff of that ship it is not unfair, at any rate in a short title for a popular lecture to mention only "*Challenger* soundings." That there was no feeling of international jealousy on the part of the *Challenger* staff is fully evidenced by the fact that the northern portion of the ridge has been named after the *Dolphin*.

Before referring to the results it may be of interest, as we have some of the *Challenger* apparatus here, to speak of the method of deep-sea soundings.

[The lecturer then briefly sketched the history of deep-sea soundings, alluded to the impulse given by the laying of cables, and mentioned how the improvement in mechanical appliances made possible now what was impossible a few years ago.]

The line used is about one inch in diameter; on this the twenty-five and seventy-five fathom distances are marked with white thread, interwoven, the fifty by red, and the 100 fathoms in blue. By this means the amount of line paid out can be easily ascertained. The weights to sink the line are so arranged, that when they touch the bottom they release themselves. There are several modifications of this apparatus, but the principle of those used on board the *Challenger* is that round flat weights with holes through them are placed one above another with a rod or tube running through them, the number of weights depending on the expected depth. To the bottom of the lowermost weight a wire ring is fastened, and a wire passes up and is fastened to a spring at the top of the tube. The tube is then attached to the line. So long as the strain of the weights is on this spring it remains closed. Directly the weights rest on the bottom the strain is removed, the spring opens, the wire is released, and when the line is hauled in it brings up the tube only, leaving the weights below. For taking temperatures a cup lead is generally used to sink the line, to which self-registering thermometers specially arranged to withstand great pressures are attached at every 100, and sometimes at every ten fathoms. It is not necessary here to speak of dredging, nor of the means for bringing up water or samples of mud from the sea bottom. We have now only to speak of soundings and taking temperatures. In both operations the line is passed through a pulley-block, which is attached to a group of elastic "accumulators," the object of this being to break the shock of the roll of the ship.

Dr. Spry, writing about the *Challenger* voyage, has said:—

"It has been found that in all deep soundings it is necessary to use steam power. No trustworthy results can be obtained from a ship under sail, as even in the calmest weather the heave of the sea or the surface current is sufficient to drift the ship in a very short time a considerable distance from the place where the lead was originally let go. . . . The first thing therefore to be done is to shorten and furl all sail and bring the ship head to wind, regulating the speed in such a manner as to avoid forcing her through the water."

The soundings and temperatures obtained by the *Challenger* have been from time to time issued in special reports, of which there have been seven. In the seventh is given a map on which the soundings have been marked, together with those of the other ships already mentioned. On this map the ridges and deep basins have been contoured, and where soundings have been wanting the bottom temperatures have been taken as a guide of the probable position of the separating ridges. For the *Challenger* ridge there are plenty of soundings and nearly as many for the *Dolphin* ridge. The connecting ridge is, however, assumed from bottom temperatures.

It is on this map our diagram is based.

Having now obtained approximately the contour of this ridge, which throughout the greater part of its range is known as a FACT from actual soundings, there are some few speculations concerning it which naturally present themselves for consideration. In the first place it will be noticed that along the ridge itself there are four places where it rises to dry land, at the Azores, at St. Paul's rocks, at Ascension, and at Tristan d'Acunha. In the deeper basins there is land rising above the sea-level at Fernando de Noronha, at Trinidad, and at St. Helena. In the deeper basins too there are five soundings which show a depth of more than 3,000 fathoms. These are given on our diagram. The greatest depth recorded is 3,450 fathoms. A glance at the *Challenger* map on which the soundings are marked in figures is sufficient to show that if the contour lines were drawn at every 250 fathoms the Atlantic would be found to be diversified by hills and valleys. Geologists are familiarised with invoking former rises and falls in land to account for some of the facts they study. Indeed in some cases it seems almost as if it were believed that the axis of the earth may be shifted and its ice-caps, its soil-caps, and its continents moved about with impunity to suit any particular theory. At any rate it would not be received as a startling idea that the whole area of what is now the Atlantic has been dry land. True we know that deposits are now being formed on the floor of the ocean, and at different rates, and consequently producing different thicknesses; rivers carry material which is spread out according to conditions over large or small areas, and so produce variations in the thickness of their deposits; and perhaps allowance must also be made for currents. These circumstances may to some extent modify the relative levels of parts of the ocean bottom. But they could hardly account for such extent of variations in the hills and valleys as are met with. Some of the ridges may be the result of submarine elevation analogous to that which has raised high mountain ridges elsewhere, and in this case has never brought the ridge above the sea except in a few peaks. It must too be remarked that if we admit the ridge through its whole length to have been dry land, it does not necessarily follow it was so all at the same time. There is not,

however, any readily apparent argument against the theory that it has been all dry land and at one and the same time. Let us for a while assume that it was, and let us then see what facts about climate we may infer with regard to it.

There are no doubt many other places besides those already known where the depth exceeds 3,000 fathoms. Let us, however, take the group of the known three which run in a line north-east and south-west, and are respectively 3,450, 3,200, 3,250, and we may assume that they represent a valley line. Let us suppose that the area is raised till this valley is dry land; what then will be the height of our ridge, and what will be the highest peaks of the country? To the north-west of the valley, distant about as far as from here to the Grampians, would tower the peaks, now the islands of St. Paul's Rocks, and Fernando de Noronha, rising some 30,000 feet; and to the south-east would rise Ascension to a similar height. The "ridge" itself would be about 15,000 feet. There is no reason whatever for supposing that the ridge is a table land. On the contrary, it seems more probable, judging from the variations in the soundings, that it was diversified with hills and valleys. Now a ridge of this elevation would, in all probability, have a snow capping even at the equator. Astronomers tell us that in "former" times the earth's atmosphere was higher and its pressure greater than now, but that was in a very remote past, and we may fairly assume that at the time of this ridge being land the atmospheric conditions were much as now. We should thus have a mountain ridge with hot valleys and every variation in temperature according to height; so that so far as temperature is concerned botanists would have no difficulty in accounting for the migration across the equator of plants that would be killed by great heat. With regard to the part of the ridge between Europe and America, answering to Unger's "Atlantis," the soundings are more numerous. The undulations seem to have been many, and the general elevation was probably not more than 9,000 feet, unless the original depths are masked considerably by a deposit of globigerina-ooze. Some peaks—now the Azores—still remain above water. When the ridge sank is a question on which we have at present no evidence. The whole subject is still young, and we have much yet to learn.

In conclusion the lecturer said: I hope I have given sufficient prominence to the distinction that must be drawn between fact and inferences from those facts.

I should be very sorry for anyone to go away from this place and say that they heard a lecture at South Kensington in which they were told that there formerly was a continent running down the middle of the Atlantic, and that there was a lofty mountain ridge along it, capped with snow even at the equator.

I wish carefully to point out to you I have made no statement of the kind. I have simply told you the fact that a ridge less than 1,000 fathoms beneath the ocean runs down mid Atlantic in a sinuous course, whose contour is roughly indicated by the diagram. That on each side of it are ocean depths, twice and in some cases thrice the distance it is below the sea-level. That *if* these depths were once land valleys, as geologists have no difficulty in believing possible, then there would be a ridge running north and south along the area of what is now the deep Atlantic, ranging from 9,000 to 15,000 feet above the sea-level, and that *if* the atmospheric conditions were the same then as now, judging from what we know of the Andes under the equator at the present time, there was probably a snow-capping.

Such a land-connection between Europe and America, if it existed as late as Tertiary times, would meet the requirements of Unger's hypothesis, varying in height as it sank, and the whole ridge would afford a solution of any difficulty botanists may have on the score of temperature in accounting for the migration of cold-loving and heat-shunning plants across the torrid zone.

The remarks at the conclusion of the lecture, in reference to its being the last of the series, we have already reported at p. 490.

REMARKS ON THE INVESTIGATION OF CLIMATES

TO Prof. Balfour Stewart we are indebted for the separation of meteorology into its two great divisions of *physical* and *climatic*. The latter I have proposed to separate into two sub-divisions, viz., *normal* and *abnormal*. The first of these subordinate branches includes the investigation of the usual states of the atmosphere in different parts of the earth's surface, as ascertained by periodic data derived from the averages of observations continued for a series of years. The second subordinate branch has for its object the investigation of unusual temporary disturbances of the equilibrium of the atmosphere—such, for example, as storms of wind, by means of the comparison of individual observations, extending over only a few hours or a few days.

We need hardly wonder at the disfavour with which meteorology is regarded by some men of the highest standing in physical science, from whom valuable assistance might have been expected; for we know that there is a great want of agreement among meteorologists themselves as to the means of determining even the most important fundamental data. For example, it will hardly, one would think, be disputed that the essential condition in all meteorological inquiries is *uniformity in instrumental observation*. But towards the establishment of a uniform international system no progress has as yet been made. Points of subordinate importance may have been adjusted at the Congress meetings at Leipzic and Vienna, but this all-important question remains just where it was. To Mr. Glaisher is due the adoption among his observers of the uniform height of 4 feet above the ground for thermometers, and one invariable form of screen for protecting them. The Scottish Meteorological Society, when establishing their stations in 1855, followed the example of Mr. Glaisher by adopting the 4-feet standard height, and they ultimately selected the form of double-louvre boarded protecting box, which I proposed in 1864. The Meteorological Society of England have also adopted the same uniform system as that in Scotland of boxes, and their exposure, and hours of observation. But other observers follow different methods, and on the Continent it is believed there is still less approximation to uniformity than among ourselves. The very first matter which should be taken up by home and foreign meteorologists is the settlement once for all of the questions how, when, and with what position and exposure of instruments are observations to be made. Until this is done it is impossible to arrive at useful results, because the observations which are now being obtained at different stations are not comparable the one with the other. Unless there be some such general Council as that lately proposed in NATURE by Prof. Balfour Stewart for carrying out this and other important objects, I shall certainly despair of the future of this new science.

But let us now see in what way the mode of instrumental observation bears on the subject of climate. Climates may be defined as states of the atmosphere due to the joint operation of geographical, geological, and other conditions more or less local, and they are judged of by their effects on animal and vegetable life. They do not, therefore, depend simply on the geographical position on the earth's surface of the district where the observations are made, but are largely affected by various conditions, such as the distribution of land and water, the nature of the soil and its covering, and the elevation or depression and character of the land at, and

adjacent to, the place. Climates are, therefore, frequently of a local nature, by which I mean of small superficial extent. Thus many varieties of climate may coexist about the same parallel of latitude, and even over a very limited portion of that zone. Instead of saying, then, that a whole country such as Britain has a certain mean temperature, as ascertained by lumping together observations made at places of widely different character, level, and exposure, we should rather say that there are in that island mountainous districts with a certain mean temperature, districts of open plain, having another, and sheltered districts and valleys having another; while parts near the sea-shore, have their own peculiar characteristics. To take a familiar case, we may refer to the Isle of Wight, all parts of which, small though the island be, can hardly have the same climate as Bonchurch and Ventnor, which are the favourite retreats of invalids in pursuit of health. That such local atmospheric distinctions do really exist may at once be shown by a reference to the varied distribution of plant life which, though no doubt largely affected by the nature of the soil, is nevertheless to a considerable extent dependent on the existence of certain atmospheric conditions.

If meteorological stations were to be established in some place situate in a low latitude—such, for example, as the Island of Java, we should be told, as I have more than once been in similar cases, that though 4 feet above the ground may be suitable for thermometers in Britain, it would be quite preposterous for so hot a climate as Java. Now if what were wanted was to ascertain the amount of heat emitted directly by the sun, such a statement might be correct; for then the instruments should be kept as clear of terrestrial influence as possible, and by taking proper precautions we might perhaps make our observations indifferently at sea or on land. But these would not be observations of climate. Now, as in the case we have supposed, it is the *climates* of Java and Britain that are to be compared by ascertaining the amount of heat communicated to thermometers by conduction and convection of the air which has been heated by solar, and cooled by terrestrial radiation, the observations must be made on the islands themselves and not on the sea which surrounds them, and by instruments placed at the same level above the surface of the ground. It has been farther objected that in very hot countries there are large districts where canes or other kinds of jungle vegetation rise much *above* the level of the thermometers, while in Britain there is generally a grassy sward nearly 4 feet *below* them. These differing kinds of vegetation nevertheless largely influence the character of climates, and their effects ought not to be eliminated even although it could be done. The results which have been obtained in a jungle should not, however, as I have already said, be mixed up with those of other places which have a free exposure. The truth is that by adopting different kinds of protecting boxes, and by varying sufficiently their levels above the ground, we may so far depress the temperature of a hot country and exalt that of a colder, as *instrumentally* to equalise them.

There is but one mode of getting results which shall be comparable, and that is by adopting the same standard height and the same standard form of protecting box. The results may, however, be vitiated in another way by placing the instruments near or under shelter of buildings, or still more, by the monstrous system of fixing them to the walls of houses; for masses of masonry or other building materials prevent either extreme from being recorded by the instruments. It must also be kept in view that however valuable continuous registrations may be, in showing intermediate variations of temperature, no photographic self-registering thermometer hitherto constructed gives any result which can be regarded as correct because it does not record the temperature of the air of the locality and is not comparable with those of common thermometers, nor even, perhaps, is ever comparable with those of other similar self-recording instruments. The house or framework with which the instruments are necessarily connected cannot fail variously to affect the mercury in the bulb and thus to veil the results. The only mode of counteracting this influence is to have common thermometers in the neighbourhood placed and protected in the usual way and to record their indications eight or twelve times in the course of the twenty-four hours.

It must be kept in view that I have been speaking only of local climates, or those which are subordinate to the *normal climate* due to geographical position. That such great climatic zones due to latitude exist and vary as we recede from the equator towards the poles is abundantly evident, both from the animal and the vegetable world. The best mode of investigating these climatic zones would be to select stations as little affected as possible by surrounding vegetation, the instruments being exposed as freely as possible all round and placed at the same level above the ground, and as nearly as possible at the same level above the sea, so as to avoid confusion with what have been termed the climatic zones of altitude. For this purpose I venture to suggest the use of an instrument which I proposed in 1870,[1] the indications of which depend on the heating up of a *large quantity of water* or other fluid contained in a thin glass globe which is freely exposed to the sun's rays. When the water expands under the influence of heat, the surplus fluid escapes into an adjoining vessel in which it can be afterwards weighed. On the other hand when the fluid is contracted by cold, the deficiency is continuously supplied from a connecting cistern kept always at the same, or sensibly the same, level. By this automatic arrangement the whole of the heat given out, however irregularly, by the sun, is constantly treasured up. The readings of maximum and minimum thermometers would also serve to correct errors due to the proximity of the tubes and cisterns of the instrument to which I have referred. The difference between the results of this and the common thermometer is the continuous registration of the alterations in bulk produced by the variations of temperature; whereas the common thermometer fails to record the many changes that take place between the maximum and minimum readings, and which are due to sudden obscurations and revelations of the sun caused by passing clouds during the day, while the terrestrial radiation at night is similarly affected. Even where this instrument is not used it would I think be an improvement on the present system were maximum and minimum thermometers kept constantly immersed in a large globe of thin glass filled with water.

THOMAS STEVENSON

VOLCANIC PHENOMENA DURING 1875

DR. GUSTAV TSCHERMAK'S *Mineralogische Mittheilungen* (1876, 2) contain a most interesting acoount of the volcanic occurrences during the year 1875, computed by Prof. C. W. C. Fuchs. In the short introduction Dr. Fuchs expresses his regret that the scientific academies and societies do not give more general attention to this most important branch of geological research, and points out that through the numerous and universal relations of the institutions in question the statistics of volcanic eruptions and earthquakes would become far more correct in details and numbers, than it is in his own power to make them. The publication of the valuable information now given by Prof. Fuchs therefore all the more deserves the highest praise and attention. Dr. Fuchs divides the events into two classes, viz., eruptions and earthquakes. The first volcano treated of is—

Etna.—After the short eruption of August 29, 1874, which lasted until the beginning of September, the mountain was perfectly at rest. Early in January, 1875, there were signs of new activity in the shape of repeated shocks, which, on the 8th, caused considerable damage near Acireale. But the shocks decreased again both in frequency and intensity, and a new period of rest ensued until the beginning of October. At that time a small crater on the south-side of the mountain became slightly active. From December 19, smoke mixed with reddish vapours

[1] *Journ. Scott. Met. Soc.*, vol. iii. p. 114.

was seen to rise, and the reflection of subterraneous fire could be seen from Acireale.

Vesuvius.—With the exception of a small eruption on July 18, 1874, this mountain had only given off clouds of smoke, and had come to complete inactivity by the end of that year. From January 3 to 6, 1875, slight earthquakes and subterraneous noises were remarked, but they remained without further consequences. Only in December the inclination to activity seemed to return. In the interior of the large crater of the last eruption considerable changes took place, a great portion, towards the south-east, fell in, and thick clouds of black smoke rose at this spot. On the 20th the glow of fire was seen in the crater, and all other phenomena increased in intensity, however, without it coming to an eruption by the close of the year.

Iceland.—The eruptions which occurred in this country during 1875 are the most important ones of all. They were numerous and followed each other in quick succession, some of them with extreme intensity. The first one was a side-eruption of the Vatna, which began with vehement earthquakes on January 2. A broad stream of red-hot lava broke forth on the following day and continued to flow until the third week of February. About this time a second eruption began in another locality. This was preceded by a copious fall of ashes spreading over Kelduverfet. The crater of this second eruption lies within one of the largest prehistoric lava-fields, called Odarhaun. A third eruption took place on March 10 to the north of the latter; no less than sixteen small craters ejected masses of red-hot slakes, and more to the west a broad stream of incandescent lava flowed for several days to a distance of 600 yards. The fourth eruption was perceived on the whole of the island. It occurred on March 29 on the Vatna, and was accompanied by loud reports and subterraneous noise. The most remarkable phenomenon in this eruption was an enormous fall of ashes, which was so dense in Oesterland that the sun was darkened and lights had to be lit. The ferry on the Yökul river could not penetrate for several days the enormous masses of floating pumice-stone. The fall lasted five hours in the Yökul Valley, three in the Fljotr Valley, and two at Seydisfjörd. A strong west wind carried particles of these ashes to enormous distances, *i.e.*, to Norway and Sweden. (We have repeatedly reported on the ashes found in those countries at that time, and upon their origin.) Another prolonged eruption took place on April 4. The active crater this time lay to the south of Burfell, and the phenomenon was accompanied by violent explosions and the ejection of high garbs of incandescent slakes. It lasted about twelve days. The next eruption happened between April 20 and 24 in the so-called Oster Mountains. Matter was ejected to an enormous height and streams of lava overflowed the environs to a distance of fifteen miles at a breadth of from 800 to 2,000 metres. Towards the end of June another new crater formed and several lava streams broke forth near Thingö, between Vivatn and the Yökulsan. The last eruption, another very violent one, occurred on August 15 at the same place as the last. Twenty different columns of smoke were ejected, and on the next day slakes and red-hot lava followed.

Kloët.—This volcano, one of the less-known mountains of Java, had a great eruption early in 1875, according to news dated February 3. An enormous stream of lava completely destroyed the settlement of Blikar, besides causing great damage in other localities.

Ceboruco.—This Mexican mountain (situated at lat. 21° 25′ N.), which rises to a height of 480 metres (1,525 metres above sea-level) was believed extinct since the discovery of America, its first historical eruption taking place in 1870. Another great eruption followed on February 11, 1875, together with violent earthquakes, which particularly damaged St. Cristobal and Guadalaxara. On the evening of February 10 a fall of ashes occurred, and a high garb of fire rose in the night.

Mauna Loa.—A crater on the summit of the Mauna Loa, called Mukunweoweo, had an eruption of lava on August 11, 1875, but more detailed accounts have not reached Dr. Fuchs. This is the same crater which sometimes causes the whole island of Hawaii to be covered with the so-called "hair of the Goddess Pele," a fine thread-like obsidian, resembling fine threads of cotton.

Tongariro.—This volcano, situated in New Zealand, was active in the second half of 1875, and from time to time ejected lava and slakes. At intervals great geyser eruptions occurred, and at one time more than fifty jets of hot water, surrounded by vast columns of steam, were counted.

Santorin.—Since the last eruption the fumaroles on the island of Santorin were extremely active. On October 10, 1875, M. Fouqué observed numerous openings ejecting gases, not differing much from air in a chemical sense. During the night they showed the reflection of fire, and the stones surrounding the openings were red-hot. A second group of fumaroles yielded sulphurous, carbonic, and hydrochloric acids, their temperature varying from 110° to 310° C. Yet another group ejected sulphuretted hydrogen, carbonic acid, and water-vapour, at a temperature of 90°-99° C.

Speaking of earthquakes, Dr. Fuchs gives a complete list of all the earthquakes and terrestrial shocks which were felt in different parts of the globe during 1875, and they amounted to no less than ninety-seven in number, occurring on 100 different days. We regret that our space does not permit us to enumerate them, but compels us to confine ourselves to an account of the distribution of their number over the different months. Thus we have in January, 15; February, 7; March, 12; April, 7; May, 9; June, 10; July, 6; August, 5; September, 3; October, 2; November, 9; December, 12. Of fifty-two of which exact details could be obtained, thirty-six occurred in the night. On ten days earthquakes occurred simultaneously in different localities, and fourteen distinct places were repeatedly visited by them during the year. The most lamentable of all—real catastrophes—were those of Cucuta, on May 16–18, destroying several towns and numerous villages, and of St. Cristobal and Guadalaxara (February 11), which reached from the Pacific Ocean to Leon. Very severe were the earthquakes of the Lifu Island (March 28), of Uschak (May 3–5 and 12), of Lahore (December 12), and of Porto Rico (December 21). Altogether Dr. Fuchs estimates the number of lives lost in these earthquakes at 20,000, not to speak of the great damage to property. In conclusion the author gives an account of those earthquakes which were in evident connection with the eruptions of neighbouring volcanoes; and also mentions a few whose causes were undoubtedly not volcanic but mechanical phenomena. In a short appendix Dr. Fuchs gives some details of an eruption which occurred between September 7, 1873, and January 22, 1874, on the Island of Vulcano (one of the Lipari Isles), in continuation of his Report for 1874.

BIOLOGICAL NOTES

Broca's Stereograph.—A very ingenious instrument for taking mathematically accurate drawings of human crania and other objects of natural history, known as Broca's stereograph, has been lately presented to the College of Surgeons by the President, Mr. Prescott Hewett, which will prove a useful adjunct to the systematic study of the important anthropological collection now contained in the museum. It was exhibited and its use demonstrated by Prof. Flower at his concluding lecture on the Comparative Anatomy of Man. Among recent additions to this department of the collection are the valuable series of skulls of natives of New Guinea, collected by Dr. Comrie, Staff-Surgeon R.N. of H.M.S. *Basilisk*, described in the last number of the *Journal* of the Anthropological Institute; also four of natives of the Navigation or Samoan Islands, presented by Dr. Pye Smith. On several occasions during the course, Prof. Flower pointed out the necessity of far larger series of human skeletons and skulls than are at present contained in our museums, before our knowledge of physical anthropology can be placed on a satisfactory basis, as the individual variations are so great that it is only when a considerable series of any race are brought together that their true characteristics can be determined.

Tendrils of Climbing Plants.—M. Casimir de Candolle publishes some interesting observations on the tendrils of climbing plants in the *Archives des Sciences Physiques et Naturelles* (January). The experiments the author made were suggested to him by reading Mr. Darwin's work on the movements and habits of these plants. With regard to the manner in which the curves of the tendrils which are fixed at both ends are formed, M. de Candolle arrives at the following conclusions:—When a tendril of *Bryonia*, isolated or not, is fixed at both its ends, its upper part soon assumes the shape of a sinuous curve with double curvature, just like that of free tendrils. But this curve

is composed of two segments which are curved in opposite directions. The curvatures increase gradually in both segments, and little by little transform themselves into two screws, of which the upper one is turned from left to right. The primitive sinuous curve very often spreads over nearly the whole of the tendril, and in this case only two screws are produced, wound, of course, in opposite directions. In all cases, with very few exceptions, the number of screws thus produced in the tendrils is an even one, and M. de Candolle demonstrates that the cause of this phenomenon is a simple mechanical law.

EYELESS CRUSTACEANS.—A valuable paper on the eyeless, cave, and deep-water crustaceans, by M. Aloïs Humbert, is published in the same periodical. It is principally a minute description of *Niphargus puteanus*, which M. Humbert believes to be an ancient genus, descended from a form which is now extinct, thus corresponding entirely with *Proteus*, *Leptoderus*, *Anophthalmus*, and others. With regard to the question whether the *Niphargus* found in the Swiss lakes are merely colonies from the other animals of the same genus, which inhabit subterraneous waters, or whether the reverse is the case, the author expresses himself as follows:—If we suppose that the genus *Niphargus* appeared before the ice period, it is impossible to say anything with regard to its place of origin. But, if we do not suppose it to date so far back, and only look at the present fauna, I incline to the belief that the *Niphargus* of our Swiss lakes originate from those inhabiting subterraneous waters. When they reached the lakes they acclimatised themselves at depths where they found the darkness sufficiently intense, and in such a zone, all but completely dark, where they found the necessary conditions for their existence. In a more illuminated zone they could not have escaped from their enemies so easily and could not sustain the competition with their fellow-inhabitants, which possessed better visual organs. If we consider the greater dimensions attained by the forms inhabiting caves, it seems that the lake species, although living in vaster bodies of water, yet find themselves in conditions which are less favourable to their development and are suffering, as it were, from atrophy.

ORIGIN OF THE FLYING-POWER OF BEES.—The following interesting experiments made with bees, by Herr Dönhoff, are recorded in the *Archiv für Anatomie und Physiologie*. He took some bees from the hive, just as they came out of the entrance hole, and placed them under a glass bell at a temperature of 19° C. (66° F.). First they ran hastily up and down the sides of the glass and flew about in the jar. Later on their movements became less hasty, and after forty-five minutes they all sat quietly together, moved slowly and clumsily. They were no longer able to fly about. He let a few crawl upon a pencil, and by giving it a jerk threw them into the air; they fell down perpendicularly without giving a humming sound, *i.e.*, without moving their wings. He killed and opened one or two and found their honey-bags empty. To the others he then gave a solution of sugar, and after they had fed for about 3½ or 4 minutes he again threw some into the air. They no longer fell down perpendicularly but a little further off, and also moved their wings. A minute afterwards they did not fall down at all but flew to the window; they had become the same lively insects as before. If the temperature is under 19° C. they lose the power of flying even sooner, and a longer period elapses before it returns after they are fed on sugar-water. In higher temperatures the power returns sooner. Herr Dönhoff thinks it probable "that the bee loses the power of flying because it does not possess the necessary strength to be converted into muscular action, and that this strength returns to its system because in sugar it finds the necessary vital support."

THE BIRDS OF CELEBES.—In the March session of the German Ornithological Society Dr. Reichenow gave a detailed account of the birds of the Island of Celebes. Although this island is classed geographically with Borneo, Java, and Sumatra in the Sunda group, yet its fauna is almost entirely distinct from that of the other islands mentioned, approaching very closely to the Australian fauna. Late investigations show that this is peculiarly true of the ornithology of Celebes, and that in the geographical distribution of animals, the island must be classed with Australia, New Guinea, &c., and not with the other members of the Sunda group. The speaker exhibited six new varieties of Australian Colibris lately found in Celebes.

ITALIAN PLIOCENE EQUIDÆ.—Dr. Forsyth Major (Florence) will shortly publish a work embodying the results of his long and diligent researches on the Italian Pliocene Equidæ which will form a very valuable contribution to the evolutional history of the *Horse*. The publication of the book—illustrated with numerous finely executed plates—is being prepared by the Swiss Palæontological Society, under the supervision of Prof. Rütimeyer. A short *résumé* of some parts of the work appeared some time since in the *Rivista Scientifico-Industriale*.

DEVELOPMENT OF MOLLUSCA.—Dr. Packard, of Salem, Mass., writes with reference to Prof. Lankester's review of his work entitled "Life Histories of Animals, including Man" (NATURE, vol. xv., p. 271), to the effect that on p. 112 of the work in question, and also on p. 110, Prof. Lankester's name is cited by him as the authority for the use of the word "trochosphere." The paper in which Prof. Lankester proposes the term "veliger" is quoted on p. 113. This he considers sufficient reply to the reviewer's statement that he (Dr. Packard) does not ascribe, either the terms "veliger" or "trochosphere," or the views connected with them, of which he makes use, to their author.

PARTHENOGENESIS IN A PHANEROGAM.—Prof. Kerner, of Innsbrück reprints from the "Sitzb. der k. Akad. der Wissensch. zu Wien" an account of a remarkable instance of parthenogenesis in a flowering plant. The instance is a small Alpine Composite, *Antennaria alpina*, a native of the high Alps and Arctic region. Like some other allied species it is dicœcious, and the male plants are extremely scarce. Prof. Kerner has never seen the male plant, and in 1874 cultivated the female plant with very great care in the botanic garden at Innsbrück, excluding apparently all possibility of foreign impregnation either by this or any allied species. The plants produced, notwithstanding, a number of seeds, which were sown the following spring. Six of these seedlings germinated, but four out of these shortly perished. The two remaining ones reached maturity, growing as luxuriantly as the mother plant, and showing no signs of hybridisation. It is not stated, however, whether they also flowered and produced seed. From the extreme scarcity of the male plant, Kerner believes that the seeds are ordinarily matured without impregnation.

RESPIRATION OF ROOTS.—From recent experiments on the respiration of roots (the plants employed being ivy and veronica) MM. Deherain and Vesque conclude (1) That oxygen is necessary for all organs of plants, and that for the life of a plant it is not sufficient that its air-parts be in air; the roots must also find oxygen in the atmosphere of the ground in which they grow; (2) That the absorption of oxygen which takes place through the roots is accompanied with only a slight development of carbonic acid, so that the roots produce a partial vacuum in vessels in which they are contained; (3) That this development of carbonic acid takes place just as well in an atmosphere without oxygen as in one which contains it; whence may be inferred that the excreted carbonic acid does not come from superficial oxidation of some self-decomposing organs, but from a regular circulation of gases in the plant.

NOTES

FIFTY-SEVEN candidates for the Fellowship of the Royal Society have offered themselves during the present session. From these the Council have selected the following fifteen to be recommended to the Society for election at the annual meeting on June 7 next :—Prof. James Dewar, M.A. ; Sir Joseph Fayrer, M.D., K.C.S.I. ; Rev. Norman Macleod Ferrers, M.A. ; Thomas Richard Fraser, M.D. ; Brian Haughton Hodgson, F.L.S. ; John W. Judd, F.G.S. ; William Carmichael M'Intosh, M.D. ; Robert M'Lachlan, F.L.S. ; Prof. John William Mallet, Ph.D. ; Henry B. Medlicott, M.A. ; Henry Nottidge Moseley, M.A. ; Prof. Osborne Reynolds, M.A. ; William Roberts, M.D. ; Prof. James Thomson, LL.D. ; Prof. William Turner, M.B.

THE scientific men selected this year by the Universities of Edinburgh and Glasgow for the degree of LL.D. are well deserving of the honour. Among those on whom Edinburgh has conferred it are Mr. George Gore, F.R.S., Mr. J. B. Lawes, the well-known scientific agriculturist, Dr. Reinhold Röst, principal librarian to the India Office, and Mr. John Westlake, Q.C. Glasgow has given her degree to Prof. Andrews, F.R.S., president, and Prof. Allan Thomson, president-elect of the British Association.

THE Council of the Royal Microscopical Society have resolved to institute a lecture in memory of the late Prof. John Quekett, to be delivered from time to time by eminent microscopists, to whom will be presented the Quekett Medal provided out of the Medal Fund collected some years since. The first of these lectures will be delivered in the theatre of King's College on May 2, at 8 P.M., by Sir John Lubbock, Bart., M.P., F.R.S., the subject being "On Some Points in the Anatomy of Ants."

MR. WARD HUNT stated in the House of Commons last week that the deductions of the Astronomer-Royal with respect to the late transit of Venus will be ready in about six weeks, but that some months must elapse before the photographic records will be completed, without which the report would be imperfect.

THE Paris Academy of Sciences held its anniversary on the 23rd inst., Vice-Admiral Paris being in the chair. Only one national prize was awarded this year to M. Darboux for a memoir on "Singular Integrals," obtained in the solution of the differential equations of the first order. This work, of exceptional excellence, will be published in "Recueil des Savants Étrangers" at the expense of the Academy. A number of minor prizes were awarded for memoirs in botany, chemistry, medicine, &c. But the largest number of rewards were distributed amongst authors of works already published and not specially written for competition ; this is a laudable innovation. The following are some of the awards :—The prize for the progress of the application of steam to the military navy to M. Ledieu, as author of an elementary treatise on "Marine Engines." The Poncelet Prize to M. Kretz, an engineer in the French Civil Service, for his publication of Poncelet's works on "Mechanics." The Delmont Prize to M. Ribaucourt, engineer of Ponts et Chaussées, for his geometrical disquisitions on the tri-orthogonal system. M. Violle was rewarded by a donation of 80*l.* for his researches on the heat generated by the sun ; MM. Vicaire by a donation of 40*l.* each for similar researches. The Monthyon Medal to M. Melsens for his method of working mercury ores, as practised at Ydria, where working men have been effectually protected against toxical emanations. M. André took one prize for his experiments on the causes of the "black drop" seen by some observers of the transit of Venus last century. M. Gaugain obtained a similar reward for his long continued observations on tourmaline and other electrical disquisitions. The Cuvier prize was awarded to M. Fouqué, the celebrated Santorin and Etna explorer. MM. Filhol and Velaine obtained one prize each for the excellent zoological preparations collected at St. Paul and at Campbell Islands on the occasion of the last transit of Venus. M. Palisa, director of the Pola Observatory, obtained the Lalande Medal for the discovery of nine small planets and the rediscovery of Maïa, lost from 1861 to 1876. The usual number of prizes have been proposed for 1877 and following years. A programme stating the conditions will be sent to any person writing to the secretary of the Academy of Sciences. No limitation of nationality is imposed, and the necessity of writing in French or Latin is practically abolished, at least for several of the prizes. A sum of about 4,000*l.* is to be distributed amongst thirty-eight different competitors, exclusive of the Breant prize. M. Dumas read the *éloge* of MM. Brogniard, two naturalists who were influential members of the Academy of Sciences, and whose lives were long associated in kindred work. The eminent perpetual secretary obtained one of the greatest successes of his whole academical career. The address was a masterpiece, most carefully written and admirably delivered.

A LECTURE delivered in Washington in the beginning of April, at the opening of the summer course of the National Medical College, by Dr. Elliott Coues, the well-known ornithologist, has attracted some attention in America not only by contrast with similar addresses, but for its mode of treatment and advanced views in discussing the bearings of anatomical science on the question of the origin of species and man's place in nature.

A VERY extensive Etruscan necropolis has been discovered at Montelparo, near Ascoli-Piceno (Umbria). An enormous quantity of bronze, iron, and terra-cotta objects have been and are being found in the grounds, chiefly consisting of helmets, armillas, collars, buckles, nails, spurs, bows, rings, lances, spears, swords, and thousands of perforated bronze grains or beads, besides numerous objects of amber, glass, shells, and pottery, all of which are likely to be secured by the Italian Government for the Florentine Museums.

THE Bradford Scientific Association *conversazione*, we are glad to hear, has been a great success, over 1,600 persons having visited it. It was held for two days—Wednesday and Thursday, April 11 and 12—and the members were so encouraged by the support received, that they continued the exhibition until the Saturday. Over 100 microscopes were shown nightly, and the collective display of physical and chemical apparatus has, we believe, not been equalled in the north. The society introduced a novel feature in the management of the affair—admitting those engaged in teaching at a reduced charge, while demonstrations on various subjects took place each evening, according to a printed time table, given to each person on entrance. They endeavoured to take as their model the Loan Collection at South Kensington. This enterprising society have demonstrated the immense educational value which a collection of scientific instruments must have, if accompanied by proper explanation. They are so satisfied with the success, that they will attempt things on a much larger scale in the future.

IT was announced at the last meeting of the Paris Geographical Society that the expedition organised to investigate the possibility of cutting a channel through the Isthmus of Darien has proved a failure.

TWO Prussian officers have arrived in Paris for the purpose of determining telegraphically the longitude of Berlin. Two French officers have been despatched to Berlin in order to carry out similar operations. The apparatus to be used in Paris have been located at Montsouris under the superintendence of M. Mouchez and the Bureau des Longitudes. The ultimate aim of

the operation is to connect the French trigonometrical triangulation with the system of the Geodesical International Association, which is covering almost the whole of Europe.

WE recently announced that Mr. Siddal, of the Chester Society of Natural Science, had detected Radiolarians in Carboniferous limestone. At a meeting of the Society lately it was announced that another member of the Society (Mr. Shrubsole, F.G.S.) had disovered both Foraminifera and Radiolarians in the chalk of the North Wales border.

MR. GEORGE CROSS, of Chester, a member of the Chester Natural Science Society, and conductor and teacher of the classes formed in that city under the auspices of the Government Science and Art Department, died on the 16th inst. at the early age of forty. As an able scientific man of genial disposition and kindly feeling his loss is deplored by a large circle of friends.

THE Agricultural Society of France is building a large hotel in the Rue de Bellechasse at Paris, which will be fitted with every convenience for meetings and lectures, including museum and libraries. The expenses are defrayed by a benefactor who has taken effectual measures to conceal his name. The cost will be more than 20,000*l.*

THE Society of Arts are prepared to offer prizes of 5*l.*, 3*l.*, and 2*l.* respectively, and certificates, for proficiency in qualitative blowpipe analysis. The competition is open to any person, but as it is intended principally for those interested in the mining industries of Devon and Cornwall, the examination will be held in the centre of the mining districts. The arrangements will be in the hands of the committee of the Miners' Association, and intending candidates should apply to the honorary secretary of the Association, Mr. J. H. Collins, Lemon Street, Truro. The examination will be held at Redruth, from 5 to 9 P.M., on Tuesday, June 5, 1877.

THE subject of the Rhind Lectures on Archæology in connection with the Society of Antiquaries of Scotland this year is :—"Do we possess the means of determining scientifically the condition of primeval man and his age on the earth?" The lectures, six in number, commenced yesterday, the lecturer being Dr. Arthur Mitchell.

AT four o'clock on Monday morning a sharp shock of an earthquake was felt at Oban. The motion was undulatory, accompanied by a rumbling noise, and terminating in a sort of jerk. The motion did not last above six seconds. Furniture and articles of household use were jerked upwards, and pieces of crockery were thrown from the shelves. A lighter shock was felt in the Island of Kerrera last week, and a short time ago a shock was felt in Tobermory, Island of Mull.

AT the first meeting for the year of the West Riding Geological and Polytechnic Society held at Ripon on April 4, the Marquis of Ripon gave an address on scientific pursuits and their results. He advocated thoroughness in all such work, and urged his hearers not to accept facts without complete investigation, nor yet stubbornly to reject facts because they did not accord with their own preconceived ideas.

UNDER [the title of "Giuseppe de Notaris, sua Vita e sue Opere," an interesting sketch of the life of this eminent botanist, who died in January last, is published, reprinted from the columns of the Roman journal, the *Opinione*. De Notaris was a member of a noble but poor Italian family, and was born at Milan in 1805. Brought up to the medical profession, he early devoted himself to the study of botany, and filled botanical chairs successively at Milan, Turin, Genoa, and Rome. His labours were directed mainly to the description and the principles of the classification of cryptogams, especially of mosses, in which his services to science are very great and his publications very numerous. Until the last few years his labours received but little recognition by the State, and the publication of their results was frequently interrupted by his poverty; but the Municipality of Genoa did itself immortal honour by publishing at its expense his important "Epilogo della Briologia italiana." In 1872 de Notaris was elected a foreign member of the Linnean Society of London.

THE Mathematical and Physical Sections of the Russian Geographical Society discussed at a recent meeting a scheme for the thorough exploration of the Lower Angara outflow of Lake Baikal, the pecuniary means for the purpose being offered by M. Sibiryakof. The navigability of this important water-communication would be the principal problem to be solved by the explorers. At the same meeting M. Vojeikoff described the results of his meteorological travels to British India.

SOME striking experiments have been lately made by M. Daubrée, on the physical and mechanical action of strongly-compressed incandescent gas arising from combustion of powder. In one case a thin steel plate (23 sq. ctm. surface), rolled up, was inclosed in the chamber along with 12 grm. of powder, which was fired by electricity. The steel was completely fused, and transformed into an ingot curiously twisted and swollen, resembling the ferruginous skeleton of some meteoric irons. A good deal of the iron had passed into the state of sulphuret, found as a fine powder. These remarkable changes must have occurred in a fraction of a second. In another series of experiments the gases formed had opportunity of escape by a small orifice in the side of a hollow cylindrical cock (with conical top) adapted and screwed into the chamber. Here the hot particles of gas fused and carried off the steel in the state of fine powder, which was sulphurised immediately. The cock was put considerably out of shape, deep sinuous furrows being made in its surface, and in one case reaching the central cavity so as to make a second orifice, while the terminal cone wholly disappeared. An abundant metallic dust, incandescent, was projected into the atmosphere. Analogous phenomena probably occur in volcanoes, meteorites, &c.

OUR readers will remember the announcement made by us some time ago of the shipment of a consignment of white-fish eggs, furnished by the United States Fish Commission, to Wellington, New Zealand. We are happy to state that, as the result of this action, a report has been received of the safe arrival of these eggs at Wellington in good condition. The young fish at the end of five days from the time of hatching, were three-quarters of an inch long, very transparent, with bright yellow eyes, and very lively, apparently doing well.

ACCORDING to a recent Austrian census it appears that the percentage of cretinism ranges from a small figure up to as high as forty in the different districts of the Alpine parts of the empire. The proportion to every ten thousand inhabitants is, in the Salzburg district, 40; in Upper Austria, 18·3; in Styria, 17; in Silesia, 10; in Tyrol, 7·6, &c.

THE last number of the *Isvestia* of the Russian Geographical Society contains some extracts from the journal kept by Dr. Miklucho Maclay during his cruise in Western Micronesia, from March to June, 1876. In the early part of March, after visiting the Island of Geby, lying under the equator, Dr. Maclay, about the end of March, passed by Auropic Island, the inhabitants of which he describes as not very dark, with thick curly hair. Thence he proceeded to Mogemos, or Mackenzie Island, Woap Island, and others, on his way to the Pelew Archipelago, where he stayed about two weeks, studying very interesting specimens of the "picture-writing" and folk-lore. The shameful exportation of the inhabitants by whites, which he had opportunity of witnessing during his cruise, will

be the subject of a special report. From the Pelew Islands the indefatigable traveller proceeded to the southern and then to the northern shore of Admiralty Island, noticing the remarkable prognathous development of the Melanesian natives of this island, as well as those of the island Agomes, of the Hermite Archipelago. After a short visit to the Ninigo Islands, Dr. Maclay returned to the shore bearing his name, the natives of which received him very kindly. He built a house for himself, where he intended to remain, pursuing his anthropological researches.

THE *Journal of Forestry and Estates Management* is the title of a new shilling monthly, which will appear on May, 1 published by Messrs. J. and W. Rider, of Bartholomew Close, E.C. It will be devoted to the interests of Arboriculture in its scientific, practical, and economic aspects, and will give a large portion of its space to matters appertaining to the general management of estates.

WE have received through Mr. Tucker, from Mr. J. M. Wilson, Rugby, two guineas towards the Gauss Memorial Fund.

THE inventor of the new electric seismograph referred to last week is not Father Secchi, but Father Cecchi, of the Scuole pié at Florence.

THE additions to the Zoological Society's Gardens during the past week include a Rusa Deer (*Cervus rusa*) from Java, presented by Mr. A. A. Frazer, F.Z.S.; a Bay Bamboo Rat (*Rhizomys badius*) from India, presented by Mr. J. Wood Mason; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Mr. T. Clover; a Brown Monkey (*Macacus brunneus*) from Assam, deposited; a Demeraran Cock of the Rock (*Rupicola crocea*) from Demerara, purchased; two Chinchillas (*Chinchilla lanigera*), born in the Gardens.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 15.—"On the Tides of the Arctic Seas.—Part VII. Tides of Port Kennedy, in Bellot Strait." (Final Discussion.) By the Rev. Samuel Haughton, M.D. Dublin, D.C.L. Oxon., F.R.S., Fellow of Trinity College, Dublin.

The tidal observations at Port Kennedy were made hourly for twenty-three days; and in my former discussion of these tides (Part VI.) I used only the observations made in the neighbourhood of H. W. and L. W., obtaining the following results for the tidal coefficients :—

Diurnal Tide.	*Semidiurnal Tide.*
S = 23·4 inches.	S = 7·0 inches.
$i_s = 5^h\ 12^m$.	$i_s =$,,
M = 20·9 inches.	M = 17·0 inches.
$i_m = 0^h\ 33^m{\cdot}8$.	$i_m = -\ 0^h\ 12^m$.

In the present discussion I have employed all the hourly observations made during the twenty-three days, and have obtained the following results :—

Diurnal Tide.	*Semidiurnal Tide.*
S = 36·4 inches.	S = 5·9 inches.
$i_s = 3^h\ 2^m$.	$i_s = 2^h\ 48^m$.
M = 18·5 inches.	M = 15·5 inches.
$i_m = -\ 2^h\ 48^m$.	$i_m = 6^h\ 2\frac{1}{2}^m$.

The present more complete discussion fully confirms the result before obtained by me, respecting the great magnitude of the solar diurnal tide at this station, and also shows a satisfactory agreement in the other coefficients obtained from H. W. and L. W. observations only.

The method employed in the present paper is based on Fourier's Theorem, by which the height of tide is expressed as follows :—

$$F = A_0 \begin{matrix} + A_1 \cos s + A_2 \cos 2s + \&c., \\ + B_1 \sin s + B_2 \cos 2s + \&c., \end{matrix}$$

where

F = height of water.
s = hour-angle of sun.

The coefficients A_0, A_1, A_2, B_1, B_2, &c., being found by well-known formulæ, they are again expressed, by Fourier's Theorem, as follows :—

$$A_n = a_0 \begin{matrix} + a_1 \cos u + a_2 \cos 2u + \&c. \\ + b_1 \sin u + b_2 \sin 2u, \end{matrix}$$

where u passes through all its changes in a fortnight, and the coefficients are calculated in a similar manner.

The known theoretical formulæ for the diurnal and semi-diurnal tides, expressed in terms of parallax, declination, lunar and solar, hour-angles, are now converted into functions of the true and mean anomaly, and of the sun's hour-angle, and finally into simple functions of s and u. These expansions are now compared, term by term, with the terms of the tidal expansions found by means of Fourier's Theorem, and the final lunar and solar tidal coefficients calculated out with ease.

Although the short period of observation at Port Kennedy (23 days) renders this method of discussion not much more valuable than the usual method of H. W. and L. W. observations, I have developed it at length in the hope of applying the method to more complete series of Arctic tides, which I hope shortly to lay before the Royal Society.

March 22.—"On Friction between Surfaces moving at Low Speeds," by Fleeming Jenkin, F.R.SS. L. and E., Professor of Engineering in the University of Edinburgh, and J. A. Ewing.

The common belief regarding friction, which is based on the researches of Coulomb and Morin, is that between surfaces in motion the friction is independent of the velocity, but that the force required to start the sliding is (in some cases at least) greater than the force required to overcome friction during motion; in other words, the static coefficient is usually considered to be greater than the kinetic. It occurred to the authors that there might possibly be continuity between the two kinds of friction, instead of an abrupt change at the instant in which motion begins. We should thus expect that when the relative motion of the surfaces is very slow there will be a gradual increase of friction as the velocity diminishes. Whether any such increase takes place at very low speed is left an open question by the experiments of Coulomb and Morin, whose methods did not enable definite measurements of the friction to be made when the velocity was exceedingly small. The authors have succeeded in measuring the friction between surfaces moving with as low a velocity as one five-thousandth of a foot per second, and have found that in certain cases there is decided increase in the coefficient of friction as the velocity diminishes.

The surfaces examined were steel on steel, steel on brass, steel on agate, steel on beech, and steel on greenheart—in each case under the three conditions, dry, oiled, and wet with water. In the cases steel on beech oiled or wet with water, and steel on greenheart oiled or wet with water, the coefficient of friction increased as the velocity diminished between the two limits given above, the increase amounting to about twenty per cent. of the lower value. It appeared that at the higher limit of velocity there was little further tendency to change in the coefficient, but it is impossible to say how much additional change might take place between the lower limit of the velocity and the higher. In the case of steel on agate wet with water there was a similar but much less marked increase of friction as the velocity decreased. And in the case of steel on steel oiled there was a slight and somewhat uncertain change of the opposite character, that is, a decrease of the friction as the velocity decreased. This case, however, would require further examination. In all other cases the friction seemed to be perfectly constant and independent of the velocity. Out of all the sets of circumstances investigated, the only ones in which there was a large difference between the static and kinetic values of the coefficient of friction were those in which a decided increase was observed in the kinetic value on the speed decreased. This result renders it exceedingly probable that there is continuity between the two kinds of friction.

Linnean Society, April 5.—Prof. Allmann, F.R.S., president, in the chair.—Capt. Chimmo, R.N., the Rev. J. Constable, and Prof. Liversidge, of Sydney, N.S.W., were elected Fellows of the Society.—In acknowledging a donation from the author (Mr. H. J. Elwes), of the first part folio, "Monograph of the Genus Lilium," the President congratulated the Society on

the issue of this handsome work by the private energy of one of its members.—Sir Chas. Strickland exhibited a specimen of *Crinum aquaticum* obtained from Grahamstown, South Africa, but which showy plant hitherto has rarely been seen in flower in Britain.—A paper on ferns collected by Miss Gilpin in the interior of Madagascar, was read by Mr. J. G. Baker. Some seventeen are new out of 150 species, a fair proportion, and evidence of an unsuspected richness in this department of the Madagascar flora.—The Secretary announced a paper on the fresh-water algæ of the Cape of Good Hope, by Prof. Reinsch: this being of a technical character, and in Latin, was taken as read.—Mr. R. Collett, of Christiania, then read a communication on *Myodes lemmus* in Norway. His observations on the habits and economy of the Lemming had extended over several years, and in 1876 he had published these in *Nyt. Mag. f. Naturvsk.* But his attention had lately been called to Mr. Crotch's contributions in the Linnean *Journal*, and as in many particulars he differed from that author, the present notice resulted. The number of young at a birth vary from three to eight, and two sets are annually produced. Mr. Collett regards their wandering as a necessary consequence of their temporarily strong vitality, together with an inherent migratory instinct. The tendency at intervals to appear in unusually large numbers is not confined to the genus, but is common to all the species of the sub-family Arvicolinæ. The majority of the wanderers are young, and in one instance observed, by himself, were chiefly males. The migration closes with the death of the individuals, generally brought about by an epizootic disease, the result of over population; the denser the masses the higher the rate of mortality. The bare patch on the rump considered by Mr. Crotch to be due to the habit of protecting themselves against stones in resisting attack, Mr. Collett states is due to a skin disease. He however, supports Mr. Crotch's statement as to the number of winged and four-footed enemies which devour the Lemming, and also that domestic cattle and reindeer destroy them. Their occasional enormous increase in numbers he holds to be owing to periodic prolific years, the facility of rearing their young, and the early procreative faculty of the latter. Parallel instances among other groups of animals, for instance unusual swarms of butterflies and locusts are well known, though as to the true reason of such departures in number, &c., much is only conjectural. Coincidently with the notable years of the Lemming migrations, the increase above the normal number of rats, mice, shrews, and even the grouse tribe, have been recorded. Mr. Collett affirms that the Lemmings travel chiefly in the direction of the valleys, and not constantly due west as has been asserted; their great movements are chiefly nocturnal. He is inclined to question Mr. Crotch's notion of hereditary search for a "Miocene Atlantis," and rather is of opinion that in accounting for the periodical excess of multiplication and migratory impulse a physiological necessity impels them; the nature of this is at present beyond our power to explain rationally.—A further contribution to the natural history of swine, by Prof. Rolleston, was read in abstract, this paper forming an appendix to that previously brought under the notice of the Society. The additional information is in the main confirmatory of the views already expressed, but several important facts relative to the striping of the young of *Sus celebensis* and *S. verrucosus* according to Dr. A. B. Meyer, with information from others, necessarily causes a modification in former conclusions.—On South African Hepaticæ (Liverworts), by Mr. W. Mitten, and on new Irish Lichens, by the Rev. W. A. Leighton, were two technical papers the titles only of which were read by the Secretary.

Royal Astronomical Society, April 13, Dr. Huggins, F.R.S., president, in the chair.—Lord Lindsay read a paper on the diurnal parallax of Juno observed at Mauritius in 1874 with the heliometer, which (rejecting one discordant observation) gave a value of 8″·82 for the solar parallax.—Mr. Gill read a paper on the proposed expedition to observe the approaching opposition of Mars. Observations can be made during six weeks. At the Island of Ascension the geometrical conditions are about as favourable as possible; and what is of great importance, the meteorological conditions are no less so, the range of temperature between 6 P.M. and 6 A.M being only two or three degrees. None of the stars of comparison are of less than the eighth magnitude, and they are selected so as to determine the position of the planet in right ascension as accurately as possible. Mr. Gill proposes also to observe the oppositions of the minor planets Ariadne, Iris, and Melpomene. That of Ariadne occurs ten days earlier than Mars. Its declination will be 15° south. Melpomene has 2° north declination.—Mr. Christie explained the principle of his new form of spectroscope. It depends on the fact that the half of an isosceles prism, cut perpendicular to the base, magnifies the angle between two incident pencils, by virtue of the oblique emergence. By using a compound prism composed of a half prism of flint with a prism of crown cemented to the oblique face, to correct the deviation, the magnifying effect might be increased to ten or fifteen times. By turning the half-prism about its centre different parts of the spectrum would be brought into the field without any movement of the viewing telescope. With two half-prisms the dispersion of ten ordinary compound prisms has been obtained, and with better definition; for with ten prisms the errors of forty surfaces are accumulated. When the breadth of the lines is diminished by narrowing the slit, the spectrum is still far brighter than in the other form, for the loss by absorption is enormous, amounting to 50 per cent. for three or four inches of glass, and in the large Greenwich spectroscope only $\frac{1}{200}$th part of the incident light reaches the eye. Mr. Bidder, Lord Lindsay, and Mr. Gill offered some criticisms, and Mr. Christie replied, showing that he had anticipated all the objections offered.—Prof. Pritchard read a paper on the comets of 1877. The recent dearth of comets he attributed to the probable sleepiness of seekers. Two had been observed at Oxford, and the elements and an ephemeris of Winnecke's calculated. They had made observations on April 7 and 11, which were combined with Prof. Winnecke's of the 5h. in making the calculations.—Prof. Pritchard also read a paper on a mechanical solution of Kepler's problem.—Mr. J. W. L. Glaisher read a paper on an elliptic-function solution of Kepler's problem.—The Rev. S. J. Perry described how neither he nor his assistants could see Vulcan.—Lord Lindsay stated that M. Leverrier thought it would be useless to look for Vulcan for the next six years.

Mathematical Society, April 12.—Lord Rayleigh, F.R.S., president, in the chair.—Mr. C. Pendlebury was elected a member.—The following communications were made:—On Hesse's ternary operator and applications, by Mr. J. J. Walker.—Geometrical illustration of a theorem relating to an irrational function of an imaginary variable, and on the general differential equation $\frac{dx}{\sqrt{X}} + \frac{dy}{\sqrt{Y}} = 0$, where X, Y are the same quartic functions of x, y, respectively, by Prof. Cayley, F.R.S. (Profs. Smith and Henrici took part in a discussion on these papers, the former making remarks on the question whether infinity is a point or a straight line).—Mr. Merrifield, F.R.S., vice-president, having taken the chair, Mr. Harry Hart deduced some cases of parallel motion from the consideration that the contra parallelogram represents the motion of two equal ellipses rolling upon each other, and that of these (*i.e.*, parallel motions) two especially were very simple, inasmuch as the motion was obtained in either case by the use of five bars only and was moreover perfectly continuous.—Mr. Tucker, hon. sec., read an abstract of a paper by Prof. H. W. Lloyd Tanner, on a method of solving partial differential equations which have a general first integral, applied to equations of the third order with two independent variables.

Chemical Society, April 19.—Dr. Gladstone in the chair.—The following papers were read:—On the estimation of manganese in spiegeleisen, and of manganese and iron in manganiferous iron ores, by E. Riley. For estimating manganese in spiegeleisen the author recommends the indirect method, *i.e.*, estimating the iron, adding five per cent. for impurities, and taking the difference as manganese, for accuracy and rapidity; for the estimation of manganese in its ores the author prefers to separate the iron as basic peracetate with carbonate and acetate of ammonia, and to precipitate the manganese with bromine and ammonia, taking care that the ignited precipitate contains no baryta, zinc, or lime. For the determination of the iron a standard solution of bichromate of potash yields the best results, the iron being reduced with pure sulphite of soda.—On a method of detecting small quantities of bismuth, by M. M. Pattison Muir. The author proposes Schneider's reagent, consisting of a clear solution of 12 grm. of tartaric acid and 4 grm. stannous chloride in caustic potash; one part of bismuth in 210,000, if warmed to 60°–70° C. with this reagent, gives a brownish colour.—On certain bismuth compounds, by M. M. Pattison Muir. This paper gives an account of the properties and reactions of bismuth ferricyanide.—Notes on madder colouring matters, by E. Schunck and H. Roemer. Munjistin: this substance resembles purpuroxanthic acid in its physical properties. Purpurin: a pure specimen was examined, and its properties are

given. Alcoholic lead acetate gives with purpurin dissolved in alcohol a precipitate soluble in excess, with alizarin a precipitate insoluble in excess. Triacetyl-purpurin and brom-purpurin were prepared and analysed by the authors. By heating pure purpurin in sealed tubes to 300° C. it was found to be partially converted into quinizarin.

Physical Society, April 14.—Prof. G. C. Foster, president, in the chair.—The secretary described a new form of colorimeter, devised by Dr. Mills. It consists of two vertical glass tubes about ten centimetres in length and two centimetres in diameter, and contracted at their lower ends, which are graduated in millimetres and fixed in a frame. In each tube a loosely-fitting disc of white or black glass (as occasion may require) can be raised or lowered from below by means of a glass rod fitting water-tight, and the meniscus of the liquid is concealed by a wooden screen. The two liquids under examination are introduced into the tubes to the same level, and the discs adjusted until rendered invisible.—Mr. Christie gave an account of a new form of spectroscope, in which "half-prisms" are used to magnify the dispersion (see Astronomical Society).

GENEVA

Society of Physics and Natural History, March 1.—Prof. Zahn presents preparations of the human costal cartilage, showing a fragmentary infiltration of the cellules. This infiltration is very frequent; it is observed in half of the men over forty, and especially in such as have any touch of lung disease.—Dr. Prevost described a case of aphasia observed at the Cantonal Hospital, in a young girl attacked with a right *hemiplegia*, in whom the aphasia subsisted after the cure of the hemiplegia. Though she cannot speak she has recovered the power of articulating words when she sings, and her intellect is untouched.

March 15.—M. Alph. de Candolle announced the conclusion of his work on the family of the *Smilaceæ* for the work which he will publish under the name of "Monographs of the Phanerogameæ." This family includes three principal species, *Heterosmilax*, *Smilax*, and *Riphozonum*, and is found in the division of the globe between India, Japan, and the Sandwich Islands. The first of these species is probably the most ancient.

PARIS

Academy of Sciences, April 16.—M. Peligot in the chair.—The following papers were read:—Note on a problem of mechanics, by M. Bertrand. Knowing that the planets describe conic sections, and without supposing more, to find the expression for the components of the force soliciting them, in function of co-ordinates of its point of application.—On a solar spot which appeared on April 15, by M. Janssen. While the disc had been wholly without spots on the 14th, it had, next day, a space near the centre some 2′ diameter, covered with them. This is of the order of things that occurs at a maximum; and the old idea seems incorrect that the rarity of spots at the minimum is due to an absence of activity of the photosphere. There is a tendency to prompt extinction of the phenomena.—Researches on iodic acid, by M. Berthelot.—On the theory of plane elastic plates, by M. Kirchhoff.—Determination of the differences in longitude between Paris and Marseilles, and between Algiers and Marseilles, by MM. Loewy and Stephan. The apparatus comprised a meridian instrument and pendulum, a Hipp's chronograph, a very sensitive Siemens' relay, a galvanometer, and a rheostat. The difference of longitude observed between the Paris and Marseilles instruments was 12m. 13·430s. ± 0·009s.; that between the Algiers and Marseilles instruments 9m. 23·219s. ± 0·009s. The difference of these, viz., 2m. 50·211s. expresses the difference of longitude between Paris and Algiers; which closely agrees with that got by MM. Loewy and Perrier by direct measurement (viz., 2m. 50·217s.). The velocity of transmission of the signals the authors state to be 36,000 km. per second in the aërial line and 4,000 km. in the cable.—New experiments on the origin and nature of typhoid fever, by M. Guerin. Experimenting with vomited bilious matters, bile, and fecal matters proper from the larger intestine (of typhoid subjects) introduced into rabbits by injection, he found that they rarely caused death—once in twelve experiments; while the special diarrhœic matter from the small intestine caused death almost constantly in a few hours or days. Experiments distinguishing the periods of the disease also pointed to the special toxical matter being almost entirely contained in he smaller intestine. M. Guerin offers some interpretation of these facts.—Divisibility of the electric light, by MM. Denayrouze and Jablochkoff. Using alternating currents and induction coils with interrupter and condenser suppressed, and a kaoln plate between the wires, a steady light is obtained. There is a central artery of the series of interior wires, and as many distinct conductors branch off as there are coils in the circuit. Each luminous centre is thus quite independent, and each may be extinguished or lit separately.—Discovery of a Gallo-Roman port and a Gaulish port near St. Nazaire; determination of the age of the layers at different heights (second note), by M. Bertrand.—The Phylloxera in the department of the Gironde (continued), by M. Azam. At the end of 1873 97 communes were attacked; at the end of 1876, 268.—On ozœna, by M. Brame.—Investigation of the law which must be obeyed by a central force, so that the trajectory it produces may be always a conic, by M. Darboux.—On the laws of reciprocity in the theory of the residues of powers, by M. Pepin.—On the radii of curvature of the successive podaries of a plane curve, by M. Niewenglowski.—On the rolling of ships in calm water, by M. Bourgoin.—On the state of salts in solution, by M. Gernez. His experiments contradict M. Tscherbatschew's view that saturated solutions of sulphate of soda, made under 33°, contain the hydrate with 10HO, those heated to a higher temperature the hydrate with 7HO.—On a new series of acid salts, by M. Villiers.—Transformation of ordinary pyrotartaric acid with tribromic bromhydrate of ethylene, by M. Bourgoin.—On the properties of resorcine, by M. Calderon.—Male flowers of Cordaites, by M. Renault.—Note on the calcifugal flora of the Albe of Wurtemberg, by M. Contejean.—Researches on the cardiac disorders which produce the intermittences of the arterial pulse, called *false intermittences*, by M. François Franck.—Experiments proving that the septicity of putrefied blood is not due to a soluble ferment, by M. Feltz.—On the winter of 1877 in Paris, by M. Renou. It is very rare that the minimum of the cold season falls in November or March (which show the lowest in the present case), or that March should present the lowest monthly average.—On the thunderstorm of April 4, 1877, by M. Godefroy. Figures of the hailstones are given, the form being that of a solid of revolution from a spherical pyramid.—On poisoning with salts of copper, by M. Decaisne.—On the precautions taken by tortoises against cold, and the indications they may furnish to farmers, by M. Bouchard.

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