THURSDAY, APRIL 17, 1884

SAMOA

Samoa. A Hundred Years ago and long before. By George Turner, LL.D. With Preface by E. B. Tylor, F.R.S. (London : Macmillan and Co., 1884.)

FOR the purposes of comparative ethnology Dr. Turner's new work on Samoa, that group of ten islands in the Pacific which the Frenchman Bougainville named the Navigators' Islands in 1768, is entitled to stand in the same rank with such books as Williams's account of Fiji or Mariner's "Tongan Islands." The careful study of Samoan beliefs and customs for a period of more than forty years confers unusual authority on the writer's statements, whilst his description of their heathen condition derives more than ordinary value from the fact of his having been among the earliest missionaries who visited the islands. Mr. Tylor, in the short preface he has prefixed to the book, speaks with justice of the peculiar interest which attaches to a work that describes Polynesian life as seen in its almost unaltered state before contact with European races had inaugurated a period of rapid change and made what was original and native indistinguishable from what was of foreign importation.

Complete as is the account given by Dr. Turner of Samoan life generally, of the government, social condition, and laws, of the people's food, their houses, or their canoes, the main interest and value of the work lies in the chapters which deal with the religious and mythological ideas of the Samoans. The book in this respect is not only a storehouse of curious myths and legends, but it helps to throw light on the vexed question of the origin of mythology as known in other parts of the world. The whole of Samoan mythology is based on the conception of the male and female nature of all things, such as we still find traces of in the genders of European languages. Thus, according to their cosmogony, from the marriage of the high rocks and the earth rocks sprang the earth, from the marriage of the earth and the high winds sprang the solid clouds, and so on till they come to the gods and chiefs down to the individual who was proclaimed king in the year 1878.

Stories betraying the same rude conception of nature abound. A girl turns into a mountain without difficulty (p. 117); a certain stone is a coward who fled in battle (p. 45); certain trees are transformed men (pp. 119, 219). The important thing is that these and similar stories are spoken of as "seriously believed" by many. "In all these stories the Samoans are rigid literalists and believe in the very words of the tradition" (p. 214).

Samoan ingenuity has its explanation for the origin of most things: of man himself; of the name Samoa as well as of that of all the islands and their chief places; of springs (p. 10); of the sea (p. 12); of pigs (p. 111); and, strangest of all, the story of the origin of cocoa nuts (p. 244).

Dr. Turner reckons the number of Samoan deities that had come to his knowledge at 120, yet there was a time when the Samoans were said to have no religion of any kind. Each individual, each household, each village, had his or its peculiar god, incarnate generally in some creature, but sometimes in a stone, a shell, or even a star. The rules and ceremonies of this fetichistic religion resembled very much those in vogue in America or Africa. A man, while considering it death to cut or injure the incarnation of his own god, would owe no respect to the incarnation of his neighbour's. Illnesses and death were the result of some offence against the gods, and prayers and offerings played in consequence a large part in the daily life of the Samoans.

An ill-defined supremacy among the gods belonged to Tangaloa. He made the heavens and the earth. He was specially prayed to before war, before fishing, or before planting, and thunder was the sign that the prayer was heard (p. 53). Like Zeus, he sometimes was attracted by mortal women, and to obtain the lady who ultimately became his wife he sent down first thunder and storm, then lightning and darkness and deluging rain, and, last of all, a net in which he succeeded in catching her (p. 232).

The souls of dead Samoans started for Pulotu, the spirit-world, through two circular holes near the beach, the larger hole being for the souls of chiefs, and the lesser for those of commoners. They went under the sea till they came to a land where all things were very much as they had been on earth. Chiefs looked forward with pride to the use of their bodies as pillars in the house of the Samoan Pluto (p. 260).

In the Tongan Islands there was the same belief in Boluto as the future world; and Dr. Turner's work is suggestive at every turn of comparisons with the beliefs or customs of remote parts of the world. The Samoan story of the origin of tattooing, turning on a mistake in the delivery of a message (p. 55), recalls the Kaffir and Hottentot account of the origin of human mortality. The story of the turtle and the fowl (p. 218) points the same moral as the classical fable of the tortoise and the hare. The story of the woman and her child who were taken up to the moon, where they may still be seen (p. 203), is precisely similar to the moon myths of European folklore. The custom of artificially flattening the heads of children (p. 80) connects the Samoans in habit with the American tribe who, for doing the same thing, were called the Flathead Indians.

With regard to Samoan customs generally the most interesting allusions in Dr. Turner's work are to the mock burnt-offerings, when for some offence against the gods a man would undergo a counterfeit process of baking in a cold oven (pp. 32, 69); to the ordeals for the detection of theft (pp. 19, 184); to imprecations by taboo, as when the fear of a shark was instilled into a thief by the plaited figure of one (p. 186); to the confession of crimes for the purpose of obtaining divine pardon (pp. 34, 40, 141); to purification before battle by sprinkling (p. 64). It is perhaps to be regretted that in reference to the rules of marriage the information vouchsafed by Dr. Turner is not so full as on the preceding points: we are not told whether the Samoans were endogamous or exogamous, nor to what extent purchase entered into matrimony.

A modified system of communism prevails with regard to property, every man having claims on the general possessions of the clan, so that in building a house or a canoe he can always draw on his relations. Dr. Turner says that this system is a sad hindrance to the industrious; but he also points out that it obviates the necessity of poor laws by making poverty unknown and inconceivable (p. 160).

We miss in Dr. Turner's book any estimate of the progress made by the Samoans since or in consequence of the arrival of the missionaries in 1830; though he makes it clear that before that time they had made some independent advance in the ways of civilisation. Thus he notices the previous mitigation of their penal code (p. 178); and points to tradition as attesting in former times the custom both of cannibalism (pp. 236, 240) and of human sacrifices (p. 201). One would gladly know whether their numbers are increasing or the reverse; whether their wars have stopped; and whether it can still be said of them, as Dr. Turner says of them as heathens, that "few drank to excess."

The last chapter deals with twenty-three islands away from the Samoan group, such as the Gilbert group and the New Hebrides, but in reference to these the writer speaks more on the authority of native teachers than on a prolonged personal residence among them. The most noticeable thing is the frequency of the custom of making infanticide compulsory by law; and the generality of the belief in the original resting of the sky upon the earth and in the necessity of pushing it upwards. Perhaps the most curious custom on these islands is that quoted of the isle Peru, by which a married woman for years after her marriage was prohibited from looking at or speaking to any one but her husband. When she went out she was covered in a mat with only a small hole in it by which she might see her way, and any man who saw her coming was obliged to hide himself till she had passed (p. 298).

Having touched on the chief points of interest in Dr. Turner's work, we cannot do more than commend it earnestly to the attention of all who take interest in the customs of unadulterated heathenism. We may fairly describe it as one of the most important contributions to the science of anthropology that has been published for many years. In matter and arrangement it is a great improvement on the "Nineteen Years in Polynesia" in which Dr. Turner first gave to the world his experiences of Samoa. There is an entire absence, perhaps too much, of personal missionary narrative; nor will any one regret in the present work the long chapter which in the former drew attention to a quantity of more or less trifling resemblances between the customs of the Samoans and the Jews. The similarity is doubtless a real one, but it only shows, as wherever else it appears, not that the people in question had any connection whatever with the Jews, but that the Jews in their evolution from savagery passed through the same stages of thought and custom which still characterise barbarism wherever it exists. The more the customs of remote parts of the world are brought into comparison, the more wonderful in its almost mechanical regularity must appear the history of human development.

J. A. FARRER

VOICE, SONG, AND SPEECH

Voice, Song, and Speech. A Practical Guide for Singers and Speakers, from the Combined View of Vocal Surgeon and Voice Trainer. By Lennox Browne, F.R.C.S. Edin., &c., and Emil Behnke, &c. 8vo, pp. 322. (London: Sampson Low, Marston, Searle, and Rivington, 1883.)

THIS bulky handsome volume of 322 pages seems at first sight to present considerable difficulties to a reviewer, which begin with the very title-page, wherein its contents are said to be derived "from the combined view of vocal surgeon and voice trainer." The latter occupation is fairly definite; but what exactly is the former? It might indeed be thought that the striking photograph, with wide-opened mouth and glaring eyeballs, which faces the title, represents the vocal surgeon in question, seen in the very act of giving tongue. But this explanation turns out to be incorrect; as it is an excellent though not a "combined" view of Mr. Emil Behnke's larynx, taken from nature and untouched by hand. This feature, if indeed the larynx can be correctly called a feature, of the work, is, it may be at once said, the best it contains. The gentleman just named has exhibited remarkable energy and perseverance in obtaining, for the first time, a series of autolaryngoscopic views of the vocal chords in the process of phonation, and in different registers of the voice. Four of these, given on an enlarged scale in the body of the volume, go some way towards settling the long debated question as to the different mechanism of the natural and the artificial or "falsetto" voice. In all other respects the book is very unequal, and contains little that cannot be as well or better obtained elsewhere. It has two prefaces: one of the usual kind, and in the usual place; the other at the opposite extremity of the work, quaintly termed a Preface to Advertisements, in which it is stated that "the authors have stipulated with the publishers that no advertisement whatever should be admitted without their express sanction." The opening chapter is entitled "A Plea for Vocal Physiology," and is followed by others on the laws of sound, the anatomy and physiology of the vocal organ, and on the larynx, which need no special notice except to remark that the nomenclature adopted in the description of the last-named organ, like that employed in another of Mr. Behnke's works, is somewhat un-English and clumsy. The old Greek names thyroid, cricoid, arytenoid, and the like are at least as graceful, and perhaps as easy to retain in the memory as the "ring-shield aperture," the "shield-pyramid muscles," and the "buffer cartilages.' In the chapter on vocal hygiene some characteristics, fortunately uncommon, begin to show themselves. We are told that "Better than a respirator is the veil invented by Mr. Lennox Browne, and sold by Messrs. Marshall and Snelgrove." On turning to the selected and expurgated advertisements, we find one from the latter firm, adorned with a fascinating picture of a lady wearing the said invention, of which the price is "5*s*., or by post 5*s*. 2*d*." On pp. 110 and 111 we meet two old friends, again ladies, one with a natural, another with a deformed, waist; and to our delight they reappear with farther internal detail on pp. 112 and 113. Four pages having been thus pleasantly got over, we learn with relief on p. 117, that "hygienic corsets, exactly of the kind we describe, can be obtained from Mr. Pratt (surgical mechanist of Oxford Street)." On turning to the advertisements, we, singularly enough, find Mr. Pratt also among the elect. Hutchinson's well-known spirometric experiments are then largely drawn upon, and freely quoted, by which means we reach p. 132, where we find four pages of illustrative cases, including those of the "Rev. Canon G.," who "broke down in voice"; "A. B., Esq., M.P.," who "suffered from impediment in speech"; "C. W. P., Esq., Mus. Bac.," who "spoke in a child's treble"; and "Miss D. M.," who "was rapidly losing the upper and middle notes of her voice from faulty production." All these, and others, to the number of eight, even a Scotch precentor among them, were happily cured.

We next pass to the oft-told history of the laryngoscope and its teachings, to find on pp. 163-169 some really good woodcuts of the five registers of the voice, named, according to Mr. Curwen's system, the lower thick, the upper thick, the lower thin, the upper thin, and the small respectively. Farther on two of these, and the falsetto, are reproduced by photography as above stated.

The chapters on voice cultivation, on breathing, on "attack," and on resonance go rather beyond the scope of a scientific paper. As an exercise, the pupil is recommended to repeat the syllable *koo* four times rapidly, once long; following with *oo*, *oh*, *ah*. The effect, with a large class, would be highly pastoral and pleasing. Indeed, it is a comfort to know that this "will be published very shortly by Messrs. Chappell and Co., of 50, New Bond Street" (*vide* advertisement). The most original chapter of all is, however, that on "The Daily Life of the Voice-User." He or she is instructed as to residence, "ablutions," "face and neck powders" (see advertisement), dress, and especially as to a "special woven and shaped combination, reaching from neck to ankles and wrists." On turning with feverish haste once more to the advertisements, we find that this boon to human nature can be obtained of E. Ward and Co. of Ilkley, and that the cost is only 12*s*. 6*d*. On the other hand, while treating of diet, the authors, no doubt from a "combined view," say (p. 256), "We decline to give an opinion on cucumber."

The above extracts will show the general tone and style of the work. The writer of these lines wishes to speak with the greatest respect of Mr. Behnke's really valuable photographs, which he exhibited at the Royal Institution about a year ago. He cannot help regretting that that gentleman in bringing his new conception into the world should have called in the obstetrical aid of any surgeon, however "vocal." W. H. STONE

OUR BOOK SHELF

A Sequel to the First Six Books of the Elements of Euclid. By John Casey, LL.D., F.R.S. (Dublin: Hodges, 1884.)

WE have noticed (NATURE, vol. xxiv. p. 52, vol. xxvi. p. 219) two previous editions of this book, and are glad to find that our favourable opinion of it has been so convincingly indorsed by teachers and students in general. The novelty of this edition is a supplement of "Additional Propositions and Exercises" (pp. 159-174). This contains an elegant mode of obtaining the circle tangential to three given circles by the method of false positions, constructions for a quadrilateral, and a full account, for the first time in a text-book, of the Brocard, triplicate-ratio, and (what the author proposes to call) the cosine circles. Dr. Casey has collected together very many properties of these circles, and, as usual with him, has added several beautiful results of his own. He is not so thoroughly well up in the literature of the subject as he might be, but he has done excellent service in introducing the circles to the notice of English students. Again, Question 31, p. 174, to one unacquainted with geometrical results, would appear to make its *début* here, whereas it figures as a question in the "Reprint from the *Educational Times*" (vol. iii. p. 58),[1] and is discussed there in connection with an envelope which forms the subject of a paper by Steiner (see also pp. 97, &c., and vol. iv. p. 94).

Many of the trifling errors we previously pointed out have been corrected, but some are still left, as on p. 39, line 15, "AB" should be "AC"; p. 110, reference should be to the "*Reprints from* the *Educational Times*"; p. 74, line 8 up, should be "BD," not "PD"; Question 103, p. 157, is incorrectly printed; p. 172, the Brocard angle, in all the papers we have seen, is denoted by ω and not by a. We think a better place for the "Observation" on p. 172 would be after Question 3 on p. 171. The figure on p. 134 is inverted. In the "Index," Pascal's Theorem should be referred to p. 129 and not to p. 139. We only need say we hope that this edition may meet with as much acceptance as its predecessors: it deserves greater acceptance.

The Ores of Leadville, and their Mode of Occurrence, &c. By Louis D. Ricketts. 4to. (Princeton, New Jersey, 1883.)

THE author, in accordance with the requirements of the Ward Fellowship in Economic Geology in Princeton University, spent upwards of four months at Leadville in the study of the ores and their mode of occurrence, and more particularly in the Morning and Evening Star Mines. The result of his investigations are presented in a very useful memoir dealing with the minuter phenomena of the two mines investigated, which are admirably placed for this purpose, as, although small, they have yielded an enormous quantity of carbonate of lead associated with silver ore in the form of chloride and bromide, the whole deposit being probably a pseudomorph or substitution-product of a blue limestone of Carboniferous age, by infiltration of metallic minerals from an overlying sheet of gray porphyry. This class of substitution is not unknown in other parts of the world, the famous calamine deposit of Vielle Montagne being one of the most familiar examples, but nowhere else is it illustrated on the great scale observed around Leadville, which now produces nearly one-half of the total quantity of lead raised in the United States. The ore itself varies very considerably in character, consisting of mixtures in every conceivable proportion of hard granular and soft carbonate of lead, often exceedingly pure, with quartzose brown iron ore and silver chloride and chlorobromide, the latter sometimes in lumps of a few ounces or even a pound weight; more generally, however, it is diffused through the mass, which is enriched to from 50 to 100 ounces in the ton of ore. A point of great interest, we believe first noticed by the author, is the occurrence of beds of basic ferric sulphate underlying the lead carbonate, and also containing some silver as chloride and lead as sulphate. This the author considers to be due to the oxidation *in situ* of a belt of iron pyrites more or less mixed with galena, the change being so complete that no trace of pyrites is ever seen in it. In a second section the author gives much interesting detail as to the working of the mines and their produce, the whole forming a monograph of considerable value. H. B.

[1] It was proposed in the *Educational Times* for February 1865.

Elemente der Organographie, Systematik, und Biologie der Pflanzen. Von Dr. Julius Wiesner. (Wien: Alfred Hölder, 1884.)

THIS is the second volume of a more extensive work entitled "Elemente der wissenschaftlichen Botanik," the first volume of which dealt with the anatomy and physiology of plants. The first part of this the second volume is occupied with organography: the author recognises five fundamental types of vegetative organs, viz. "phyllom, caulom, rhizicom, trichom, thallom," and thus ignores the conclusion of Sachs, that stem, leaf, and root are not coordinate categories, but that the root should rather be coordinated with the shoot, a structure composed jointly of stem and leaf. Further, he cites the sporangia of Ferns as examples of trichomes (p. 5), and thus does not adopt the view of Goebel, that the sporangium is an independent organ, and is not referable to the categories of vegetative organs. These two points are sufficient to show that the book is not abreast of current morphological opinion.

The second part is devoted to the systematic study of plants. The arrangement adopted is that of Eichler's "Syllabus," in which the classification of Angiosperms is different from that in current use in England. This section appears to consist chiefly of an enumeration of facts, and the student is left to draw his own comparisons between the plants described.

Then follows a part on "Biology," a very readable treatise on the life of the individual, reproduction, and the origin of species. As an appendix a short history of the development of botany is given, and in a few pages of notes, references are given to the most important works on various branches of the subject. It is surprising under the head of classification of Phanerogams (p. 424) to find no mention of the "Genera Plantarum" of Bentham and Hooker, the most important publication of the sort in recent years. The book is illustrated by numerous woodcuts, many of which are taken from older books, for example Schleiden's "Grundzüge." Looking at the book as a whole, there is nothing sufficiently new either in the material or in the treatment to recommend it above others already before the public.

LETTERS TO THE EDITOR

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

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

On the Motion of Projectiles

I HAVE read with great interest Mr. Bashforth's article on a new method of estimating the steadiness of elongated shot when fired from large guns, and I have no doubt that we should have a much better knowledge of every new gun to be brought into service if we could try it, using the Bashforth chronograph, which is the most perfect for measuring the times occupied by a shot in passing over a succession of equal distances. That would give us at once the coefficient of resistance of the air to the projectiles used in that special gun, and then by very simple formulæ and tables the calculation of trajectories (which is one of the main points in artillery) would be a very easy task.

Instead, with the present system, viz. knowing only the muzzle velocity, we must rely for these calculations on the coefficients determined with only one sort of projectiles; and of course such coefficients must vary very much (more, perhaps, than is generally thought) with different projectiles, with different shapes of the head, and especially with the different methods of giving rotation.

Lately many improvements have been made in the form of the projectiles; many ogival-headed shots of two diameters have been introduced, and the use of breechloaders instead of muzzle loaders has allowed the use of better means of giving rotation.

Of course the present coefficients still hold good for comparatively short ranges, and for heavy projectiles, because then the loss of velocity is little on account of the small $\frac{d^2}{w}$. But when the $\frac{d^2}{w}$ is rather large, as in the case of small guns or rifles, then the coefficients K_v are less reliable.

I have had great experience in calculating with the Bashforth method, and I have been able to calculate trajectories for heavy guns, which were not far out from the actual practice; I had still better results using Prof. Niven's method and table; but when I had to calculate trajectories for small guns, both these methods failed to give me reliable results.

For instance, in calculating the trajectories for the Nordenfeldt one-inch gun, I had with Bashforth's method for an angle of elevation of 9° a range of 2282 yards, and for 12° of elevation a range of 2539 yards: instead by actual practice the elevations required were found to be—

For 2200 yards	7° 12′
,, 2400 ,, ...	8° 20′
,, 2600 ,, ...	9° 36′

The bullets have an ogival head struck with a radius of one diameter and a half, therefore they are not different in shape from the shots used by Mr. Bashforth in his experiments. Besides I divided the trajectory into many small arcs, and I was very careful in applying the correction for the different density of the air, viz. using always the formula $\frac{d^2}{w}\left(1 \pm \frac{\Delta}{534 \cdot 22}\right)K_v$, instead of simply $\frac{d^2}{w} K_v$. I was even rather afraid of overdoing this correction, taking a lighter weight of the air than was necessary; and I was very much astonished when I saw that the trajectories calculated were much too short.

It seems to me also that the correction to be applied when the bullet rises to a great height, requires a little more consideration, and a thorough mathematical investigation.

I think that the problem of a body moving in a medium which becomes less and less resistant as the body advances through it is more complicated than we would think at first, and cannot be dealt with by only considering the density of the medium equal to the mean of the densities at the two terminal points.

E. RISTORI

Christian Conrad Sprengel

THE interest in my note on Sprengel (NATURE, vol. xxix. p. 29) may excuse some additional facts. In the Life of Dr. E. L. Heim (by G. W. Kessler, Leipzig, 1835, 8vo) the following is reprinted from Heim's diary, vol. ii. p. 72:—

"I read Rector Sprengel's work with indescribable satisfaction. Since the time when I read Hedwig's system of the fructification of the mosses, fourteen years ago, I never had such a great and thorough pleasure as to-day. I cannot admire enough the power of observation, the untiring assiduity, the acuteness, and the correct and clear exposition of the facts which he had observed. His work is a masterpiece, an original, which gives him honour and of which Germany can be proud."

Dr. Heim, who afterwards became a distinguished physician in Berlin, Prussia, was an enthusiastic mycologist, who had made the acquaintance of Sir J. Banks and Solander, had studied carefully Dillenius's Herbarium in Oxford, had later visited Gærtner and Koelreuter. He speaks rather enthusiastically about this naturalist, who showed and explained to him his experiments. Dr. Heim gave also the first instructions in botany to Alexander von Humboldt.

Mr. Kessler, the editor of Heim's Life, says (vol. i. p. 286):—"Heim found in Rector Sprengel, to whom he gave the first instructions in botany, a remarkable student. Sprengel repaid largely all pains which Heim had spent on him by the fruit of his careful studies."

The editor wrote this in 1835, and the fact that he selected out of the diary the above-quoted note proves well how much Sprengel's work was appreciated and admired even by non-scientists.

In Kœnigsberg, Prussia, Prof. C. F. Burdach, in his yearly lectures on physiology, taught and appreciated highly Sprengel's discoveries. In his large "Physiology," published in 1826 with the assistance of C. E. von Baer and H. Rathke, and in the second edition, 1835, with the same assistance, and, besides them, with E. Meyer and J. Valentin, and in a French translation of the same work, § 237 gives an account of Sprengel's discoveries. "If he should have gone a little too far in some cases it would be without importance; the same occurs with every scientist who makes a great discovery, and becomes with it enthusiastically excited." I know personally that Burdach's well-reputed assistants were thoroughly acquainted with Sprengel's observations.

Prof. H. Burmeister had studied in Greifswald and in Halle, and published his "Handbuch der Entomologie," 1832; an English translation by F. Shuckard. He speaks (vol. i. p. 303) about Sprengel's and Koelreuter's observations at some length, also as well known and of the highest importance. Prof. Burmeister will be indeed best able to state if he became acquainted with the facts in Prof. Hornschuck's lecture on the physiology of the plants, "naturæ mysterias nobis aperire expertus est" ("vita" in Prof. Burmeister's dissertation), or in Halle by Prof. Carl Sprengel, the nephew of Rector Sprengel, or somewhere else. I know personally that in Berlin, Link, Lichtenstein, Klug, Erichson were entirely acquainted with Sprengel's discoveries. Prof. Kunth was a very old friend of Heim (Life, ii. p. 9), and beyond doubt acquainted with the facts, though he has not brought it forward in his lectures after Dr. F. Müller's statement. I was assured by scientific friends that Treviranus in Bonn and Nees von Esenbeck in Breslau were well acquainted with Sprengel. I confess that I am entirely at a loss to understand how it happened that Sprengel was unknown to scientists in England, where Kirby and Spence's "Introduction," &c., had seven editions from 1815 to 1867, the last of 13,000 copies. There would be no difficulty to find in German libraries more publications to corroborate my views, but I believe those quoted are sufficient to prove what I intended to state in my former note.

H. A. HAGEN

Cambridge, Mass., March 24

Salt-water Fish-Types in Fresh Water

MR. HARDMAN'S observations on the occurrence of "sea-fish in fresh-water rivers" (NATURE, vol. xxix. pp. 452-53) are not by any means unique, as he has supposed. On the contrary, cases similar to those he has recorded are so frequent as to justify him in believing that "some caution must be observed in the classification of strata as fresh-water or marine on the evidence of fish alone." The incursion and confinement of the two types specially mentioned—the "sunfish" and "shark"—in fresh water have many parallels. For instance, in NATURE, vol. xiii. p. 107, Messrs. W. W. Wood and A. B. Meyer have recorded that "near Manila is the Lacuna de Baij, a large sheet of water" whose "water is quite fresh, and, after settling, perfectly potable," but in which live a sunfish (*Pristis perotellii*) and a small shark. Further, in Lake Nicaragua, whose mean height above mean tide in the Pacific and Atlantic Oceans is 107·63 feet, are likewise found a sunfish—apparently *Pristis antiquorum*—and a peculiar shark—*Eulamia* (or *Carcharias*) *nicaraguensis*. The last have been especially noticed in a "Synopsis of the Fishes of Lake Nicaragua, by Theodore Gill, M.D., and J. F. Bransford, M.D., U.S.N.," in 1877 (*Proc. Acad. Nat. Sci. Phila.*, pp. 175-91). Therein it is also urged that "these instances, supplemented as they are by many others, are sufficient to convey a caution against too extensive generalisation of the physiographical conditions hinted at by fossil remains of aquatic types."

THEO. GILL

Washington, April 1

"The Axioms of Geometry"

MR. ROBT. B. HAYWARD has written to me that some of the statements in my article, "The Axioms of Geometry," in NATURE, March 13 (p. 453), are too sweeping, and that in particular Euclid I. 16 does not necessarily hold for the geometry of the eye-being, or, to use the more familiar language of spherical geometry, that this theorem does not hold unless the median line of the triangle on the side on which the exterior angle lies is less than a quadrant.

Mr. Hayward has also pointed out that the error lies in the assumption that a terminated straight line "may be produced to any length."

All this is clear enough, and I was conscious of it when I wrote the article. In fact I meant to add, but somehow omitted to do so, that every figure considered has to be limited to less than a hemisphere, or to less than half the space round the eye-being. If this is done, and if by the whole figure is understood the given figure together with any addition required for the proof, then my statements will hold, but with one exception. I was wrong in saying that Legendre's proof, given by Mr. Casey, can be treated in the same manner as Sir Wm. Hamilton's. For in this proof a series of triangles is constructed with sides which increase till they become infinite. The reasoning is therefore not applicable to the sphere. But neither is it to the plane. We have no right to reason about infinite figures as we do about finite ones.

O. HENRICI

Wild Duck laying in Rook's Nest

A WEEK ago to-day six wild duck's eggs were taken out of a rook's nest about four miles from here. The rookery is situated on the banks of the River Test. The nest from which these eggs were taken (the bird flew off as the nest was approached) was in a horse-chestnut tree, and was about thirty feet from the ground; the tree was about twenty-five yards from the river, and was surrounded by others, mostly elm. An instance of so unusual a situation for wild duck's eggs might, I thought, interest some of your readers.

JOHN H. WILLMORE

Queenwood College, near Stockbridge, Hants, April 3

[Our correspondent has sent us one of the eggs referred to, which we have submitted to a well-known oologist, who is of opinion that the egg is most likely a wild duck's.—ED.]

The Remarkable Sunsets

I LEARN from Mr. Frank Atwater, a teacher in the Native College here, that he observed the "glow" at 5 a.m. on September 5, when landing from the steamer at Maalaea, thirteen miles south-east of this. He had arrived in the islands only two days before, and marvelled much if such were the sunrises here. He is the only person I have met who observed it prior to the evening of that day. Mr. Atwater's date is verifiable by the regular movements of the steam-packet.

Lahaiua, Hawaiian Islands, March 14 S. E. BISHOP

Cats on the District Railway

WITH reference to Mr. Vicar's letter last week (p. 551) about the cats at Victoria Station, I beg to state that there are cats all over the District Railway both in and out of the tunnels, and many of them—familiarly called "Stumpy" by the men on the line—can testify by the shortness of their tails to the hairbreadth escapes they have had from passing trains. Those I have seen are mostly full-grown cats, and only once have I seen a kitten walking on the rails, and that was at night after the traffic had ceased. At one signal-box which is built on a platform over the line, and the only access to which is by a steep iron ladder, down which no cat could climb, there are two full-grown tabbies—toms I believe—and I have often seen them asleep behind the signal bells or even on the handrail of the platform, utterly callous to the trains rushing by underneath. As a rule the men are very kind to them, and give them milk, &c.

I would add that until quite recently there was a small fountain and circular basin near one of the pumping-engine houses wherein were two fish which had been there for about twelve years. One died last year, and now I see the basin has been converted into a flower-bed by the man in charge.

E. DE M. MALAN

Victoria Station, District Railway, April 14

THE GEODETIC SURVEY OF THE UNITED STATES[1]

WE would congratulate Prof. J. E. Hilgard, the Superintendent of the Survey, on his first general Report on the work of his department, which gives an account of the Survey for the fiscal year ending June 1882. We are unable to gather why its issue has been deferred until now, but its arrival at the present time is not the less opportune, particularly as the programme of

[1] "Report of the Superintendent of the Survey," Washington, 1883, 556 pp., 4to.

the approaching International Geodetic Conference at Washington is beginning to claim decision.

The Report describes the nature and general procedure of the coast and topographical surveys, with a description of the instruments employed ; full details of the observations and their methods of reduction being given.

Whilst the original leading aim of the Survey, the security of navigation, has been kept in view, other objects incidental to the work of trigonometrical survey, and of the highest scientific interest, have not been lost sight of.

Hydrographic surveys have been prosecuted in the waters and off the coasts of seventeen States and Territories, and topographic surveys for the exact definition and delineation of shore line have been carried on in eleven States and Territories. The triangulations for this work have been advanced in twenty-two States and Territories, and included the measurement of the base-line in California ; and also, as is well known, the extension of the trans-continental triangulations urged by the late Prof. Peirce, for connecting the surveys of the Atlantic and Pacific coasts. In the interior States the work has included the continuation of the triangulations of Kentucky, Tennessee, and other States.

The incidental work has comprised the carrying of lines of precise "leveling" between points far distant (1125 miles) ; the exchange by telegraphic signal of the longitudes of important cities ; the usual observations for latitude and azimuth, and of the magnetic elements ; the determination of the force of gravity by pendulum experiment ; and the study of ocean currents, particularly of the Gulf Stream.

For the year ending June 1884 the cost for carrying on the work of the U.S. Coast and Geodetic Survey, by which designation this department has been known since 1878, was estimated at $573,000, and it is gratifying to note that on the other side of the Atlantic the value of active scientific inquiry continues to be recognised by the State, provision having been made for further tidal, magnetic, gravity, and other scientific observations.

In a geodetic survey extending over an area so large as that of the United States the question of the size and figure of the earth becomes of great importance. Although, as Prof. Hilgard points out, different opinions are held as to the mode of prosecuting gravity experiments, all geodists agree that widely-distributed pendulum observations will give results valuable to geodesy and geology. It is undoubtedly desirable that opportunity should not be lost of combining the results of pendulum observations taken in different parts of the globe, and we trust that the valuable pendulum work done in India ("Great Trigonometrical Survey," vol. v.), and the discussion at the informal conference on gravity determinations between Col. J. Herschel, R.E., Prof. S. Newcomb, and the officers of the Survey Department, which was held at Washington in May 1882, may stimulate the recognition in this country of the necessity of further experiment and inquiry in this direction. Although the conclusions proposed by Prof. Newcomb, as amended and adopted by the conference, have been elsewhere discussed, it appears desirable at the present time again to invite attention to them. Generally they are as follows :—

1. The main object of pendulum research is the determination of the figure of the earth.
2. A complete geodetic survey should include determinations of the intensity of gravity.
3. A minute gravimetric survey of some limited region is at present of such interest as to justify its execution.
4. Extended gravimetric linear exploration is desirable.
5. Each series of such determinations should be made with the same apparatus.
6. Such determinations ought commonly to be accurate to the 1/200,000th part.
7. All pendulums should be compared at some central station.
8. Determinations of absolute gravity will probably prove useful in comparing the yard and the metre, and they should at any rate be made in order to test the constancy of gravity against the constancy of length of a metallic bar.
9. In the present state of our experience, unchanged pendulums are decidedly to be preferred for ordinary explorations.

In an appendix (No. 21) is given the reduction, with the employment of modern constants, made by the late Dr. C. R. Powalky at the charge of the Bache Fund of the National Academy of Sciences, of the places of 150 stars observed by La Caille at the Cape of Good Hope and at Paris, between 1749 and 1757. Since all these stars have been re-observed in recent years at Melbourne and at the Cape, the comparisons of La Caille's places with these determinations and with those of Dr. B. A. Gould at Cordoba became of scientific value.

An account is also given of the measurement of the primary base-line in Yolo county, Sacramento Valley, begun in 1879 with the new compensating base apparatus designed by Assistant C. A. Schott. The measurement was made under the directions of Assistant George Davidson, but the discussion of its results does not appear in the present Report.

The measuring bar of the compensating apparatus is of a construction different from other compensating bars, but involves no new mechanical principle. It is composed of two metals, zinc and steel, so proportioned as to be compensatory for change of temperature, the expansion or contraction of a zinc bar five metres in length being counteracted by the expansion or contraction of the two steel bars between which it is placed.

The determination of the rate of expansion of the subsidiary steel and zinc bars by which the five-metre standard was verified was done by means of two micrometer microscropes securely fixed to stone piers placed a metre apart, the metre bar whose rate of expansion was to be determined being compared when at different temperatures with the distance between the two microscopes as determined at a constant temperature by reference to a second standard metre bar. The distance between the microscopes thus becomes a function of the temperature, and in this respect we cannot but think that the method attributed to General Wrede, by which the variable distance between the microscopes becomes unimportant, has a decided advantage.

The active investigations since 1871 as to the distribution of terrestrial magnetism in North America have beome generally known from the reports of Prof. Hilgard, as well as by the publication of Mr. Schott's paper on the magnetic variation of secular declination. Mr. Schott also now gives an important appendix to the Report on the distribution of the magnetic declination in the United States at the epoch January 1885, together with three isogonic charts in continuation of those issued by the Survey up to the year 1876. The results are also given of the magnetic observations made by Lieut. Very on the north-eastern coast of America, particularly at Labrador, in the remote settlement of Nain (lat. = 56° 33′ N., long. 61° 44′ W.).

In the exploration of the Gulf Stream, the facts brought out by the deep-sea soundings of Commander J. R. Bartlett during 1881, with Siemens's admirable electrical deep-sea thermometer, are also referred to ; and the account of the deep-sea soundings taken off the Atlantic coast between 1879 and 1883 by Lieut. J. E. Pillsbury, in connection with the exploration of the Gulf Stream, and the discussion by Prof. Ferrel on the tides of the Pacific coast are now published. The inquiries of Dr. Thos. Craig as to fluid motion, particularly as to the motion of vessels and of bodies such as pendulums, when totally immersed in fluid, are also adverted to.

Twenty-five useful maps and charts are attached showing the general progress of the survey, particularly on the coasts of Florida, California, Oregon, and Carolina; together with illustrations of the apparatus used. As compared for instance with the precise drawings given by General Ibanez in his Reports in 1860 and 1865 on the Madrid base-line, there may perhaps be room for improvement in the finish of the illustrations given in this Report.

In the Report of the Superintendent for 1883 we shall look forward with interest to the results of the experimental researches on the force of gravity, by Assistant C. S. Peirce, who is now visiting Europe for the purpose of his inquiries.

In the success with which the Superintendent has been able to deal with the different branches of his department, much is due, as he indicates, to the forethought and systematic treatment of his eminent predecessors, particularly to Carlile P. Patterson, to whose memory a graceful tribute is rendered in the Report; as well as to the able assistance which the Government have placed at the Superintendent's disposal.

AGRICULTURE IN SUSSEX[1]

THIS Report bears evidence of a considerable amount of careful research bearing upon the agricultural practice of Sussex. The honorary secretary, Major Warden Sergison, must be congratulated upon his zealous administration of the finances, whereby an annual income of about 770*l.* has been secured for the three successive years of active operations. This Report deals with the results of the third year's work, which completed the period over which it was originally calculated that the work should be extended. We are therefore in a position to form some opinion as to the practical value of the results which have been gained. It appears from this Report that it is intended to extend this inquiry.

These experimental researches have been conducted by Mr. Thomas Jamieson, the Fordyce Lecturer on Agriculture in the University of Aberdeen, and it will be interesting to notice the improvements and economies which are claimed in his Report as resulting from this rather costly investigation. He says:—"The results are too numerous to give, . . ." but "an attempt will be made to give in a general way the lessons they seem to teach." He then proceeds to indicate these, placing them in the form of question and answer. We will take the first of these.

"*What food do plants need?* Prior to the experiments now recorded, the answer to this question would have been 'Nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, iron.' The results of the experiments warrant us in saying that the latter four substances may be disregarded by farmers. We thus realise the value of experiments. If the farmer of 100 acres will lay his manure bill before a chemist, and ask him to calculate how much he has paid for those useless—or hurtful—ingredients, he will recognise the direct benefit of such experiments."

Those who have watched the good work which Mr. Jamieson has done in connection with the Aberdeenshire Agricultural Association, and who have recognised the opposition with which he had to contend, cannot but regret the hasty conclusion at which he has arrived. It is a very bold assertion to make that sulphur, calcium, magnesium, and iron are not needed as plant-food. He cautions his friends "not to be led away by opposed statements, however plausible, if unaccompanied by proof." In this case Mr. Jamieson shall supply his own proof, for which purpose we refer to the Report of the Aberdeenshire Agricultural Association, 1875-76, p. 29. Here Mr. Jamieson reports a very valuable series of experiments which he made. White sand was supplied with all the ingredients found in turnips—except one—and turnip seeds were then sown. He says:—"Precisely the same sand, precisely the same seed, precisely the same watering, precisely the same ingredients added, except one—which was purposely omitted—*calcium*. In consequence of this omission, although all the other ingredients were present in abundance, the healthy seed produced healthy young plants, but speedily *the whole of them died*. Just as in an ordinary chemical experiment *the desired substance cannot be formed if one of the essential ingredients is absent.*" The lesson derived from this experiment is perfectly consistent with agricultural science, and it is a source of profound surprise to find that this substance—*calcium*—is one of the four bodies named in the Sussex Report as being unnecessary, and that it should be stated that "farmers will not hurt their crops by omitting these four elements." This is *a dangerous lesson* to deduce from this valuable series of experiments, and we regard it with the greater regret because the facts do not justify such a conclusion.

Other examples might be selected from this Report, which conflict with other experimental trials conducted with, at least, equal care, which also tend to show the necessity for taking more *practical* views of the results gained. The opinions expressed upon permanent pasture are also open to severe criticism. If the general series of Sussex experiments be placed in comparison with the investigations carried out for the Aberdeenshire Agricultural Association, they will be found devoid of those great national advantages which must long attach to the Scotch experiments. The value of the Aberdeen Association work has never been as fully appreciated as it deserves, and the agricultural public would have been highly gratified if the Sussex Association experiments had been equally definite and satisfactory.

[1] "The Annual Report of the Proceedings of the Sussex Association for the Improvement of Agriculture in Sussex. Season 1883."

SOCOTRA[1]

FOUR years have elapsed since an expedition was sent out from this country by the British Association and the Royal Society to explore the Island of Socotra. With the exception of diplomatic visits by the resident at Aden in the two or three preceding years, and of a short exploration in 1847 by the French naturalist Boivin, there is no record of any European having sojourned on the island since the date, forty years ago, of its abandonment by the Indian troops which had occupied it for this country during four years, and Wellsted's account of his survey of the island (in *Journ. Roy. Geog. Soc.* v. 1835) made in 1834, has been up till now the most recent and most satisfactory. It is remarkable that an island so long neglected and forgotten should be visited in two successive years by exploring expeditions; yet this has happened. In 1881 a party of German explorers followed the British Expedition. This German Expedition to Socotra formed part of a scheme of scientific exploration of many unknown or but little-known regions of the globe set on foot by Dr. Emil Riebeck, and for which his liberality provided the means, and the results of this portion of his undertaking, some account of which now lies before us, must be gratifying to him as they are valuable to and welcomed by science. Dr. Riebeck was accompanied to Socotra by the well-known traveller Dr. Schweinfurth and two other companions, Drs. Mantay and Rosset—a quartet of observers well qualified to take advantage of every opportunity of extending our knowledge of nature. Many

[1] "Ein Besuch auf Socotra mit der Riebeck'schen Expedition." Vortrag von Professor Dr. Schweinfurth. (Freiburg, 1884.)
"Allgemeine Betractungen über die Flora von Socotra," von G. Schweinfurth. Sep. Abd. aus *Engler's botanischen Jahrbüchern*, v. (1883).
"Land-Schnecken von Sokotra," von E. von Martens, aus *Nachrichtsbl. d. deutsch. Malakol. Gesellschaft*, No. 10 (1881).

difficulties and dangers beset their progress to the island, and their leave-taking appears to have been no less troubled; but eventually it has been their good fortune to bring to Europe a magnificent collection of specimens illustrative of its structure, its products, and the character of its inhabitants.

Most of the collections have now been worked out either in this country or on the Continent—Schweinfurth's large herbarium having been, with rare generosity, sent by him to this country to be examined along with that of the British Expedition—and the details regarding them are published in various periodicals. Herr von Martens' paper above mentioned is a supplement to the first part of Godwin-Austen's account (*Proc. Zool. Soc.* 1881, p. 251) of the shells brought home by the British Expedition, and deals with some new forms collected by the German explorers not mentioned in that account. It appeared, however, when the second part of Godwin-Austen's paper was in the press, and this overlapping of the papers has unfortunately led to some forms being described by both authors and under different specific names.

In the other pamphlets before us Schweinfurth gives us in his usual lucid and vigorous language a general *résumé* of results so far as they have been at present determined. It is satisfactory to find that his conclusions, drawn from considerations of the physical features and the fauna and flora, are almost entirely in consonance with those deduced by the British observers (see Bayley Balfour in *Rep. Brit. Ass.* 1881, and *Proc. Roy. Instit.* for April 1883). The antiquity of the island, the strong affinities of the animals and plants with those of the adjacent African and Arabian coasts, the presence in the flora of Mediterranean and general tropical types, as well as of forms related to those found on the highlands of Abyssinia, South Africa, and West Tropical Africa, are features insisted on by both. There is, however, a divergence of opinion regarding the Madagascar affinities. Godwin-Austen supposes these point to the conclusion that in Socotra and Madagascar we have remnants of an ancient and more advanced coast-line on the western side of the Indian Ocean, which was probably continuous through Arabia towards the north. Martens questions the identifications upon which this supposition rests, and does not agree with it, and Schweinfurth, though without advancing any cogent reasons, concurs with him.

The question, who are the Socotrans, and whence have they sprung? is one to which the German Expedition gave special attention, and Schweinfurth devotes a considerable portion of his address to its discussion. At the present time he estimates the population at ten to twelve thousand inhabitants. Of these about one-tenth are Arabs, colonists from the adjacent mainland, who live in the coast-villages, and are the merchants of the islands. Along with these are found many negroes, most of them runaway slaves. But the dwellers on the hills are the true Socotrans, and speak a language quite peculiar. Amongst them Schweinfurth recognises, as did Vicenzo in the seventeenth century, two races—a darker with curly hair, and a lighter one with straight hair. In addition he finds an apparently Semitic type, characterised by small head, with long nose and thick lips, straight hair, and lean limbs. The Socotran generally is of average height and size, with a quick, intelligent eye. The type of the true Socotran is quite different from that of the Somali, Galla, Abyssinian, South Arabian, and Coast Indian. From the little known of the Mahra and Qara tribes which inhabit the hill regions of middle South Arabia opposite, Schweinfurth is inclined to consider the Socotran resembles them most nearly. Many skulls were obtained from the grave caverns, and these are now in the hands of Prof. Welcker, whose report upon them may be looked forward to with interest.

From a study of the peculiar Socotran language the Germans anticipated much aid in elucidating the problem of the origin of the people. Unfortunately difficulties with interpreters prevented their achieving much success in this line. Schweinfurth notes, however, regarding the language two marked features. Firstly, its resemblance with the Mahra dialect, which is quite different from the old and the new Arabic, and is a peculiar element amongst the South Arabian dialects. This is opposed to the statement of Capt. Hunter, who says it in no way resembles Mahra. But Schweinfurth in support of his statement quotes the report of Wellsted, that the Mahras and Qaras could understand the Socotrans whilst coast Arabs could not do so; and further, a comparison of the vocabularies made by Wellsted and by his own expedition with the results of von Maltzhahn's studies on the Mahra dialect show many similarities between them. Secondly, it contains many foreign elements, and this is especially noticeable in the names of plants and animals, many of them having a thoroughly Greek sound.

Turning to history for a clue to the origin of the Socotrans of to-day, we find many references to their island in the older writers, and to these Schweinfurth refers. The author of the "Periplus" speaks of the people as a mixture of Arabs, Indians, and Greek merchants; and the presence of the Greeks is explained by subsequent writers by the story that Alexander the Great on the advice of Aristotle sent a colony of Greeks—some say Syrians—to cultivate the aloe. Cosmas relates that under the Ptolemies many colonists were settled on the island, and Jakut in the thirteenth century tells of the Greeks who had become Christians dying out and thus making room for an incursion of Mahra Arabs from the opposite coast. In these old narratives there is, as Schweinfurth points out, much that is contradictory and conflicting, and unfortunately there is at the present day but little internal evidence confirmatory of the existence in earlier times of a cultured race on the island. The visit of the Wahabees in 1800, as Wellsted says, may probably account for the disappearance of monuments and temples. Schweinfurth speaks of certain small heaps of ruins as perhaps representing old altars—but the only definite relic of this character now known is a series of hieroglyphics upon a wide limestone slab at Eriosch near Kadhab. These have attracted the attention of all who have visited the island in recent times, and Dr. Riebeck has paid especial attention to them. His interpretation has not yet been made public, but Schweinfurth states that in them some rows of Greek cipher are to be recognised. It may be hoped that their explanation may afford some clue which will help the solution of the interesting problem of the derivation of the Socotrans. The evidence existing at present is of so imperfect a character that it is impossible to determine with certainty their stock. Schweinfurth conjectures that in the Semitic element he observed may be traced a Greek type, and that the Mahra Arabs have most probably had a great share in forming the features of the present people. Future exploration must settle the question.

Altogether these papers by Schweinfurth are of the greatest interest, and his long experience amongst the native tribes of Africa gives to his observations regarding the people of Socotra great value. The material obtained by the two expeditions—British and German—has enabled us now to obtain a fair idea of the general character of the people, the natural history and physical features of Socotra; but the short time for work possible to the members of the expeditions—little more than six weeks in each case—naturally renders their results somewhat fragmentary. What has been done as yet is but preliminary, and from it we learn that there is still a vast field for future explorers—not only in Socotra itself but on the adjacent mainlands of Africa and Arabia. Until such further investigation takes place many most interesting problems—ethnological as well as concerning the distribution of plants and animals—must remain unsolved.

THE THREE HUNDREDTH ANNIVERSARY OF THE UNIVERSITY OF EDINBURGH

THIS week the University of Edinburgh is holding its Tercentenary Festival. An elaborate programme of festivities is being gone through by a collection of guests of literary, scientific, and social eminence such as rarely graces a British or even any foreign University seat. A mere recital of the list of those who are to be present to receive honorary degrees would be interesting, as showing the scope and catholicity of modern University culture. We see Hermite, Helmholtz, Pasteur, Haeckel, Virchow, Browning, Renan, Bishop Lightfoot, and Principals Tulloch and Rainy, capped by the same academic hand.

It may not be without interest to our readers to dwell for a moment on certain parts of the history of an organism whose appreciatory functions are so varied and at first sight even contradictory.

Three hundred years, though not an infant's age, is after all no great age for a University. Any uncertainty therefore that surrounds the early history of the University of Edinburgh is more the result of initial obscurity than the glamour of remote antiquity. She is, as some one has said, hopelessly modern. Nevertheless, her history is in some respects a very remarkable one. What has now developed into one of the largest of the Universities of Europe, numbering its students by thousands, began as a college for the "town's bairns," under the patronage of the Town Council, who in fact remained its rulers until 1859. There can be little doubt that the comparatively modern date of the foundation of the college, and the peculiar[1] nature of the governing body favoured its growth and development into what has claims to be the most liberally constituted of the Scottish Universities.

A glance at the chronology of science will show that the opening of the new Town's College in Edinburgh in 1583 falls at the time when the tide of progress in physical and mathematical science was just beginning to rise over Europe.

Napier of Merchiston was living hard by; Gilbert was probably collecting material for his great work on the magnet; and Galileo and Kepler were doing great things for physical science.

Nevertheless, the progress of the young institution was not at the outset very remarkable. This arose partly from the miserable poverty of its early endowment and of Scotland itself, partly from the plan of "regenting" on which it was organised, which compelled each of four regents to carry his students in four years through the whole course of the seven liberal arts of the mediæval curriculum. This plan, so fatal to special excellence in teaching or learning, continued until 1708, when it was finally abolished, and professors of the separate subjects established. During this first century, however, the patrons had already engrafted the germs of the modern University by appointing professors of separate subjects, which were sometimes outside the curriculum of the regents altogether, sometimes auxiliary to it. In this way arose some of the present chairs of the faculty of arts, and in this way originated many of the chairs that now form the separate faculties of theology, law, and medicine.

The powers of the Town Council left them absolutely unfettered in the founding of new chairs, and they proceeded in this work guided by their own views as to the necessities of the times, and aided by the best advice they could obtain inside, or more frequently outside, the University. They were not always quite judicious or wholly unbiased in their procedure, and many of their reforms were carried out in the face of bitter hostility from within the University. Yet it cannot be denied that, on the whole, their action as patrons and founders of chairs was for the good of the University. The sectarian feuds which occasioned the Disruption of the Established Church ultimately led, in 1859, to the severance of the close tie between the Town Council and the Town's College, long ere then grown into a full-blown University. There is no need here to dwell on the dark side of the picture of the management of the University by the Town Council. Their misdeeds are, we may hope, not likely to be imitated by modern patrons, and their enlightened policy in the foundation of chair after chair as the wants of the institution grew is, after all, the more important part of the story, and well worthy to be read in this day of infant Universities and of experiments on the large scale in the remodelling of older Universities of the kind.

As most of our readers probably know, the strength or weakness of a Scottish University depends wholly on the professoriate, with whom lie the whole of the teaching and disciplinary duties. Within certain limits set him by the Ordinances, and with some restrictions owing to the presence of colleagues in allied departments, a Scottish professor within his own class-room is absolutely free, and may develop into a great success, a mediocrity, or a great failure, according to circumstances; and with him rises or falls the department intrusted to his care. The system has its drawbacks sufficiently obvious; but it has this to say for itself, that it is an economical arrangement, and that it has produced a large body of citizens sufficiently well educated to take rather more than their own share of the higher employments in the British Empire. It will thus be seen that the interest of the educational history of a Scottish University centres mainly in the record of the occupants of its various chairs. We offer a few desultory remarks on this subject, chiefly from the scientific point of view, referring those who are interested in the matter generally to the recently published "Story of the University of Edinburgh," by Principal Sir Alexander Grant.

The earliest foundation of a special scientific chair was that of mathematics, to which the Town Council called James Gregory in 1674. This distinguished mathematician and physicist, the author of various theorems in pure mathematics and of several great ideas in optics (represented to the mind of the ordinary student by Gregory's "Series" and the Gregorian telescope), came of an Aberdeenshire family (related, by the way, to the notorious Rob Roy Macgregor), which, during the last three hundred years, has furnished something like a score of distinguished professors and men of science to the Scottish and English Universities. Gregory was not the first nominal Professor of Mathematics, but he was the first professor who had more than the name. After his brief but brilliant tenure, the office, with but little intermission, was filled by a line of distinguished followers, among whom we must content ourselves with naming David Gregory, who became Savilian Professor of Astronomy at Oxford, who was appointed on the urgent recommendation of Newton himself, who was in fact the friend and interpreter of Newton, and was by him reckoned worthy, along with Halley, to continue the great work of the co-ordination of celestial phenomena begun in the "Principia." He has the credit of introducing the Newtonian philosophy into the curriculum of Edinburgh thirty years before it obtained a similar place in the University of its author. Colin Maclaurin is the greatest perhaps of all the men of science that Edinburgh has produced; of his wide culture and extended activity we may give some idea when we say that he was a worthy successor to Newton in pure and applied mathematics, that he was a great teacher of mathematics and physics, a great popular lecturer in his day (one of the first of the scientific tribe of such, perhaps), that he was an authority on life assurance, on surveying, on geographical exploration, that he was an excellent classical

[1] Peculiar from a University point of view, for the older Universities as a rule were privileged corporations independent of, nay, often antagonistic to, the municipalities where they were situated.

scholar, a man of great social qualities, and lastly, that he tried to organise a defence of the town of Edinburgh against the Pretender in 1745, and caught thereby the malady that ended his life. Other occupants of the chair were Matthew Stewart, still remembered for his "Propositiones Geometricæ"; John Playfair, distinguished as a critic and historian of science, introducer of the Continental methods into the mathematical studies of Edinburgh; John Leslie, an excellent geometer, but now better remembered for his contributions to the science of heat; and William Wallace, inventor of the eidograph.

At first, natural philosophy, in so far as it was distinct from Aristotelian physics, seems to have been in the province of the Professor of Mathematics. It was so in Maclaurin's time, although a separate professorship for it had been founded in 1708. The first professor that need be mentioned here is John Robinson, whose articles in the third edition of the *Encyclopædia Britannica* are still worth consulting, and whose "Elements of Mechanical Philosophy" was for a time a standard work on the subject. The original close connection between mathematics and natural philosophy probably led to what at first sight seems a curious succession of professors. It more than once happened—notably in the cases of Playfair and Leslie—that the holder of the Chair of Mathematics was transferred to that of Natural Philosophy; in fact, it was in the latter subject that both these professors attained their greatest distinction, the former by his account of the Huttonian Theory of the Earth, the latter by his well-known researches on heat. But the greatest of all the past Professors of Natural Philosophy was undoubtedly James David Forbes; he, along with David Brewster, at first his patron, and for a long time his rival, are to be reckoned among the greatest ornaments of the University of Edinburgh during the generation that has passed away. Both were students of the University and both were candidates for the Natural Philosophy Chair; Brewster, failing probably for political reasons, was reserved for the higher honour of the principalship. The works of these two great men are so fresh in the recollection of our readers that no words need be wasted here in emphasising them. It is worthy of mention, however, that the late James Clerk Maxwell and Prof. Balfour Stewart, whose fame sheds undying lustre on their Scottish *alma mater*, were trained in practical physics under Forbes.

The Chair of Chemistry, founded in 1713, was at first essentially a medical chair; its first occupant, James Crawford, was a remarkable man in every way, a pupil of Boerhaave, and well versed in what little chemical knowledge then existed. It is noteworthy, as showing the small extent of medical and chemical knowledge at that time, that he was also Professor of Hebrew! His immediate successors call for no remark until we reach Cullen (1755), who, though better known as a great physician, was also distinguished as a great teacher of chemistry; he was, in fact, the first to establish that science as a study separate and distinct from medicine. His two immediate successors, Black and Hope, followed his lead, and were very successful teachers; in fact, in Hope's time the class reached the astonishing number of 500. Besides being a good teacher, Black was a man of genius. His results regarding carbonic acid, embodied in his graduation thesis "De humore acido a cibis orto, et magnesia alba," and his discovery of latent heat form cornerstones in the structure of modern chemical and physical science. Perhaps the greatest praise is that Lavoisier regarded him as his master. Hope will be remembered for his experiments on the maximum density point of water, and for his discovery of strontia as a separate alkaline earth. In 1844 the chair became a chair of pure chemistry. Among the past professors since then we may mention Sir Lyon Playfair, whose scientific reputation is now overshadowed by his fame as an educational organiser, and an able political champion of the interests of science.

The Chair of Natural History was a later foundation (1770?), and at first was a sinecure. Since the beginning of the century, however, it has not wanted for distinguished occupants. Jameson (1804) was an excellent mineralogist; he founded the splendid museum now absorbed in the Museum of Science and Art, and must have been a great teacher to judge by the number of distinguished pupils that he trained, among whom were Edward Forbes, John and Harry Goodsir, Macgillivray, Nicol, and Darwin. The first of these succeeded him, but was cut off after a brief but brilliant career too well known to need description. The last of the past occupants of this chair, Wyville Thomson, has done the University of Edinburgh enduring honour by connecting it with that most fascinating of all the walks of modern natural science—the exploration of the deep sea.

The history of the Chair of Astronomy has been little but a record of misfortune, as far as the University is concerned. The first professor, Robert Blair, was endowed with a fair salary, but no Observatory was given him, and he never lectured or took any part in the work of the University. He is remembered chiefly for his researches on achromatic telescopes, which he brought to great perfection by means of fluid lenses of his own invention. The second professor, Thomas Henderson, was invested with the dignity and duties of Astronomer Royal for Scotland, and was provided with the present Observatory on the Calton Hill. He devoted himself ardently to his duties as an observer, and will be remembered as the first to determine the parallax of a fixed star (α Centauri). He never lectured. Where the blame of the unsatisfactory position of the Astronomy Chair and of the Edinburgh Observatory rests, and how the matter is to be remedied, is one of the vexed questions to be settled by the coming University Commission for Scotland.

The Chair of Technology was inaugurated with great promise of success by George Wilson, whose brilliant lectures and important services in connection with what is now the Museum of Science and Art showed how important such a chair might under favourable circumstances become. The chair was, however, abolished in 1859, under circumstances that do not appear to reflect much credit either on those who then acted for the Senatus, or on the Government department which was concerned in the transaction. It may be hoped that, now the importance of technical education is being recognised, the mistake then committed will be remedied. This is all the more to be desired because Edinburgh already possesses the rudiments of a technical faculty in the Chairs of Engineering and Agriculture.

There remains but one more Chair of Natural Science to be mentioned, viz. Geology. It numbers but one past professor, Archibald Geikie, concerning whom we need only express the wish that his followers may be worthy of him.

Although the subject scarcely belongs to these pages, yet no notice of the scientific side of the University of Edinburgh would be complete without at least an allusion to the glories of its medical school, which have attracted the admiration, if not occasionally the envy, of similar institutions. It may seem curious, but it began by the institution of a botanical, or, as it was properly then called, a physic garden. The keeper of this garden (originally it is believed a member of the characteristically Scotch Guild of Gardeners), was after a time constituted (1676) the first Professor of Botany, and in fact the first medical professor.

If it were needful to insist farther upon the important place which the University of Edinburgh occupies among the educational bodies of Great Britain, we might point to the number of her students that now hold professorial chairs all over the United Kingdom, and indeed throughout the British Empire; and to the work which her *alumni* have done, and are doing, in science both pure and applied.

It might be profitable also to dwell on her defects, which she has in plenty, like other institutions guided by human brains, and endued with her own share of human inertia. But, as she has no want of candid critics, and is by and by to be put into the refining crucible, along with the other Scottish Universities, to emerge, let us hope, purified and strengthened, we may content ourselves with offering her, and asking of readers to join us therein, a hearty wish that she may prosper during the next hundred years as she has done during the present century.

G. CHRYSTAL

THE CONGO[1]

ALTHOUGH claiming to be little more than the record of a passing visit paid to the Lower Congo Basin towards the end of the year 1882, this is really a work of permanent interest to the naturalist and ethnologist. The author, a young and ardent student of biology in its widest sense, here conveys his impressions of

FIG. 1.—Floating Reed Island on Stanley Pool.

West African life and scenery in a series of graphic pictures, which owe much of their freshness and vigour to the circumstance that they are always drawn at first hand from nature, and are often an exact reproduction of jottings made with pen and brush in the midst of the scenes described. His skill as a draughtsman he turns to good account by illustrating the text with numerous drawings of plants, animals, and human types, many of which are absolute fac-similes executed by the Typographic Etching Company.

But Mr. Johnston does much more than merely describe in striking language the varied aspects of tropical nature revealed to his wondering gaze as he ascended from the low-lying marshy coastlands along the great artery from terrace to terrace to the grassy steppes and park-like uplands of the interior. Informed by the quickening influences of the new philosophy now accepted by all intelligent students of nature, he compares as he describes, carefully observes, and in apparently trifling incidents endlessly recurring throughout long ages he discovers the causes of mighty revolutions in the organic world. In Stanley Pool and elsewhere on the Congo he meets with numerous floating islands, tangled masses of aquatic vegetation, firmly matted together by their roots and fibres, and strong enough to bear the

FIG. 2.—*Lissochilus giganteus.*

weight of a man (see Fig. 1). These, like the huge snags and trunks of trees borne along by the swift current, are thickly peopled with all forms of animal and vegetable life, which are thus carried a long way from their original homes. Hence the inference that "on many rivers these floating trees must serve as a great means for the diffusion of species" (p. 283). So also in his recent work on the "Indians of British Guiana," Mr. Im Thurn notices the presence of turtles on the logs and stems swept down the rivers of that region.

[1] "The River Congo, from its Mouth to Bólóbó," by H. H. Johnston, F.Z.S. (Sampson Low, 1884.)

Another inference is that the Congo cannot possibly form a true parting-line or natural boundary in the distribution of the West African flora and fauna. "I have read in many works on Africa that the Congo was the southern boundary of the habitat of the gray parrot, the anthropoid apes, and the oil-palm (*Elaïs guineënsis*). Now the gray parrot reaches, perhaps, its great development in Malanje, a district of Angola nearly 300 miles south of the Congo, and, together with the oil palm, continues to be found as far as the tenth degree south of the equator, while the anthropoid apes can hardly be said to be limited southward in their distribution by the lower course of the Congo, for they do not reach even to its northern bank, or approach it nearer than Landana, 100 miles away. . . . There are, besides, many West African plants which stretch right away from the Gambia, across the Congo, into Angola on the south. In short, I have never seen any difference between the fauna and flora of the northern and southern banks of this great river; nor do I believe that it acts in any way as a limitation in the range of species" (p. 318).

On another point also our explorer differs from some distinguished botanists, who hold that tropical vegetation is inferior in brightness and fragrance to that of the temperate zone. "Although the Congo offers nothing, as we yet know, that is unique as genus or family, yet probably nowhere in Africa are there such magnificent displays of colour formed by the conspicuous flowering trees and plants. Here, at any rate, no one can maintain that the temperate zone can offer anything equal in the way of flower-shows. Many of the blossoms also exhale strong odours, sometimes very offensive, but also in many cases fragrant and delicious. Few perfumes are more pleasing than the clove-like smell of the *Camoensia* or the balmy scent of the *Baphias*" (p. 324).

His botanical descriptions and sketches are generally admirable, as, for instance, of the *Lissochilus giganteus* (see Fig 2), "a splendid orchid that shoots up often to the height of six feet from the ground, bearing such a head of red-mauve, golden-centred blossoms as scarcely any flower in the world can equal for beauty and delicacy of form. These orchids, with their light-green, spear-like leaves, and their tall swaying flower-stalks, grow in groups of forty or fifty together, often reflected in the shallow pools of stagnant water round their bases, and filling up the foreground of the high purple-green forest with a blaze of tender peach-like colour, upon which no European could gaze unmoved'" (p. 35).

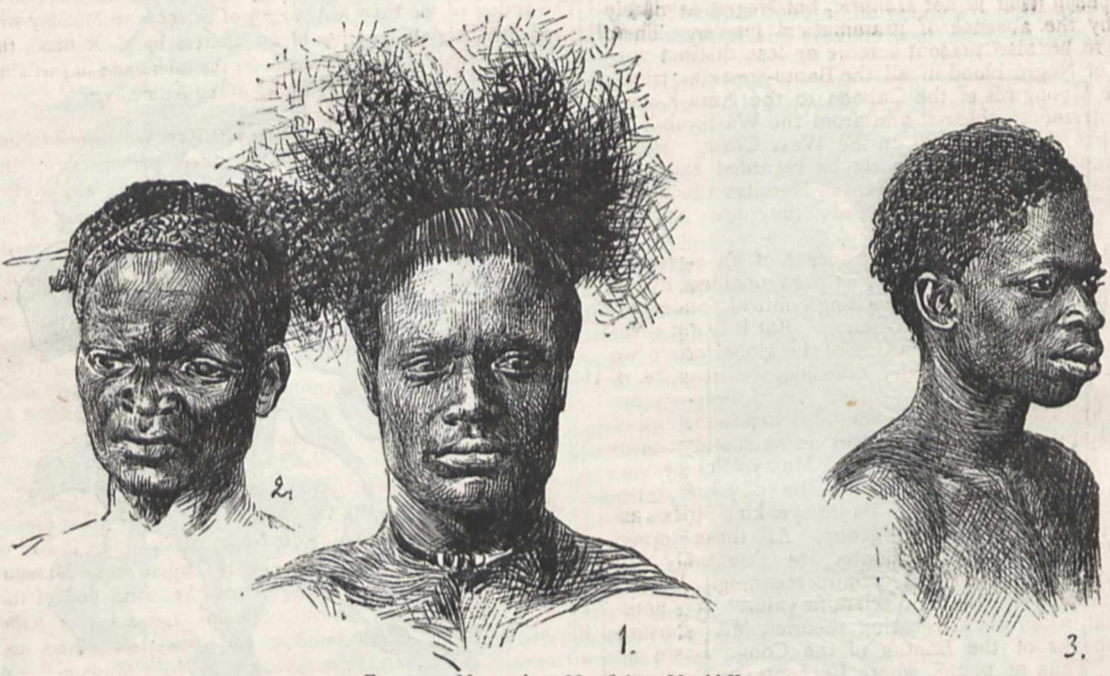

FIG. 3.—1, Mu-yansi; 2, Mu-téké; 3, Mu-shi-Kongo.

There is a deeply interesting chapter on the "People of the Congo," who, with the doubtful exception of some dwarfish or Bushman tribes, are all grouped in "that great Bantu family which, when seen in its purest exemplars, the Ova-héréro and Ova-mpo of the south-west, the tribes of the Zambesi, the people of the great lakes of Tanganyika and Nyassa, and the western shores of Victoria Nyanza, and finally of the Upper Congo, is so distinct, physically and linguistically, from the divers Negro, Negroid, and Hamitic populations to the north of it, and from the Hottentot-Bushman group to the south" (p. 396). Here we find the Bantus as a race distinguished by a good observer, not only from the Hottentots, Hamites, and Negroes proper, but even from the surrounding Negroid populations Further on the Bantus themselves are said to vary considerably in physical appearance, a statement fully borne out by the accompanying typical heads of a Mu-yansi, a Mu-téké, and a Mushi-Kongo (see Fig. 3). "The Congo tribes," we are told, "on nearing the coast, begin to lose their distinctive Bantu character, either through the degradation the coast climate seems to entail, or because on their migration westward from the north-east Bantu focus, they originally met and mixed with, in the low-lying coastlands, an earlier Negro population. This latter supposition sometimes strikes me as being the true one, for the reason that, in such a littoral tribe as the Kabinda or Loango people, there are distinctly two types of race. One—the Bantu—a fine, tall, upright man, with delicately small hands, and well-shaped feet, a fine face, high thin nose, beard, moustache, and a plentiful crop of hair; the other an ill-shaped loosely-made figure, with splay feet, high calves, a retreating chin, blubber lips, no hair about the face, and the wool on his head close and crisply curled. The farther you go into the interior the finer the type becomes, and two points about them contrast very favourably with most of the coast races, namely, their lighter colour—generally a warm chocolate—and their freedom from that offensive smell which is supposed, wrongly, to characterise most Africans" (p. 397).

In this instructive passage all the facts are stated with tolerable accuracy. Yet the general inference cannot be accepted. There is, strictly speaking, no Bantu type at all, and the expression, correct in a linguistic sense, has no definite anthropological meaning. But for the fact that most of the peoples occupying the southern half of the continent speak dialects of a common mother-tongue, no ethnologist would ever have thought of grouping them together as forming a separate branch of mankind. Physically they must be regarded as distinctly Negroid, that is, an essentially mixed race presenting every possible shade of transition from the true Negro of Sudan and the West Coast to the true Hamite of the north-east coast. Between these two extremes they oscillate in endless variety, presenting nowhere any stable type distinct from either, and bound together only by the single element of their common Bantu speech. On the other hand, this Bantu speech itself is not Hamitic, but Negro, as clearly shown by the absence of grammatical gender. There appears to be also present a more or less distinct substratum of Negro blood in all the Bantu-speaking tribes, from the Mpongwés of the Gaboon to the Ama-Khosas of the extreme south-east, and from the Wa-Swahili on the East to the Ba-Congo on the West Coast. Hence these peoples should apparently be regarded rather as Negroes affected by Hamitic than as Hamites affected by Negro elements. In other words they are Negroid rather than Hamitoid.

The spread of a single organic speech of an extremely delicate structure over such a vast area, unaided by the prestige of letters, or by far-reaching political influences, is certainly a surprising phenomenon. But it is not without its analogues in other quarters of the globe, where we find an equal and even wider diffusion, for instance, of the Malayo-Polynesian, Ural-Altaïc, Aryan, Athabascan, and Guarani-Tupi forms of speech, also before the rise of literatures and great empires. And as no sound anthropologist regards the Aryan or the Malayo-Polynesian-speaking peoples as belonging to one physical type, neither can they regard the Bantu-speaking tribes as constituting a single ethnical group. All these terms, Aryan, Malayo-Polynesian, Bantu, are essentially linguistic, and as such have a definite meaning. Ethnologically they have little or no scientific value. It is noteworthy that, when not advocating theories, Mr. Johnston himself speaks of the Bantus of the Congo Basin as Negroes. Thus at p. 298, where he contrasts them unfavourably with the half-caste Wa-Swahili of Zanzibar, he writes:—"The mixture of Arab blood and Arab culture gives a stability and manliness to the Wa-Swahili which is lacking even in the finest race of pure Negro origin. The Congo peoples, for instance, are usually amiable and soft-mannered, but at heart they are seldom to be depended on. There is something so eminently childish in the Negro's character. . . . All these traits are found in the black races of Africa *that are of purely Negro or Bantu stock;* but in the Semiticised people of Zanzibar you find men of thought and reflection, whom you may use as counsellors and confidants; men who are really capable of zealous service, of disinterested affection, and to whom gratitude is a concept neither foreign to their intelligence nor their tongue." This is true and well put, and is the common experience of all travellers who have had dealings with the natives of South Central Africa. It shows at the same time that "even the finest" Bantu peoples must ultimately be affiliated to the Negro stock.

Besides the numerous illustrations, two useful maps and a copious index, this handsome volume is furnished with comparative linguistic tables of the chief Bantu languages current in the Congo basin, as well as full lists of the plants, birds, and mammals occurring in the same region. A. H. KEANE

NOTES

EUROPEAN science has sustained a terrible loss during the past week. Monsieur Dumas, the venerable Perpetual Secretary of the French Academy of Sciences, died at Cannes on the 11th inst. at exactly the age of the century. Old as the great chemist was, his death will be felt as a real and serious loss to French science, for up to the last he took an active interest in all its doings. We gave in vol. xxi. so full a biography from the masterly pen of Prof. Hofmann of Berlin, that it is unnecessary to go over the ground again. We may, however, attempt in a future number to appreciate to some extent the position of Dumas in the chemistry of the past sixty years. The funeral took place at Mont Parnasse Cemetery on Tuesday, when MM. Bertrand, D'Haussonville, and others delivered addresses at the grave. The sitting of the French Academy of Sciences on Monday was postponed after the reading of an address by M. Rolland, the president, who praised M. Dumas for the talent and impartiality he exhibited as Perpetual Secretary of the Academy.

THE Museums of Economic Botany at Kew are second in importance to none in the world, and, except perhaps as to the size and splendour of the buildings, they are in every way worthy of a nation which has trade relations with every part of the globe. The foundation of these museums was laid by Sir W. J. Hooker in 1847, when he obtained leave to fit up an old fruit store with cases suitable for the exhibition of important vegetable products. Ten years later the house now known as Museum No. 1 was opened to the public, and in 1881 this was added to and the approaches greatly improved. It will be remembered that these buildings were not originally designed for museum purposes, and yet such is the arrangement of the cases and so well are the objects displayed and illuminated that we know of no museum built for the purpose that we would prefer to No. 1 Museum at Kew. The collections are contained in Museum No. 1, which is directly opposite the Palm House, on the other side of the Ornamental Water, in Museum No. 2, which is close to No. 1, at the northern end of the Herbaceous Garden, while Museum No. 3 occupies the old Orangery. At the north end of the Broad Walk the last Museum contains specimens of large timber, while the monocotyledons and flowerless plants are arranged in No. 2, and the dicotyledons in No. 1 Museum. An official guide to the contents of the latter Museum has just been published. As nearly every object exhibited is fully labelled, this guide-book does not enumerate a tithe of these, but a certain number of important objects are marked with a conspicuous number, and these numbers are referred to in the catalogue. In the 130 pages of this guide there is compressed a vast amount of information, a great deal of which is easily understood, even apart from the interesting collection on which it is founded; and if the student, as he walks through the Gardens, is struck at the beauty of the vegetable kingdom, he will, as he studies the products of that kingdom within these museum walls, be more struck at the extreme indebtedness of mankind to this kingdom for the necessaries and luxuries of life.

WE regret to learn that Sir Sidney Smith Saunders, C.M.G., for many years British Consul in various Mediterranean ports, and a distinguished entomologist, died suddenly on Tuesday evening (15th) at an advanced age. He was one of the original members of the Entomological Society of London, and was a vice-president of the Society at the time of his death. He devoted special attention to the singular bee-parasites known as *Stylopidæ*.

THE following are the arrangements for the lectures at the Royal Institution after Easter:—Dr. Klein, two lectures on the Anatomy of Nerve and Muscle, on Tuesdays, April 22 and 29; Prof. Gamgee, five lectures on the Physiology of Nerve and Muscle, on Tuesdays, May 6 to June 3; Prof. Dewar, seven lectures on Flame and Oxidation, on Thursdays, April 24 to June 5; Mr. Hodder M. Westropp, three lectures on Recent Discoveries in Roman Archæology, on Saturdays, April 26 to May 10; and Prof. T. G. Bonney, four lectures on the Bearing of Microscopical Research upon some Large Geological Problems, on Saturdays, May 17 to June 7. The following is a list of the Friday evening lectures:—April 25, the Art of Fiction, by Walter Besant; May 2, Krakatoa, by Prof. Judd; May 9, Mohammedan Mahdis, by Prof. Robertson Smith; May 16, the Dissolved Oxygen of Water, by Prof. W. Odling; May 23, Sidereal Astronomy, by Dr. David Gill; May 30, Sur les Couleurs (in French), by Prof. E. Mascart; June 6, Prof. Dewar.

BESIDES subjects of general anthropological interest, the following specially American topics, as to several of which Canada affords important evidence, are suggested for papers to be read in the Anthropological Section at the Montreal meeting of the British Association. The papers on each subject will, as far as possible, be grouped for reading on the same day, so as to insure a general discussion. (1) The native races of America: their physical characters and origin; (2) Civilisation of America before the time of Columbus, with particular reference to earlier intercourse with the Old World; (3) Archæology of North America, ancient mounds and earth-works, cliff-dwellings and village-houses, stone architecture of Mexico and Central America, &c.; (4) Native languages of America; (5) European colonisation and its effects on the native tribes of America. It is requested that all papers may be sent to the office of the Association, 22, Albemarle Street, London, W., on or before July 1.

THE International Ornithological Congress at Vienna was brought to a conclusion on Friday last by an appropriate speech from its patron, the Crown Prince Rudolph, who, among other things, warmly thanked the scientific men from abroad for their appearance in Vienna. The next Congress will not take place till three years hence, and will be held in Switzerland. The Crown Prince has accepted the honorary office of Patron of the Permanent International Committee for the Establishment of Ornithological Observatories, or stations for the observation of the habits of birds, especially those of the migratory species. Prof. Blasius, the president of the third section, to whose sphere the subject belongs, explained the nature, object, and importance of such ornithological stations of observation. M. Rodde proposed that the meteorological stations should be used as ornithological ones. Dr. Schier of Prague afterwards gave an account of his efforts to secure a regular system of observation. He had received from some hundreds of correspondents many valuable notices in regard to the line of passage of migratory birds.

THE Academy of the Lincei have elected Prof. Francesco Brioschi, a senator, to fill their presidential chair recently left vacant by the death of Signor Quintino Sella, electing at the same time Commendatore Fiorelli, who so long directed the excavations at Pompeii, to fill the office of vice-president. The new president, Signor Brioschi, is a distinguished mathematician.

AN interesting little volume appears this week in Edinburgh containing an annotated list of the illustrious dead who have been in any way connected with Edinburgh University. The names are classified according to the departments with which they are connected, "Zoologists and Botanists," for example, beginning with Erasmus Darwin and ending with Charles Darwin. The brief notes attached to the names have, we believe, been compiled by various specialists.

THE Anthropological Institute will hold its first meeting in its new premises, No. 3, Hanover Square, on the 22nd instant.

THE next Ordinary General Meeting of the Institution of Mechanical Engineers will be held on Thursday, May 1, and Friday, May 2, at 15, Great George Street, Westminster. The Chair will be taken by the President, Mr. I. Lowthian Bell, F.R.S., at half-past seven p.m. on each evening. The following papers will be read and discussed as far as time will admit:—On Thursday, May 1, on the consumption of fuel in locomotives, by M. Georges Marié, of Paris; on portable railways, by M. Paul Decauville, of Petit-Bourg, Paris; on the Moscrop engine recorder, and the Knowles supplementary governor, by Mr. Michael Longridge, of Manchester. On Friday, May 2, description of the automatic and exhaust-steam injector, by Mr. A. Slater Savill, of Manchester; description of the apparatus used for testing current-meters, at the Admiralty Works at Torquay for experimenting on models of ships, by Mr Robert Gordon, of Burmah; description of the Francke "Tina" or vat process for the amalgamation of silver ores, by Mr. Edgar P. Rathbone, of London.

THE Report of the U.S. Solar Eclipse Expedition, *Science* states, has just been ordered to be printed by Congress. Among its contents are:—Meteorology of Caroline Island, by Mr Winslow Upton; Botany of Caroline Island, collections by Dr. W. S. Dixon, U.S.N., and identifications by Prof. W. Trelease; Notes on the zoology of Caroline Island, by Dr. W. S. Dixon, U.S.N.; Memorandum on the butterflies, &c., of Caroline Island, collections by Dr. J. Palisa, identifications by Messrs. Herman Strecker and Arthur G. Butler; Chemical constituents of the sea-water of the lagoon of Caroline Island, determined by Messrs. Stillwell and Gladding; Observations of twenty-three new double stars, by Prof. E. S. Holden and Prof. C. S. Hastings; Plans for work on the day of the eclipse, by Prof. E. S. Holden.

FROM *Science* we learn that at the request of the Navy Department, the Fish Commission steamer *Albatross*, Capt. Tanner commanding, was fitted out during the winter for the purpose of carrying on a series of deep-sea soundings and dredgings in the Caribbean Sea, a region very little known in respect to its depths. The vessel left Washington on January 1, and reached St. Thomas on the 17th, and, after coaling, proceeded on her voyage, making the following ports:—Curaçoa, Trinidad, the Island of Oruba, Alta Vela, Jacmel, Gonaives, Santiago de Cuba, Navassa, and Kingston (Jamaica), where she arrived March 1. She left Kingston March 11, and arrived at Aspinwall, *viâ* Savanilla, March 25. On her return from Aspinwall she will proceed *viâ* Cape San Antonio to Key West, expecting to arrive at the Washington navy-yard about the middle of May. The expedition has been a great success in all respects, numerous satisfactory series of soundings and temperatures having been taken, and large numbers of marine animals obtained. In the collections incidentally obtained during the stay of the steamer at Trinidad were two specimens of the guacharo bird, *Steatornis caripensis*, which is such a rarity in museums, and two of the great fishing-bat.

ON Easter Monday the Essex Field Club held a meeting at Saffron Walden, about sixty members and visitors being present. Alighting at Audley End Station, the party drove to Lord Braybrooke's mansion, where they had an opportunity of inspecting the fine collection of birds and prehistoric and Roman antiquities contained in the museum. The Club was then conducted to a neighbouring hill, known as Ring Hill, where an ancient circular entrenchment is to be seen, and from there proceeded to a wood known as Peverels, where the true oxlip (*Primula elatior*) grows in profusion, the ground being in parts carpeted with the flowers of this interesting species. After luncheon a visit was paid to Mr. Joshua Clarke, F.L.S., at his residence, Fairycroft, and the visitors viewed the magnificent collection of humming-birds and birds of Paradise formed by this gentleman. The Club next assembled in the grounds of Mrs. Gibson, and inspected the site of the ancient Saxon cemetery and the collection of skulls and relics found therein during the excavations undertaken by the late Mr. G. S. Gibson, a full description of which has been published in a recent number of the *Transactions of the Essex Archæological Society*. The splendid library of scientific and other works belonging to the late Mr. Gibson having been hastily viewed, and the party having partaken of the hospitality offered by Mrs. Gibson, they were next conducted to the Saffron Walden Museum, where the various collections were greatly admired, and the curator, Mr. Maynard, much complimented upon the ability and zeal which he had displayed in their organisation and arrangement. In the ruins of the ancient castle adjoining the Museum Mr. Maynard read a paper on the history of these remains, and the party then proceeded to view the church, under the guidance of the Rev. Mr. Stevens. After tea an ordinary meeting of the Club was held, the president, Prof. Boulger, being in the chair. A paper, on the cultivation of the saffron in connection with the old town of Saffron Walden, was read by Mr. Joseph Clarke. With the object of promoting the extension of natural history science throughout the county, the Club proposes to establish local centres in the chief towns of Essex, and arrangements will shortly be made to commence operations at Saffron Walden, where so much interest was shown in the visit of the Club.

ON Saturday next, April 19, at three o'clock, a meeting of the Essex Field Club will be held at the British Museum of Natural History, South Kensington, under the direction of Dr. Henry Woodward, F.R.S. Dr. Woodward will deliver an address in the lecture-room on "Wingless Birds," and afterwards give a demonstration of the species, extinct and recent, in the geological and zoological galleries.

THE Council of the Linnean Society of New South Wales have been presented by a member of the Society with 100*l*., accompanied with a request that it should be offered as a prize for an essay on "The Life History of the Bacillus of Typhoid Fever." The Council has assented to the proposal, and advertisements to that effect will be immediately inserted in the most prominent scientific publications throughout the world. The essay will be received by the Society not later than December 31, 1884. The intention and wishes of the donor of the prize will be best given in his own words. "The questions chiefly to be solved in the investigation of the life history of the *Bacillus* of typhoid fever, are—1. What are the specific characters of the organism, as distinguished from other *Bacteria?* 2. What are the changes, if any, which the organism undergoes in the human body? 3. What are its modes of development and reproduction in the human body? 4. What changes or metamorphoses, if any, does the organism undergo after ejection from the human body, or in any other condition of its existence? 5. What fluids or other substances seem best adapted for the growth and multiplication of the organism? 6. Can the organism live or be cultivated in pure or distilled water? 7. What are its limits of endurance of heat, cold, dryness, or humidity? As far as these points are concerned the author should confine himself entirely to facts which come under his own observation, and those should be given in detail, with a full explanation of the method of investigation. But in dealing with the results obtained by these investigations, and the consideration of the means whereby a knowledge of the life history of this most dangerous organism may help towards its eradication, the theories and observations of others may appropriately be referred to, but in every such case the authority must be correctly cited. The chief points to be ascertained in this branch of the subject are—1. How, and under what conditions, does the organism get access to the human body? 2. How can its growth be impeded, or its vitality destroyed in the human body without serious injury to the individual affected? 3. How can it be eradicated or rendered innocuous in wells, water-holes, drains, &c."

AMONG the superabundant "Universities" of the United States Harvard is unquestionably taking its place as a national institution on a par with British establishments which hold a similar designation. The last quarterly *Bulletin* of its proceedings is before us, which has to acknowledge during that short time nine legacies or donations in money, varying from 200 to 100,000 dollars, and amounting to 168,000 dollars. One of these is 10,000 dollars subscribed for the purchase of meteorites, and another is 2000 dollars from the Massachusetts Society for Promoting Agriculture, to assist in the establishment of a veterinary hospital, to which institution also a collection of pathological models is presented. Other donations are, a new building for the law schools, two portraits of eminent divines, and the anatomical collection of a doctor who had previously founded a museum there. The *Bulletin* is edited by the well-known Harvard librarian, Mr. Justin Winsor, and a very carefully printed catalogue of the chief accessions to the University library in English, French, German, Italian, Spanish, Danish, Russian, Polish, and Hindustani, forms the bulk of it. Many of these additions are treasures which few libraries can acquire possession of, a few only of which have been printed, chiefly for private circulation, others, nevertheless, being both important and familiar books published a year or two ago. The books are divided into ten subjects, and it shows how different technical experience sometimes is from theoretical ideas, when so experienced a librarian finds it convenient to class together "History and Geography," while "Antiquities" are under a separate heading. We doubt, however, whether Izaak Walton or any one else would have looked for "The American Angler's Guide; or the Complete Fisher's Manual for the United States," under the head of "Law and Sociology," even if "Caxton's Game and Play of the Chesse" may in some sense belong to the latter. The advantages possessed by the librarian of such an institution as this are being fully utilised by Mr. Justin Winsor who is issuing in each number of the *Bulletin* most carefully written results of his researches into the bibliography of various subjects—in this January number, of "Ptolemy's Geography" and "The Kohl Collection of Early Maps," specially noting the gradual and irregular spread of the knowledge of America.

A STALACTITE cavern was recently discovered by accident near Cerdon in the Ain Department (France). It is situated near the old high road connecting Lyons with Geneva. Some country people who ventured into it state that it extends about 300 metres underground, and that its height varies considerably. Lyons and Geneva naturalists are now making a more minute investigation of the cave.

A STRONG shock of earthquake was felt at Urbino at a few minutes before 8 a.m. on the 9th inst. Its duration was five seconds. A shock was also felt at Belpasso, near Catania, at 10 a.m. on the 10th. It occasioned no damage.

OWING to the frequent earthquakes that have recently occurred in Slavonia, Prof. Pillar has been sent to observe these occurrences by the Hungarian Government, and will shortly present a detailed report to the Government on the subject.

ACCORDING to Herr Jæger of Rinde, on the Sogne Fjord, who, since 1858, has noted the number of earthquake shocks that have been felt in the district, there have been appreciable shocks from that period till 1879. Since the latter year no shock has been felt. It is worthy of record that on two occasions, viz. in 1860 and 1865, the shocks were perceived on the south side of the fjord, the districts on the northern coast being wholly undisturbed.

THE last number of the *Transactions of the Seismological Society of Japan* (Yokohama, 1884) contains various papers on seismology. The first is by Prof. Milne, on earth pulsations; the next is by Mr. Alexander, on the interpretation of a diagram described by a particular form of earthquake instrument. The object of the writer is to calculate not only the maximum velocity, but also the maximum rate at which the velocity changes, "which is a measure of the effect which an earthquake exerts in overturning and fracturing bodies placed on the earth's surface." Prof. Ewing describes the construction of a pendulum which shall be without a tendency to swing when the point from which it is suspended suffers displacement. Mr. Gergens gives a note on ripple-like marks found on the surface of an iron casting supposed to have been shaken while solidifying, which marks are picturesquely described as "a note in a congealed earthquake." The remainder of the volume is occupied by suggestions for new types of seismographs, a list of earthquakes in Tokio, and a report on systematic earthquake observations.

A CORRESPONDENT in *Naturen* has drawn attention to the great differences of climate observable last winter between Christiania and Stavanger. While in the former place there was a depth of from ten to twelve inches of ice during the month of January, vegetation had never been wholly arrested in the latter region at the same period. The grass plots in the various gardens at and near Stavanger were as green as in summer: daisies, snowdrops, pansies, violets, and primroses had their blossoms well set; peonies had appeared above the ground, and many roses had thrown out vigorous shoots. The thermometer fell only once in January to freezing point.

MM. MIGNON AND TOUARD, who established the refrigerating service at the Paris morgue, have made experiments with their system on hams infected by trichinæ, and are stated to have proved that these are rendered wholly innocuous by exposure during an hour to a cold of -20° C. It will be proposed for the protection of consumers from trichinosis to render exposure obligatory in the case of importations from America or Germany.

THE great work of lighting the Paris Opera by incandescent light has already begun. The whole house will require 6000 lamps; at present 400 lamps are used.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus* ♀) from Java, presented by Dr. Benthall; a Weeper Capuchin (*Cebus capucinus* ♀) from Brazil, presented by Miss Vincent; a Short-eared Owl (*Asio brachyotus*), British, presented by Mr. Oscar Burrows; a Smooth Snake (*Coronella lævis*), a Common Viper (*Vipera berus*), a Common Snake (*Tropidonotus natrix*), a Slow-worm (*Anguis fragilis*) from Hampshire, presented by Mr. W. H. B. Pain; an Alligator (*Alligator mississippiensis*) from the Mississippi; a Horrid Rattlesnake (*Crotalus horridus*) from Florida, presented by Mr. A. Begg; a Philantomba Antelope (*Cephalophus maxwelli*) from South Africa, deposited; a Moose (*Alces machlis*) from North America, two Mute Swans (*Cygnus olor*), European, a Common Viper (*Vipera berus*), British, purchased; six Long-fronted Gerbilles (*Gerbillus longifrons*), born in the Gardens.

GEOGRAPHICAL NOTES

WE much regret to learn of the death, at Loanda, on March 17, of Dr. Paul Pogge, the successful African explorer. Dr. Pogge, since 1880, was the companion of Lieut. Wissmann in the exploration of the region inland from the Portuguese possessions, and around the kingdom of Muatà Janvo. He accompanied Wissmann as far as Nyangwé in the journey of the latter across Africa, and in May 1882 set out to return to the station at Mukenge. Doubtless the hardships to which he has been subject, combined with fever, have told on Dr. Pogge's health. In 1874 he was a member of the German African Expedition which was sent out to explore the same region, and with only native companions succeeded in penetrating as far as the capital of Muatà Janvo.

THE announcement that Mr. Stanley intends to proceed from the Middle Congo north-east to the Mombuttu country, partly, no doubt, to settle the question of the course of the Aruwimi, the great north-east tributary of the Congo, renders Dr. Junker's discoveries in the Wellé region of special interest. In the map sent home and published in the new number of *Petermann's Mittheilungen* we find in the northern part the Wellé, after receiving the Gádda, proceeding west-north-west, and on the north it is joined by the Mbrúōle, and not much further westwards by the Gúrba—both considerable rivers rising in the southern A'-Sandeh kingdom. After taking up the waters of the Gúrba, the Wellé curves sharply round, at first southwards, making many windings in its course, and describing a large semicircle round the land of A-Madi, a semicircle variegated by a series of islands. Later on it resumes its west and west-north-west direction. With the exception of the two larger tributaries from the north just mentioned, the Wellé along the whole extent of the sketch receives no considerable waters either from north or south. As far as the southern territory is concerned, this fact is explained by the circumstance that the most important tributary of the Wellé-Makua, the Bomokándi or Májo (Nemajo of Schweinfurth) flows in an extremely long course from east to west and north-west, approximately parallel to the Wellé Hut, an interval of hardly two days' journey. Further to the west, however, it discharges into the Wellé River. The Bomokándi, showing almost half the breadth of the Wellé, rises far in the east, and may also have its source in the mountainous country bordering the Albert Nyanza in the west. In consequence of this approach to each other of the two streams, no other tributaries are developed in the long tongue-shaped peninsula formed by the junction of the Wellé and Bomokándi. Except innumerable little rivulets, few rivers of any size run either northwards to the Wellé or southwards to the Bomokándi from the plateau of this peninsula. It is otherwise, however, with the rivers discharging into the Bomokándi from the south. The watershed whence flow its southern tributaries lying considerably further to the south, there is ample scope here for the formation of larger accessory streams. Proceeding from west to east, we come upon three rivers of almost equal rank with the Mbrúōle and the Gúrba—the Makongo, Pokko, and Telli. A river no longer paying tribute to the Bomokándi, but discharging further to the west directly into the Wellé, is, according to information, the Mbe'lima, the source of which is not far from that of the Makongo to the east. With these partly indirect tributaries to the Wellé through the medium of the Bomokándi and the direct tributary, the Mbe'lima, the river-system of the Wellé to the south comes to an end. Further south, and flowing from east to west, is the Náwa, belonging, according to information received, to a more southern river-system, forming indeed a northern tributary to the Népoko. Dr. Junker made his way south to the Népoko, four days' journey from the Bomokándi, and reached it in the middle of its course, where it holds the same longitude with the Bomokándi. He evidently travelled a long way from the region in which lie the sources of the Népoko, the Bomokándi, and the Kibuli, that is, the Kibbi (Wellé)—rivers which collectively descend from the mountain and table-lands west of Albert Nyanza; the water-parting must be sought in a line running approximately from south-south-west to north-north-east. That the Népoko, from the point at which he met it, and where probably it describes a northern curve, bends in its further course in an approximately south-west direction, may be inferred from the fact that though indeed known in the western territories, it is yet transferred far to the south beyond the Náwa, which rises in the west, not far from his line of route to the Népoko. In the region between Bomokándi and Népoko traversed by Dr. Junker, the watershed of the two river-systems is hardly perceptible, yet the country of the Népoko tributaries from the north is highly characteristic. Instead of the high trees which everywhere else clothe the banks of the streams, you here meet broad, flat, treeless swamps. A floating vegetation, very like the Ssett in the Nile, forms a bridge by which to cross these swamps, though it is unavailable for riding and for beasts of burden. Dr. Junker closes his remarks on the hydrography of this region with the observation that he feels entitled to identify this Népoko, which does not belong to the Wellé system, with the Aruwimi of Stanley. Proof that the Wellé is the upper course of the Shari he hopes to be able to adduce later on.

IN *Petermann's Mittheilungen*, 1884, Heft iii., is a map of the Amambara Creek of the lower Niger region, which we owe to the indefatigable African explorer Eduard Robert Flegel. Just as by way of preparation for his Adamawa expedition he executed maps of the route from Eggan to the Akoko Mountains, and of the Niger tract, till then unknown, from Bussa up the river as far as Gomba, and finally explored the route from Bidda by way of Keffi Abd-es-Senga to Loko on the Benuë; so now as preparatory to his third African exploration he has executed a map of the Amambara which discharges into the lower course of the Niger. While Flegel was waiting at Lagos for a remittance from Germany to enable him to prosecute his travels, the representative of the Marseilles "Compagnie du Sénégal et de la Côte occidentale d'Afrique," J. Zweifel, the well-known discoverer of the sources of the Niger, undertook in July 1883, for trading purposes, an expedition up the Amambara, on the banks of which are planted a series of old commercial establishments, but which, nevertheless, had never yet been mapped out. To this expedition Flegel at once gladly joined himself, and hence the map in question. This must be reckoned as another valuable contribution towards clearing up the geography of the Lower Niger, so complicated by tributaries, arms, deltas, creeks, &c. In an article in the *Mittheilungen* commenting on the map of the Amambara Creek, an interesting sketch is given of the progress of geographical knowledge of the Niger for the last 300 years, or rather of the misconception and vacancy that prevailed up till quite recently regarding that region, our knowledge of which is still so very defective. Since the discovery of the rich produce in palm-oil yielded by the banks of the Niger and Lower Benuë, trade has rapidly developed there, and is now so lively that Flegel, in 1883, counted as many as twenty-three large ships, mostly steamers, constantly plying on their waters, besides a series of flat barges.

WE find in the last issue ot the Caucasian *Izvestia* the following new information on the Merv oasis, due to M. Alikhanoff:—Its surface is about 2150 square miles, which area could be increased by irrigation, the whole of the oasis having its origin due to the irrigation of the sands by canals drawn from the Murgab. This river, being dug at Kaushut-khan-bend, two canals, subdivided into numerous *aryks* (smaller canals), issue from it, taking in nearly all the water of the river which does not flow beneath the dam. Notwithstanding the southern position of the oasis, it has a cold winter, and there falls every year some snow, sometimes two feet deep; it soon disappears, however, as the temperature rises rapidly, and reaches occasionally 30° Celsius in February. During the summer, strong hot winds, which bring masses of hot sand, blow, mostly from the south-west. Still the climate is healthy enough, and healthier than that of Akhal-tekke; but the mortality is very great, owing to the poverty of the inhabitants and the dirtiness of their habits: the *kara-masta*, or black disease, a kind of pestilence, and the *merghi*, a kind of cholera, are endemic. The population is estimated at 32,700 *kibitkas*, which M. Alikhanoff considers to represent no less than 194,000 or 200,000 inhabitants. This population is, however, too numerous for the oasis, the average area of irrigated land being only six acres per inhabitant. M. Alkihanoff considers the Mervis as the least attractive of the Turcomans, and discovers in them only one good feature—their hospitality.

AT the annual meeting of the Bremen Geographical Society it was stated that a young German naturalist intends to start on an exploring expedition to Ovambo-land and further into the interior of Equatorial Africa, accompanied by Dr. Hoepfner. A member of the Society has presented him with good astronomical instruments, and the traveller will report to the Society from time to time, and his cartographic results will belong to the Society. The Society is also preparing a geographical and natural history expedition to the Bonin Islands, lying south of and belonging to Japan. Dr. Gottsche of Kiel, an eminent geologist, who is now in Japan, will be the leader of this expedition.

THE Russian Imperial Geographical Society has received the following telegram from Col. Prjevalsky, who is for the fourth time attempting to penetrate into Thibet:—"Alashan, January 8.—We have traversed the desert of Gobi without mishap. In the northern part the cold exceeded the freezing point of mercury. We are all well, and start to-morrow for Koukou-nor. It is said that hitherto the Thibetans pray heaven to shower down stones on our heads."

THE Melbourne *Age* has despatched to New Guinea a second exploring party, the members of which include a naturalist and an artist.

ONE result of Mr. Colquhoun's recent journeys in Indo-China has been the appointment of an English official to reside at Cheng-mai, or Zimmé, on the borders of the Shan States, and an officer of our consular service in Siam has been selected for that purpose, and is now at the post. This town, it may be recollected, forms the centre of the railway communication which Mr. Colquhoun proposes between British Burmah and South-Western China, and it can be reached either from Rangoon or from Bangkok. Mr. Bock travelled from the latter town up the Meinam. With the example of the exploration of the English consuls who have resided at Chung-king on the Yangtsze before him, it is to be hoped that the consul at Zimmé will be able to add largely to our knowledge of the regions, especially of the Shan States, lying between China and Siam. His appointment is certainly another step in the prolonged efforts to obtain a trade route into South-Western China, and he will serve, on the south of the frontier line, the same purpose as the officer at Chung-king on the north.

VOLCANIC ASHES AND COSMIC DUST[1]

IN the session of 1876, Mr. John Murray communicated to this Society a paper on the distribution of volcanic debris over the floor of the ocean,[2] and in it announced the discovery of cosmic dust in deep-sea deposits. It was shown that at points where neither the action of waves, rivers, or currents can transport the debris of continents, volcanic materials play the most important *rôle* in the formation of the mineral constituents of the deep-sea deposits. It was pointed out that pumice, on account of its structure, was able to float to great distances, but in time became waterlogged and sank to the bottom, there to decompose. On the other hand, incoherent volcanic matters, ejected in the form of lapilli, sand, and ashes, into the higher regions of the atmosphere, may, *cæteris paribus*, be conveyed, in consequence of their small dimensions and structure, to greater distances than other mineral particles derived from the continents. The possibility was also admitted that submarine volcanic eruptions might also contribute to the accumulation of those silicates and pyrogeneous minerals and rocks whose microscopic characters and distribution at the bottom of the sea we shall presently point out.

During the past few years we have added greatly to the observations which were the subject of Mr. Murray's communication. The present paper has been suggested by the striking analogy which exists between the volcanic products we have found in all deep-sea sediments, and the ashes and incoherent products of a recent celebrated eruption,—that of Krakatoa. The remarkable meteorological phenomena we have recently witnessed have been attributed by some to the presence in the atmosphere of mineral particles derived from this volcanic eruption, and by others to that of cosmic dust. It is said that in several places in America, and even in Europe, matters have been collected which must be regarded as the ashes from Krakatoa, which have been suspended for several months in the upper currents of the atmosphere. The importance of this matter has been recognised by the Royal Society of London, which has appointed a committee of its members to collect all the documents and observations relative to the distribution of these ashes. The present state of the question induces us to make known some results of the detailed researches which we have undertaken upon similar subjects. We desire to make known, to those who wish to study atmospheric dust, the distinctive microscopic characters by the aid of which we have been able to establish the volcanic or cosmic nature of certain particles found in deep-sea deposits, and to show at the same time the enormous area of the ocean over which we have been able to detect their distribution.

We believe that no better example could be found in support

[1] "On the Microscopic Characters of Volcanic Ashes and Cosmic Dust, and their Distribution in the Deep-sea Deposits." A paper read before the Royal Society of Edinburgh by Mr. John Murray an M. A. Renard.

[2] *Proc. Roy. Soc. Edin.*, 1876-77.

of our interpretations than the microscopic study of the ashes from Krakatoa, whose mineralogical and chemical composition M. Renard [1] was the first to make known, and whose observations on this subject have been amply confirmed by the later researches of other mineralogists. On the other hand, the conditions under which floating pumice was found after that eruption agree perfectly with the interpretation given eight years ago by Mr. Murray relative to the mode of transport of these vitreous matters and of the accumulation of their triturated debris on the bottom of the ocean. We shall also see how the sorting which takes place in the transport of the ashes of a volcano has its analogy in what we find in the deep-sea deposits.

In the first part of this communication we shall give the mineralogical description of the fragmentary products of Krakatoa, and consider generally the observations relative to these ashes. We shall also give the diagnostic characters of this volcanic dust, and of all similar particles which we find in deep-sea deposits. In the second part we will treat of the cosmic matters found in the abysmal regions of the ocean, to which Mr. Murray was the first to draw attention, and discuss their origin and distribution.

First Part

It is unnecessary to refer to the abundance of floating pumice, to its various degrees of alteration, to its conveyance by means of rivers, waves, and currents, and to its universal presence in deep-sea deposits, which have been pointed out in some detail in Mr. Murray's paper above referred to; but we will briefly recapitulate the characters of these volcanic matters, in accordance with the examination we have made of a large number of soundings and dredgings. We need not describe in detail the special characters of the lapilli which have been brought up in the dredge and sounding-rod from great depths. These fragments of more or less scoriaceous rocks belong to the same lithological varieties as those derived from terrestrial volcanoes. They consist of fragments of trachyte of various dimensions, of basalt, and, above all, of augite-andesite; the most remarkable, beyond all question, being lapilli of sideromelan, which are often entirely transformed into palagonite, and pass into the clay which is found so widely distributed, especially in the Pacific.

We do not propose here to take up in detail the wide distribution of the materials ejected from Krakatoa; we are engaged in collecting these, and will place the observations on maps along with those of Mr. Buchan on the upper currents of the atmosphere, which will be published in the *Challenger* Reports.

Before, however, passing to the description of the ashes themselves, we will briefly refer to some points touched upon by Mr. Murray in his paper. It is there pointed out that, in regions far removed from coasts, rounded fragments of pumice were collected on the surface of the sea by means of the tow-net, and that, at certain points on the bottom of the ocean, the greater part of the deposit is composed of vitreous splinters derived from the trituration of pumice-stones. The description of the phenomena connected with the Krakatoa eruption gives us a complete explanation of these observations. The specimens of pumice from Krakatoa, which have been collected floating on the sea and which we have examined, are in like manner rounded. The angular surfaces are all worn away just as in pebbles; the only asperities to be observed consist of crystals and fragments of crystals, which project beyond the general surface of the vitreous matter, which last, on account of its structure, presents less resistance to wear and tear than the minerals which are embedded in it.

We may recall the fact that the Bay of Lampong, in the Straits of Sunda, was blocked by the vast accumulation of pumice, formed in a few hours by the eruption of Krakatoa, which completely filled the bay. This floating bar of pumice-stones was about 30 km. long, 1 km. broad, and 3 m. to 4 m. in depth, 2 m. or 3 m. of which were below the surface of the water, and 1 m. above. These numbers give about 150 millions of cubic metres of ejected matter. This moving elastic wall rose and fell with the waves and tide,[2] and was carried by currents thousands of miles from the point of eruption over the surface of the ocean. The rounded form of blocks of pumice met with everywhere floating on the surface of the sea, as well as of those samples which, after having floated some time, became waterlogged and sank to the bottom, may be perfectly explained if we remember the friability of this rock, and, at the same time, the agitation to which it is submitted by the waves, through which the pieces are continually being knocked against each other. We understand also how this wear and tear gives rise to an immense quantity of pulverulent pumice fragments, which contribute in a great measure to the formation of oceanic deposits. As a matter of fact, rounded fragments of pumice have been met with floating on the surface of every ocean, and during the last few years many samples have been sent to us by captains of ships and missionaries. As has been already pointed out, they are universally distributed in oceanic deposits, although frequently highly altered.

If it be easy to pronounce upon the volcanic nature of these larger fragments, it becomes, on the other hand, exceedingly difficult when we have to deal with particles reduced to powder, and when recourse must be had to the microscope. Let us see what are the microscopic characters by which we recognise the particles of this dust.

We may here point out that it is not so much the presence of volcanic minerals which enables us in a marine sediment, as well as in an atmospheric dust like the ashes of Krakatoa, to recognise that the small fragments have an eruptive origin, as the microscopic structure of the small vitreous particles. It is well known that minerals reduced to small dimensions and irregularly fractured, as in the case of volcanic ashes, often lose their distinctive characters. Their size does not allow us to judge of their optical properties; their form, irregular and fragmentary, renders it difficult to determine the characteristic extinction of the species; the phenomena of coloration, of pleochroism, and the tint peculiar to the mineral, all lose so much of their intensity that they no longer serve for the identification of isolated minerals like those of the volcanic ashes which we have to study. As a result of our observations, we believe that in most cases where a mineral, under the conditions we have just described, reaches dimensions less than 0·05 mm., its determination with certainty is no longer possible, and consequently its origin can no longer be established; whilst a vitreous fragment, like those of volcanic ashes or triturated pumice, continues to be discernible when its dimensions are less than 0·005 mm. A reason for showing that the absence or rarity of crystals, or of fragments of volcanic crystals, ought not to be taken as a proof that a sedimentary matter, either from the atmosphere or from the deep sea, is not of volcanic origin, is the sorting process to which these matters are subjected in the air and in the water, a phenomenon to which we shall presently recur.

The most reliable distinctive character is always found in the structure of the small vitreous particles which are derived from the trituration of pumice or have an analogous origin, inasmuch as they have been ejected from the volcano in the state of ash. The structure peculiar to these materials is seen in their fracture, which leaves its impress upon the smallest fragments of debris, in which the microscope can decipher no characteristic properties except such as have relation to form. In order to assure ourselves that these characters of pumice remain constant to the extreme limits of pulverisation, such as are employed in the preparation of silicates for chemical analysis, we pounded in an agate mortar several varieties of pumice, and the powder thus produced clearly showed itself to be composed of particles in which were recognisable, with little trouble, the characters of the pumice-like material which is constantly met with in the sediments, and of which the ashes of Krakatoa give us beautiful examples. The diagnostic character to which we here make allusion rests on the distinctive peculiarities of incoherent volcanic products. What distinguishes them from lavas is not merely the extraordinary abundance of vitreous matters, but also the prodigious number of gas-bubbles which are inclosed by the pumice and vitreous volcanic sands and ashes. These bubbles are due to the expansion of the gases dissolved in the magma, which also determine the eruption. If we admit, as everything seems to show, that these incoherent volcanic matters are the products of the pulverisation of a fluid magma, we can understand that these particles, on cooling rapidly, will remain in the vitreous state, and, on the other hand, that the dissolved gases, yielding to the expansion, will form numerous pores which will become elongated owing to the mode of projection. It is the existence of these bubbles, or of such a filamentous structure, which points out to us the vitreous volcanic materials in spite of the great fineness of subdivision. It is also this structure which allows these bodies to be carried to such great distances from the scene of eruption.

The examination of the Krakatoa ashes, and of the dust resulting from the pulverisation of the pumice of that volcano,

[1] "Les cendres volcaniques de l'éruption du Krakatau" (*Bull. Acad. Roy. de Belgique*. sér. 3, t. vi. No. 11, Séance du Nov. 3, 1883).

[2] *Comptes rendus de l'Académie des Sciences*, November 19, 1883, p. 1101.

shows markedly the peculiarity due to the bullous structure. If this gray-green pulverulent matter be placed under the microscope, it is seen to be composed of almost impalpable grains, with a mean diameter of 0·1 mm., which are almost exclusively colourless or brownish vitreous particles permeated by bubbles. The bubbles are rarely globular, but often elongated, as we have just pointed out, and they give a drawn-out appearance to the fragments. As often happens, several bubbles are elongated parallel to each other, and in this case the pore becomes a simple streak; the fragment then assumes a fibrous texture, which may cause it to resemble at first sight a striated felspar or an organic remnant; but an examination of the outline will never allow of this confusion. If we examine the terminal contours and lines of these bubble-containing fragments, we never find that they are straight lines, but that they show a ragged appearance, all the sinuosities being curvilinear. This mode of fracture is in correspondence with the vacuolated structure, and, just as in the porous pumice, the vitreous volcanic ashes are permeated by vacuoles; besides, everything goes to show that the fragmentary condition and the fresh fractures are due to a tension phenomenon which affects these vitreous matters in a manner analogous o what is observed in the "Rupert's drops."

FIG. 1.—Vitreous particles of the ashes of Krakatoa, which fell at Batavia, August 27, 1883 ($\frac{1}{250}$).

We have pointed out that brown vitreous fragments are rare in the ashes of Krakatoa. These, however, contain skeletons of magnetic iron, and are devitrified by microliths.[1] It is scarcely necessary to add that the particles, whose form we have indicated, are isotropic. If under crossed nicols we sometimes see the field illuminated, this is due to crystals in the vitreous matter, or to phenomena of tension, which are sometimes observed in the neighbourhood of the bubbles.

These details on the micro-structure of the vitreous particles from Krakatoa can be applied with most perfect exactitude to the volcanic dusts, which we have determined as such, in the deep-sea deposits. In virtue of their bullous structure, their dimensions, and their mode of projection, they are capable of being widely transported from the point of eruption by aërial currents. It must be admitted, however, that in the deep-sea sediments a very large part of these vitreous splinters has not been derived from the pulverised ejections from a volcano, but from the trituration of floating pumice, of which we have given above a striking example. It will be understood that it is scarcely possible to trace the difference between volcanic ashes, properly so called, and the products resulting from the pulverisation of floating pumice which we have just indicated. As in the incoherent products of Krakatoa, so we find spread out on the bottom of the sea many more vitreous particles, similar to those we have just described, than of true volcanic minerals. This is easily explained, however, when we remember how the distribution of volcanic dust takes place.

Let us now point out the minerals which can be determined with certainty in the ashes of this great eruption; and we may at once remark that they are the same which we have almost always found associated in the deposits with the splinters of glass. In general all the crystals are fractured, except those which are still embedded in a vitreous layer; this vitreous coating is often crackled and bullous. In the ashes of Krakatoa, however, we have not remarked the globules of glass which are often described as glued to the minerals of volcanic ashes, nor have we seen the drawn-out vitreous filaments resembling Peles hair. The minerals of the Krakatoa ashes which are susceptible of a rigorous determination belong to plagioclase, augite, rhombic pyroxene, and magnetite.[1] We shall presently see the peculiarity which distinguishes each of these species in the ashes.

[1] Just as we can divide pumice microscopically according as it is acid or basic, so the products of its trituration may be recognised under the microscope, inasmuch as the former often give colourless and more elongated particles, while the fragments of basic pumice have a more pronounced tint and more rounded pores.

Among the most frequent minerals, but poorly represented in comparison with the vitreous matter, plagioclase felspar comes first. This mineral has about the same dimensions as the vitreous fragments, and, with the exception of the crystals, entirely inclosed in the pumice matter, is in the form of debris. Sometimes twins on the albite plan can be distinguished, and the results of analysis clearly indicate that it is triclinic felspar which should almost exclusively be found in this ash. But the most interesting crystals of plagioclase, and the most characteristic of this ash, although represented very rarely, are in the form of rhombic tables, extremely thin, and covered with a fine lacework of vitreous matter. We know that the crystals described by Penck[2] in a great number of lapilli and of volcanic ashes, upon the nature of which doubts have been expressed, belong incontestably to the plagiocalases, and represent an isomorphic mixture analogous to that of bytownite. It is to Mr. Max Schuster[3] that we owe this specific determination. Having found in numerous sediments of the Pacific these same crystals in the form of rhombic tables, and possessing preparations which would be of great interest to him in his remarkable optical studies on the felspars, we submitted them to this ingenious mineralogist in order to confirm our determination. We believe it will be interesting to give a *résumé* here of the results of the observations of Mr. Schuster, which are perfectly applicable to the characteristic crystals of felspar from Krakatoa, as well as to those which we have discovered in a great number of deep-sea soundings.

This plagioclase occurs for the most part in flat tabular crystals with the clinopinacoid especially developed. Individuals of the columnar type, elongated in the direction of the edge P/M, are rare. These tabular crystals consist essentially of a combination of the clinopinacoid with P and *x*, more rarely with P, *u*, and *y*, and occasionally *x* and *y* appear together. In the first case the crystals have the form of a rhomb, in the second case they are elongated through the predominance of either *x* or P. The dimensions of those crystals which were examined and measured lie between the line 0·61 mm. broad and 1 mm. long as maximum, and 0·015 mm. broad and 0·042 mm. long as minimum. The extinction of the plagioclase is negative. Its value was found to vary between 22° and 32° on the clinopinacoid, and between 8° and 16° on the basal plane. The average values of many measurements made on good crystals are as follows:—24° 12′, 25° 6′, and 29° 6′ on the clinopincaoid, 10° 42′ on the one side, and 10° 18′ on the other side of the twinning line, as this is shown on the basal plane. Polysynthetic individuals, made up of repeated twins on the albite plan, were very rarely observed. The felspar in its optical properties is thus seen to lie between labradorite and bytownite. The twin growths are particularly frequent and interesting on account of the structure of the individuals. In addition to those of the albite type, others were observed in which the edges P/M and P/K could be definitely determined as the axes of twinning, whilst P and K formed the twinning planes. The plane of composition was principally either P or M when penetration twins were not observed.

These fragments and crystals of plagioclase contain inclusions of vitreous matter, and sometimes grains of magnetite. Perhaps a small number of felspathic grains may belong to sanidine, the presence of which is insinuated by the percentage of potass indicated by the analysis which follow (K_2O = 0·97 per cent.).

We have said that the pyroxenic minerals of the ash are augite and a rhombic pyroxene; we distinguish them by the microscope sometimes in the form of fragments—and this is usually the case—sometimes in the form of crystals, which we can isolate from the volcanic glass covering them by treating them with hydrofluoric acid. In the crystals of augite we distinguish the faces of

[1] Lately the works on these same ashes have made known as accidental elements pyrites, apatite, and perhaps biotite (?). It is to be remarked, however, that these minerals must be extremely rare in comparison with the vitreous matters and mineral species above-mentioned.

[2] Penck, "Studien über lockere vulkanische Auswurflinge," *Zeitschr. d. deutsch. geol. Gesellsch.*, 1878.

[3] Schuster, "Bemerkungen zu E. Mallard's Abhandlung sur l'isomorphisme des feldspaths tricliniques, &c.," *Min. petr. Mitth.*, v, 1882, p. 194.

a prism, of the brachypinacoid, and indications of the faces of a pyramid. This augite is pleochroic and has a greenish tint, and extinguishes in certain cases obliquely to the prismatic edges. It is this character which often permits it to be distinguished from rhombic pyroxene with which the augite is associated. The crystals of hypersthene are transparent, of a deep brown colour, strongly dichroic, with green and brown tints. They are in rectangular prisms terminated by a pyramid, and extinguish between crossed nicols parallel to their longitudinal edges. Magnetic iron, which is rather abundant in the ashes, is recognised in the form of grains and octahedrons. We have not been able to detect with certainty either hornblende or olivine. The largest grains of this ash are true microscopic lapilli, where we distinguish in a vitreous mass microlithic crystals of felspar, of magnetite, and more rarely of pyroxene. Finally, we observe with the microscope particles of an organic origin, which are easily recognisable by their fibrous and reticulated structure. These impurities may have been transported by winds, or may have come from the ground where the ashes were collected.

In spite of all the uncertainties which the exact diagnoses of volcanic dust present, we can consider them often, from the point of view of their mineralogical composition, as analogous with the augite-andesites. We know, besides, that it is to these rocks that the lavas of the volcano of Krakatoa should be referred.

The ashes which fell at Batavia on August 27, 1883, and samples of which were sent to Holland by M. Wolf, resident on that island, have been analysed with the following results:—

I. 1·119 grm. of substance dried at 110° C., and fused with carbonate of soda and potash, gave 0·7799 grm. of silica, 0·1754 grm. of alumina, 0·0911 grm. of peroxide of iron, 0·0401 grm. of lime, 0·398 grm. of pyrophosphate of magnesia, answering to 0·01434 grm. of magnesia. A recent determination of titanic acid has given 0·62 per cent. TiO_2.

II. 1·222 grm. of substance dried at 110° C. gave 0·0335 grm. of loss on ignition (water, organic substances, chloride of sodium); the same substance treated with hydrofluoric and sulphuric acids gave 0·1161 grm. of chloride of sodium and potassium, and 0·0118 grm. of chloroplatinate of potassium, answering to 0·0118 grm. of potash and to 0·0188 grm. of chloride of potassium; by difference = 0·0973 grm. of chloride of sodium, answering to 0·05163 of soda.

III. 1·7287 grm. of substance dried at 110° C. was treated in a closed tube with hydrofluoric and sulphuric acid. The oxidation required 2·3 cc. of permanganate of potash (1 cc. = 0·0212 grm. FeO), answering to 0·047876 grm. of peroxide of iron.

	I.	II.	III.	
SiO_2	65·04	—	—	65·04
Al_2O_3	14·63	—	—	14·63
Fe_2O_3	4·47	—	—	4·47
FeO	—	—	2·82	2·82
MnO	traces	—	—	traces
MgO	1·20	—	—	1·20
CaO	3·34	—	—	3·34
K_2O	—	0·97	—	0·97
Na_2O	—	4·23	—	4·23
Loss	—	2·74	—	2·74
				99·44

It will be understood that it is barely possible to submit this analysis to discussion. The abundance of vitreous particles in the ashes renders illusory the calculation of the values obtained, and the distribution of the substances among the different species of constituent minerals. This vitreous matter can indeed contain an indeterminate quantity of the different bases. On the other hand, the difficulties of the calculation are all the greater, as the constituent minerals of the ashes may contain, as isomorphs, the bases which the analysis suggests. It is none the less true, however, that the percentage composition expressed by the analysis supports the preceding mineralogical determinations, without permitting the species to be precisely determined. It agrees with the interpretation that the magma from which the ashes were formed belongs to the augite-andesites.

The vitreous and mineral fragments we have just described rom the Krakatoa eruption being identical with those which we encounter in deep-sea sediments, we may conclude that both have a similar origin. In certain cases, however, we have in place of augite a predominance of hornblende, and sometimes black mica is abundant. Again, we find more or less fragmentary crystals of peridote, of magnetite, of sanidine, and, more rarely, of leucite and of hauÿne. We can easily understand this variation in composition, following the nature of the magma from which the ashes collected in different regions of the sea were derived. But in all cases it is the predominance of vitreous particles, with their special structure, which indicates most clearly the volcanic nature of the inorganic constituents of a sediment.

If now we consider the conditions which govern the distribution of ashes in the atmosphere or at the bottom of the sea, we shall be able to show how it is that there is generally a predominance of vitreous particles in these ashes. In the first place, these are vitreous matters rather than minerals, properly so called, from the moment of ejection from the crater. Moreover we should, in a general way, not expect to find that incoherent eruptive matters, which are spread out at a distance from the volcano, present a perfectly identical composition with those other loose products, such as lapilli, volcanic bombs, and scoriæ, which are projected only a short distance from the focus of eruption. Even where there exists a perfect chemical and mineralogical identity, in the crater itself, between the lavas and the pulverulent materials of the same eruption (the supposition being that the ashes arise simply from the trituration of the lavas), we can easily understand that these latter, being carried far and wide by the winds, must undergo a true sorting in their passage through the atmosphere, according to the specific gravity of the amorphous elements or crystalline constituents. It results from this that, according to the points where they are collected, volcanic ashes may, although belonging to the same eruption, present differences not only with respect to the size of the grains, but also with respect to the minerals.

In this mode of transport it is evident that the vitreous particles, other things being equal, will be transported farthest from the centre. In the first place, they are more abundant than the other particles, and again they possess in their chemical nature and in their structure conditions which permit the aërial currents to take them up and carry them to great distances; they consist of a silicate in which the heavy bases are poorly represented as compared with the other constituent elements; they are filled with gaseous bubbles which lower their specific gravity, and at the same time are capable of being broken up into the minutest particles. The minerals with which they are associated at the moment of ejection from the crater are not, like them, filled with gaseous bubbles; they do not break up so easily into impalpable powder, for they are not porous, and are not in the same state of tension as the rapidly-cooled vitreous dust. Finally, many of these species are precisely those whose specific gravity is very high, on account of the bases entering into their composition. These minerals will not then be carried so far from the centre of eruption, and in all cases the vitreous particles are the essential ones in the atmospheric dusts derived from volcanic ashes.

We have a beautiful illustration of this in the ashes of Krakatoa. In proportion as the ashes are collected at a greater distance from a volcano, so are they less rich in minerals, and the quantity of vitreous matter predominates. According to a verbal communication from Prof. Judd, the ashes collected at Japan contain only a relatively small proportion of pyroxene and magnetite.

If we wish to assure ourselves of the nature of an atmospheric dust, and, as has lately been frequently attempted in Europe, to show that the dust is really from the Krakatoa eruption, it is important above all to seek for the presence of vitreous fragments. The characters which we have indicated permit any one to recognise them easily under the microscope. We would remark, however, that the presence of crystals, either of hypersthene, of augite, or of particles of magnetite in an atmospheric dust collected in Europe, does not prove in a certain manner that the dust belongs to the ashes from Krakatoa; for, besides the difficulties of an exact mineralogical determination of the fragmentary elements, it is difficult to understand how these heavy minerals should have been carried by the aërial currents, while the vitreous dust is absent. As we have just shown, it is the contrary which should have taken place.

It results as a corollary from these considerations that the chemical composition of an ash may vary according to the point at which it has been collected, and it tends also, other things being equal, to become more acid the further it is removed from the centre of eruption. If we admit, for example, that the magma which gave birth to the ashes of Krakatoa is an augite-andesite, as everything seems to indicate, the percentage of silica (65 per cent.) which our analysis shows appears too high, but if we remember, what we have just said, that the ashes become deprived, during their passage through the atmosphere, of the heavier and more basic elements, it will be understood that the vitreous and felspathic materials, which have a lower specific gravity, and are at the same time more acid, will accumulate at points farthest from the volcano. It will be sufficient to have directed the attention to this fact to show how the percentage of silica in the ashes from the same eruption may vary according as they are collected at a variable distance from the crater.

The predominance of vitreous splinters in deep-sea sediments far removed from coasts is even more pronounced than in volcanic ashes collected on land. This arises, as we indicated at the commencement, from the large quantity of pumice carried or projected into the ocean, whose trituration, which takes place so easily, gives origin to vitreous fragments difficult to distinguish from those projected from a volcano in the form of impalpable dust. In addition, we may state that, in the distribution of volcanic materials on the bottom of the sea, the ashes are subjected to a mode of sorting having some analogy to that which takes place during transport through the atmosphere. When these ashes fall into the sea a separation takes place in the water; the heaviest particles reach the bottom first, and then the lighter and smaller ones, descending more slowly, are deposited upon the larger and heavier fragments and crystals from the same eruption. We have a fine example of this stratification of submarine tufa in the centre of the South Pacific, lat. 22° 21′ S., long. 150° 17′ W. This specimen is entirely covered with peroxide of manganese, and at the base of the fragment we see the large crystals of hornblende and particles of magnetite. This lower layer is covered by a deposit in which these minerals and coarser grains are observed to pass gradually into a layer composed of small crystals of felspar, debris of pumice, and more or less fine material.

We do not propose to occupy ourselves here with the mode of formation of volcanic ashes, and with those of Krakatoa in particular. It will suffice to indicate that in the dust of a volcano we find all the characters supporting the interpretation which regards volcanic ashes as formed by the pulverisation of an igneous fluid mass in which float crystals already formed, and from which, when projected by gases, the pulverised vitreous particles undergo a rapid cooling and decrepitation during their passage through the atmosphere. It is not only the microscopic examination of these volcanic matters that leads us to this conclusion, but the prodigious quantity of ashes formed during the eruption of this volcano, which do not agree with the interpretation that regards these ashes as the result of a pulverisation of a rock already solidified in the crater. Indeed one cannot understand how in two or three days the immense quantity of ashes ejected from Krakatoa could be formed by this process, as, for instance, on August 26, 1883, and in the May eruption, which was the prelude to that catastrophe.

Second Part

The recent brilliant sunsets have been attributed to the presence in the atmosphere of minute particles of an extra-terrestrial origin, as well as to volcanic dust. This induces us to conclude this brief abstract of our observations by a description of the cosmic particles which we have found, along with volcanic ashes and pumice, in those regions of the deep sea far from land, where the sediment accumulates with extreme slowness. In another memoir[1] we have pointed out the distribution of these particles on the floor of the ocean, and indicated the conclusions which we believe are justified by their relative abundance in the red clay areas of the Central Pacific.

It is known that the atmosphere holds in suspension an immense number of microscopic particles which are of organic and inorganic origin, and are either dust taken up by aërial currents from the ground, or are extra-terrestrial bodies. A large number of scientific men, headed by Ehrenberg, Daubrée, Reichenbach, Nordenskjöld, and Tissandier, have studied this interesting problem, and have brought forward many facts in support of the cosmic origin of some of the metallic particles found in atmospheric precipitations. It is certain that serious objections may be raised against the origin of a large number of so-called cosmic dusts.

In a great many cases it can be shown that these dusts are composed of the same minerals as the terrestrial rocks which are to be met with at short distances from the spot where the dust has been collected, and we can attribute a cosmic origin only to the metallic iron in these dusts. It is somewhat astonishing, however, that no trace is ever found in these dusts of meteoric silicates, although in a great many meteorites it might be said that the iron is only accidentally present, while the silicates predominate. On the other hand, having regard to the mineralogical composition of meteorites, it appears strange that the so-called cosmic dusts should present characters so variable, from the point of view of their mineralogical composition, in the different regions where they have been collected. It might also be objected that even the iron, nickel, and cobalt would come from volcanic rocks in decomposition in which these bodies are sometimes present, and this objection would seem quite natural, especially in our particular case, when we remember the numerous volcanic fragments in decomposition on the bottom of the sea. Again, according to numerous researches, native iron is found, although rarely, in various rocks and sedimentary layers of the globe. A reduction of the oxide of iron into metal might also be admitted under the influence of organic substances. It might still further be objected in opposition to the cosmic origin of the fine particles of native iron that they might be carried by aërial currents from our furnaces, locomotives, the ashes of our grates, and in the case of the ocean, from steamers. All our materials of combustion furnish considerable quantities of iron dust, and it would not be astonishing to find that this, after having been transported by the winds, should again fall on the surface of the earth at great distances from its source.

Such are the objections which present themselves when it is proposed to pronounce upon the origin of particles which we are inclined to regard as cosmic, and of which we propose here to give a short description. We shall see that many of these doubts are at once removed by a statement of the circumstances under which cosmic spherules are found in deep-sea deposits, and it will be found also that all the objections are disposed of when we show the association of metallic spherules with the most characteristic bodies of undoubted meteorites.

In the first place, the considerable distance from land at which we find cosmic particles in greatest abundance in deep-sea deposits, eliminates at once objections which might be raised with respect to metallic particles found in the neighbourhood of inhabited countries. On the other hand, the form and character of the spherules of extra-terrestrial origin are essentially different from those collected near manufacturing centres. These magnetic spherules have never elongated necks or a cracked surface like those derived from furnaces with which we have carefully compared them. Neither are the magnetic spherules with a metallic centre comparable either in their form or structure to those particles of native iron which have been described in the eruptive rocks, especially in the basaltic rocks of the north of Ireland, of Iceland, &c.

Having referred to the objections, let us now see on what we must rely in support of the hypothesis that many of the magnetic particles from the bottom of the sea which are specially abundant in those regions where the rate of accumulation of the deposit is exceedingly slow are of cosmic origin. If we plunge a magnet into an oceanic deposit, specially a red clay from the central parts of the Pacific, we extract particles, some of which are magnetite from volcanic rocks, and to which vitreous matters are often attached; others again are quite isolated, and differ in most of their properties from the former. The latter are generally round, measuring hardly 0·2 mm., generally they are smaller, their surface is quite covered with a brilliant black coating having all the properties of magnetic oxide of iron; often there may be noticed upon them cup-like depressions clearly marked. If we break down these spherules in an agate mortar, the brilliant black coating easily falls away and reveals white or gray metallic malleable nuclei, which may be beaten out by the pestle into thin lamellæ. This metallic centre, when treated with an acidulated solution of sulphate of copper, immediately assumes a coppery coat, thus showing that it consists of native iron. But there are some malleable metallic nuclei extracted from the spherules which do not give this reaction, they do not take the copper coating. Chemical reaction shows that they contain cobalt and nickel; very probably they constitute an alloy of iron and these two metals, such as is often found in meteorites, and whose presence in large quantities hinders the production of the coppery coating on the iron. G. Rose has shown that this coating of black oxide of iron is found on the periphery of meteorites of native iron, and its presence is readily understood when we admit their cosmic origin. Indeed these meteoric

[1] *Proc. Roy. Soc. Edin*

particles of native iron, in their transit through the air, must undergo combustion, and, like small portions of iron from a smith's anvil, be transformed either entirely or at the surface only into magnetic oxide, and in this latter case the nucleus is protected from further oxidation by the coating which thus covers it.

One may suppose that meteorites in their passage through the atmosphere break into numerous fragments, that incandescent particles of iron are thrown off all round them, and that these eventually fall to the surface of the globe as almost impalpable dust, in the form of magnetic oxide of iron more or less completely fused. The luminous trains of falling stars are probably due to the combustion of these innumerable particles, resembling

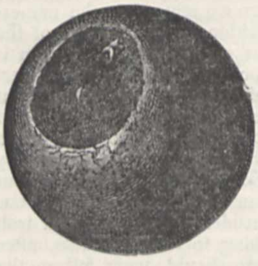

FIG. 2.

FIG. 3.

FIG. 2.—Black spherule with metallic nucleus (60 : 1). This spherule, covered with a coating of black shining magnetite, represents the most frequent shape. The depression here shown is often found at the surface of these spherules. From 2375 fathoms South Pacific.

FIG. 3.—Black spherule with metallic nucleus (60 : 1). The black external coating of magnetic oxide has been broken away to show the metallic centre, represented by the clear part at the centre. From 3150 fathoms Atlantic.

the sparks which fly from a ribbon of iron burnt in oxygen, or the particles of the same metal thrown off when striking a flint. It is easy to show that these particles in burning take a spherical form, and are surrounded by a layer of black magnetic oxide.

Among the magnetic grains found in the same conditions as these we have just described are other spherules, which we refer to the *chondres*, so that if the interpretation of a cosmic origin for the magnetic spherules with a metallic centre was not established in a manner absolutely beyond question, it almost becomes so when we take into account their association with the silicate spherules, of which we have now to speak. It will be seen by the microscopic details that these spherules have quite the constitution and structure of *chondres* so frequent in meteorites of the most ordinary type, and on the other hand they have never been found, as far as we know, in rocks of a terrestrial origin; in short, the presence of these spherules in the deep-sea deposits, and their association with the metallic spherules, is a matter of prime importance. Let us see how we distinguish these silicate spherules, and the points upon which we rely in attributing to them a cosmic origin.

Among the fragments attracted by the magnet in deep-sea deposits we distinguish granules slightly larger than the spherules with the shining black coating above described. These are yellowish-brown, with a bronze-like lustre, and under the microscope it is noticed that the surface, instead of being quite smooth, is grooved by thin lamellæ. In size they never exceed a millimetre, generally they are about 0·5 mm. in diameter; they are never perfect spheres, as in the case of the black spherules with a metallic centre; and sometimes a depression more or less marked is to be observed in the periphery. When examined by the microscope we observe that the lamellæ which compose them are applied the one against the other, and have a radial eccentric disposition. It is the leafy radial structure (*radialblättrig*), like that of the *chondres* of bronzite, which predominates in our preparations. We have observed much less rarely the serial structure of the *chondres* with olivine, and indeed there is some doubt about the indications of this last type of structure. Fig. 4 shows the characters and texture of one of these spherules magnified 25 diameters. On account of their small dimensions, as well as of their friability due to their lamellar structure, it is difficult to polish one of these spherules, and we have been obliged to study them with reflected light, or to limit our observations to the study of the broken fragments.

These spherules break up following the lamellæ, which latter are seen to be extremely fine and perfectly transparent. In rotating between crossed nicols they have the extinctions of the rhombic system, and in making use of the condenser it is seen that they have one optic axis. It is observed also that when several of these lamellæ are attached, they extinguish exactly at the same time, so that everything induces us to believe that they form a single individual.

In studying these transparent and very thin fragments with the aid of a high magnifying power, it is observed that they are dotted with brown-black inclusions, disposed with a certain symmetry, and showing somewhat regular contours; we refer these inclusions to magnetic iron, and their presence explains how these spherules of bronzite are extracted by the magnet. We would observe, however, that they are not so strongly magnetic as those with a metallic nucleus.

We designate them under the name of bronzite rather than of enstatite, because of the somewhat deep tint which they present; they are insoluble in hydrochloric acid. Owing to the small quantity of substance at our disposal, we were obliged to limit ourselves to a qualitative analysis. We have found in them silica, magnesia, and iron.

We have limited our remarks at this time to these succinct details, but we believe that we have said enough to show that these spherules in their essential characters are related to the *chondres* of meteorites, and have the same mode of formation. In conclusion, we may state that when the coating of manganese depositions, which surround sharks' teeth, ear-bones of Cetaceans and other nuclei, is broken off and pounded in a mortar to

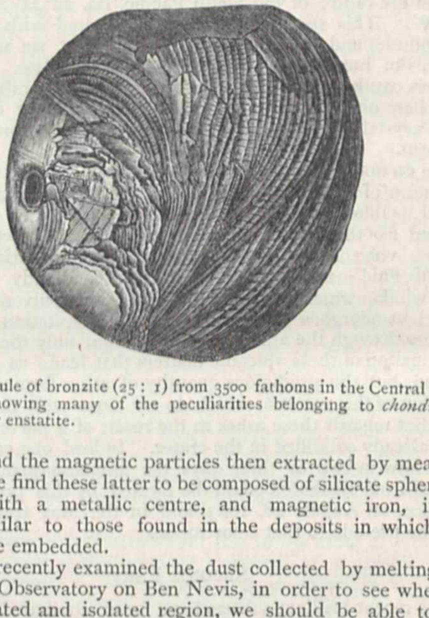

Fig. 4.—Spherule of bronzite (25 : 1) from 3500 fathoms in the Central South Pacific, showing many of the peculiarities belonging to *chondres* of bronzite or enstatite.

fine dust, and the magnetic particles then extracted by means of a magnet, we find these latter to be composed of silicate spherules, spherules with a metallic centre, and magnetic iron, in all respects similar to those found in the deposits in which the nodules were embedded.

We have recently examined the dust collected by melting the snow at the Observatory on Ben Nevis, in order to see whether, in that elevated and isolated region, we should be able to find volcanic ashes or cosmic spherules analogous to those we have described. This atmospheric dust, which we have examined microscopically, has not shown any particles which could with certainty be regarded as identical with those substances which are the subject of this paper. Particles of coal, fragments of ashes, and grains of quartz predominated. Besides these, there were fragments of calcite, augite, mica, and grains of rock of all forms and of variable dimensions. These were associated with fibres of cotton, of vegetables, splinters of limonite and of tin—in short, everything indicating a terrestrial origin.

In order to give an idea of the facility with which the winds may carry these matters even to the summit of the mountain, we may add that Mr. Omond has sent to us fragments of crystalline rocks, some having a diameter of two centimetres, which, he states, were collected on the surface of the snow at the summit after the storm of January 26, 1884.

Arrangements are being made to collect the dust at the top of Ben Nevis during calms with great care.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

COLLEGE OF AGRICULTURE, DOWNTON, SALISBURY.—At the close of the winter session on Wednesday, 16th inst., the certificate of membership and the certificate of proficiency in practical agriculture were granted to Mr. R. A. Benson, F.H.A.S., 11, Caledonia Place, Clifton; Mr. W. de Hoghton Birch, 1, Bathwick Street, Bath; and Mr. C. W. Lincoln Hardy, F.H.A.S., Gittisham, Honiton, Devon; and the certificate of proficiency alone to Mr. B. S. Dunning, 2, Warwick Square, S.W.

THE authorities of University College, Liverpool, have asked that that institution be incorporated with Victoria University.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, April 3.—Sir J. Lubbock, Bart., president, in the chair.—Mr. W. Brockbank exhibited a series of double daffodils, wild forms of *Narcissus pseudo Narcissus*, which were gathered in a Welsh meadow from among many of both the single and double forms occurring there in every stage of growth. Sections invariably revealed stamens and pistils, and in two of the most double forms ovaries filled with seeds were present. With this evidence he therefore contended against the current notion of cultivation and root-growths having produced a heterogeneous multiplication of the perianth segments, split-up crown, and conversion of stamens into petal-growths, his belief being that the plants in question were propagated in the ordinary seed-bearing manner.—Mr. R. M. Middleton showed a jackdaw with albinism of the wing feathers, causing considerable resemblance in the bird to a magpie.—Prof. P. M. Duncan gave a revision of the families and genera of the Sclerodermic Zoantharia, the Rugosa excepted. Since MM. Milne-Edwards and Haimes' work, 1857-60, no systematic revision of the Madreporaria has appeared, while since then a great number of new genera have been founded; hence the necessity for a revision has arisen, and more especially in consequence of the morphological researches of Dana, Agassiz, Verrill, and Moseley. Prof. Duncan explained that the old sections of the Zoantharidæ required modification and addition. In his present revision the sections Aporosa and Perforata remain shorn of some genera, the old family Fungidæ becomes a section with three families, two of which are transitional between the sections just mentioned. The section Tabulata disappears, some genera being placed in the Aporosa, and the others are relegated to the Hydrozoa according to Moseley. The Tubulosa cease to be Madreporarian. Hence the sections treated are Madreporia-Aporosa, M.-Fungida, and M.-Perforata. The nature of the hard and soft parts of these forms is considered in relation to classification, and an appeal is made to naturalists to agree to the abolition of many genera, the author having sacrificed many of his own founding. The criticism of 467 genera permits 336 to remain good, and as a moderate number (36) of sub-genera are allowed to continue, the diminution is altogether about 100. The genera are grouped in alliances, the numbers in families being unequal. Simplicity is aimed at, and old artificial divisions dispensed with. There is a great destruction of genera amongst the simple forms of Aporosa, and a most important addition to the Fungida. The genera *Siderastreæ* and *Thamnastræ* are types of the family Plesiofungidæ, as are *Microsolenia* and *Cyclolites* of the family Plesioporitidæ. The families Fungidæ and Lophoseridæ add many genera to the great section Fungida. There is not much alteration in respect of the Madreporaria-Perforata, but the sub-family Eusamminæ are promoted to a family position as the Eusammidæ.—Mr. Chas. F. White thereafter read a note on some pollen from funereal garlands found in an Egyptian tomb *circa* B.C. 1000. It appears that from among the dried flowers of *Papaver Rhœas* the pollen obtained freely absorbed water, became swollen, and in other respects the grains were barely able to be differentiated by the microscope from the pollen grains of the recent poppy.—A paper was read by Mr. F. J. Briant, on the anatomy and functions of the tongue of the honey bee. Authorities, it seems, are yet divided in opinion as to how the organ in question acts. Kirby and Spence, Newport and Huxley, aver the bee laps its food; while Hermann Müller and others attribute a full share to the terminal whorl of hairs to which the honey adheres, and therefrom is withdrawn. Mr. Briant, on the other hand, from experiment and study of the structures, is inclined to the view that the honey is drawn into the mouth through the inside of the tongue by means of a complicated pumping action of the organ, aided by the closely contiguous parts.

Chemical Society, April 3.—Dr. W. H. Perkin, president, in the chair.—The following papers were read:—On the influence of certain phosphates upon vinous fermentation, by A. G. Salamon and W. de Vere Mathew. It has been suggested that the addition of phosphates to beerworts stimulates the growth of the yeast-plant and increases the rapidity of attenuation of the wort. The authors find that ordinary English wort contains an excess of phosphoric acid over that which is proved by their experiments to be most favourable to fermentation; hence it follows that the addition of phosphates to wort is not advisable.—On the occurrence of rhabdophane in the United States, by W. N. Hartley. The author shows that a new mineral, scovillite, described by Brush and Penfield in the *Amer. Journ. Sci.*, xxv. 459, is but a variety of rhabdophane. In a subsequent number of the journal, March 1884, the identity of the two minerals is recognised by the above authors.

Geological Society, April 2.—Prof. T. G. Bonney, F.R.S., president, in the chair.—Frank Gotto and George Varty Smith were elected Fellows, and Dr. E. Mojsisovics von Mojsvár, of Vienna, a Foreign Correspondent of the Society.—The following communications were read:—The rocks of Guernsey, by the Rev. E. Hill, M.A.; with an appendix on the microscopic structure of some of the rocks, by Prof. T. G. Bonney, F.R.S. The southern part of the island is a high plateau consisting entirely of gneiss. This is very coarse, and the bedding is seldom well marked. The bedding, when visible, coincides with the foliation, and the author hopes that hereafter an order of succession may be established. At Rocquaine Castle occur a few slaty beds intercalated in the gneiss, the origin of which is somewhat difficult to understand. The northern part, low ground with hummocks, consists principally of a group of crystalline or subcrystalline rocks, in constitution diorites or syenites. They are described by Ansted as sedimentary rocks metamorphosed into syenites; but they show no bedding either in the many quarries, or, in general, in the shore outcrops, nor do their varieties occur in any manner indicating an order of succession. They appear at Castle Cornet to meet the gneiss intrusively, and their microscopic structure is igneous. A remarkable appearance of bedded structure at Fort Doyle is the only strong argument for a metamorphic origin, and this may be explained as a caught-up mass in conjunction with crushing-planes. The author therefore regards them as igneous. An oval area between St. Sampson's and St. Peter's Port is occupied by hornblendic rocks, locally called "birdseye," which may be described as hornblende-gabbros. These also have been called metamorphic. They too, at Hogue-à-la-Perre and another point, present appearances of bedding; but on the same general grounds as for the preceding group these also are regarded as igneous. Two granitic masses are described: the coarse pink granite of Cobo, on the west coast, and the finer-grained gray granite weathering pink of Lancresse, on the north. Each is seen to intrude: the Cobo granite into gneiss at Hommet Barracks, the Lancresse granite into diorite at Fort Le Marchant. Besides these are some smaller masses. Dykes are remarkably abundant and various. Granites and elvans are plentiful everywhere; felsites very rare. The majority of the dykes are diorites, varying in coarseness and often of enormous size; there is also mica-trap. In some of these dykes a cleavage has been developed, so that some resemble slates. Infiltration-veins are abundant. In relative age the gneiss appears to be the oldest rock, the hornblende-gabbro to be next, then comes the diorite group, while the granites are newer still. Of the dykes the newest are the compactest diorites. As to the absolute geological age of the rocks no satisfactory evidence at present is known; it will have to be sought for in the other islands and in France.—On a new specimen of *Megalichthys* from the Yorkshire coalfield, by Prof. L. C. Miall.—Studies on some Japanese rocks, by Dr. Bundjiro Kotô. Communicated by Frank Rutley. The author has studied series of Japanese rocks from the collection of the Tokio University and the Geological Survey of Japan. The microscopical investigation was carried on at the Mineralogical Institute at Leipzig, under the direction of Prof. Zirkel, and the chemical analyses were made in the laboratory of Prof. Knop. The most abundant rocks are the pyroxene-andesites, which are not of a glassy texture, but for the most part holocrystalline. The most abundant mineral in these rocks is a plagioclose felspar with twinned and zonal structure, which is proved, by its extinction-angles and by the chemical analysis of its isolated fragments, to be labradorite. Sanadine is present in small quantities. The augites of these rocks present many peculiarities; they are all decidedly pleochroic; and they exhibit the oblique extinction in basal sections first pointed out by Mr. Whitman Cross, and which is characteristic of triclinic and not of monoclinic crystals. A careful examination of the question has led the author to conclude that the mineral which has lately been regarded as a rhombic pyroxene (probably hypersthene) is really only ordinary augite cut parallel to the optic axis. He does not regard the property of pleochroism as distinctive of hypersthene, while the absence of a brachypinacoidal cleavage and the presence of 10 per cent. of lime in the mineral forbids our referring it to that species. The other abundant minerals in these augite-andesites are magnetite, which is always present, and quartz, which occurs in some of them, both as a primary and a secondary constituent. Hornblende is very rare in these rocks, and when present the peripheral portions of the crystals are seen to be converted into augite, probably by the action of the caustic magma upon them. Enstatite is rare in these rocks, but apatite is always found in them, while tridymite occurs not unfrequently. The author described a number of structural variations in the augite-andesite from different localities. Among the most interesting is a variety containing as much as 69 per cent. of silica. Among the less abundant rocks are the enstatite-andesite, the quartz-augite-andesite, and the hornblende-andesites. The plagioclase-basalts of Japan can only be distinguished from the augite-andesites by the presence in them of olivine. Magma-basalts are rare, most of the varieties being of the dolerite type; but under the name of "basalt-lavas" the author describes varieties with a glassy base. In an appendix some account is given of a number of pre-Tertiary rocks, including granite, one variety of which contains the new mineral, reinite, of Fritsch (the tetragonal form of the ferrous-tungstate), quartz-mica-diorite, diorite-porphyry, and diabase.

Victoria Institute, April 7.—A paper was read by the Rev. J. M. Mello, F.G.S., on the prehistoric flint implements at Speinnes, implements used by man before the mammoth and rhinoceros had disappeared in Europe. The author described the works at Speinnes, and afterwards said there was one question, namely, were these early men of Europe always in the condition in which they appear to have been living, or were they offshoots of the parent stems of humanity, and had their ancestors no higher civilisation?

EDINBURGH

Mathematical Society, April 10.—Mr. Thomas Muir, F.R.S.E., president, in the chair.—Dr. Alexander Macfarlane, F.R.S.E., submitted a note on simple, combination, and cumulative voting, after which Mr. A. J. G. Barclay read a paper on the teaching of geometry.—Mr. Muir gave an explanation of an algebraical theorem communicated by Prof. Tait to the January meeting of the Society.

MANCHESTER

Literary and Philosophical Society, February 5.—Charles Bailey, F.L.S., in the chair.—On the introduction of coffee into Arabia, by C. Schorlemmer, F.R.S.

February 19.—H. E. Roscoe, Ph.D., LL.D., F.R.S., &c., president, in the chair.—Notice of the geology of the Haddon district, eight miles south-west of Ballarat, Victoria, by F. M. Krausé, Professor of Geology in the School of Mines, Ballarat. Communicated by the President.

PARIS

Academy of Sciences, April 7.—M. Rolland in the chair.—An exact or highly approximate calculation of the thrust of sandy masses against their retaining walls, by M. de Saint-Venant.—On the specific heats of water and of carbonic acid at very high temperatures, by MM. Berthelot and Vieille.—Note on Brioschi's theorem respecting symmetrical functions, by M. Sylvester.—Documents relating to the liquid air condensers for several years employed in the piercing of the Mount Cenis Tunnel, by M. A. de Caligny.—Tabulated results of the various circumstances attending electric discharges during the thunderstorms that occurred in France during the second half of the year 1883, communicated by the Minister of the Posts and Telegraphs.—Telegraphic determinations of the differences of longitude in South America, by M. de Bernardières.—Charts of the atmospheric movements passing over Europe in the various *régimes*; remarks on their application to the prediction of storms, by M. A. Poincaré.—Note on the influence of luni-solar attraction on the action of pendulums, by M. A. Gaillot.—On the solar spots observed in Rome during the first three months of the year 1884, by M. P. Tacchini.—Note on the halos of diffused light observed round the sun on March 31 at Auteuil, by M. Ch. Moussette.—On the aspect presented by the Pons-Brooks comet on January 13, 1884, by M. L. Cruls.—Note on an error committed in determining the exact moment of the chief eruption at Krakatoa last year, by M. A. A. Buijskes. This disturbance, generally stated to have occurred a few minutes before noon on August 27, really took place exactly at eight o'clock in the morning of that day. Hence the calculations of the velocities of marine and atmospheric currents based on the former date must be rectified accordingly.—On the principle of the prism of greatest thrust laid down by Coulomb in the theory of the equilibrium of sandy masses, by M. J. Boussinesq.—On the quaternary quadratic formulas, and on the corresponding hyperabelian groups, by M. E. Picard.—On the theory of quaternions in connection with Prof. Sylvester's recent solution of equations in which all the given quaternions are found on the same side as the quaternion sought for, by M. Ed. Weyr.—Note on the application of Faraday's law to the study of the conductivity of saline solutions, by M. E. Bouty.—Note on the verification of the laws of transverse vibrations in elastic rods, by M. E. Mercadier.—Fresh experiments in the liquefaction of hydrogen; solidification and critical point of pressure for nitrogen, by M. K. Olszewski.—On the chief circumstances attending the transformation of superheated octahedral sulphur into prismatic sulphur, by M. D. Gernez.—Quantitative analysis of the phosphoric acid found in arable lands and in rocks, by M. Ad. Carnot.—On the artificial production of fayalite, by M. Alex Gorgeu. The author's experiments show that the protochloride of iron, fused with silica, produces fayalite under conditions in which the chloride of manganese yields tephroite. It appears incapable of producing a bisilicate corresponding to rhodonite, and yields chlorosilicate of iron with difficulty. Highly crystallised magnetite and hausmannite may be obtained under analogous conditions by the fusion of their respective chlorides in contact with the air.—Claim of priority of discovery in connection with recent communications on the vitality of virus and of the yeast of beer; letter addressed to the President by M. Melsens.—Researches on the incubation of hens' eggs in confined air, and on the part played by ventilation in the development of the embryo, by M. C. Dareste.—On the variations of electric excitability and of the period of latent excitement in the brain, by M. H. C. de Varigny.—Note on a Siberian pseudo-meteorite, by M. Stan. Meunier.

CONTENTS