THURSDAY, JANUARY 24, 1884

THE ALPS OF NEW ZEALAND

The High Alps of New Zealand; or, A Trip to the Glaciers of the Antipodes, with an Ascent of Mount Cook. By William Spotswood Green. (Macmillan, 1883.)

THE laborious explorations of Dr. Julius von Haast and his associates, undertaken in 1862 and subsequent years, had, as their results, an excellent sketch map of the New Zealand Alps, and a general knowledge of their topography and geology. It was also made evident that, although the summits did not attain the elevation of many in the Swiss Alps, yet, as they were steep and precipitous, as they rose from valleys comparatively low, and as the snow line descended far below its ordinary level in the Northern Alps, there would be considerable difficulty in scaling the higher peaks. No real attempt on these was made till the year 1881, when Mr. Green decided to try his hand at mountaineering in New Zealand.

It was of course necessary for any one contemplating glacier excursions to take guides from Europe. Mr. Green was fortunate enough to secure the services of Emil Boss and Ulrich Kaufmann, both well known guides from Grindelwald. His narrative shows that he could not have made a better choice—the two men proved to be not only first rate mountaineers, but also pleasant and trustworthy companions, always uncomplaining and unselfish.

Mr. Green must have begun his journey under an unlucky star. Small-pox broke out on board among the forecastle passengers before they reached Table Bay. On arriving in Australia, all were put in quarantine for some three weeks, where, we may add, the arrangements for the reception of the unfortunates appear to have been disgracefully bad. Then, when Mr. Green escaped from this bondage just in time to catch the New Zealand steamer, it happened to be full, so that altogether more than a month of valuable time was lost.

At last, after touching at one or two spots on the western coast of the Southern Island, Mr. Green landed at Christchurch, and, after a brief consultation with Dr. von Haast, hastened to push up the country towards Mount Cook. The physical structure of the Southern Island is comparatively simple. A map of it bears some resemblance, except for the smallness of the scale, and the greater height of the mountains, both relative and absolute, to the southern part of the Scandinavian peninsula. The watershed—that of the Southern Alps—lies comparatively near to the western coast, and runs roughly parallel with it; between these is a mountain land, pierced with beautiful fjords, especially towards the south, and covered with dense and generally impenetrable forest; on the eastern side, between the main range and the sea, is a comparatively level district; a zone of lakes borders the mountain region, similar to that on the southern flank of the European Alps; and the lowlands extend far into the recesses of the peaks. The Tasman valley, for example, which runs up to the glacier of the same name in the very heart of the chain beneath the peak of Mount Cook, is described by Mr. Green as an immense flat, from which the mountains rise as from a shore. The end of the glacier being 2400 feet above the sea, the average fall of the river is about 25 feet to a mile. Mount Cook, which attains an elevation of 12,349 feet above the sea, is the culminating point of the Southern Alps, but there are several fine peaks near it which are not very much lower. A grand group of glaciers descends from these, of the beauty of which Mr. Green speaks in enthusiastic terms.

The mountains of New Zealand are of great interest to the student of physical geography. The latitude of Mount Cook corresponds with that of Florence in the northern hemisphere, but the mean annual temperature of the Southern Island is 10° lower than that of corresponding latitudes in Western Europe. There is, however, much less difference between the extremes. For instance, the mean summer temperature of Dunedin (lat. 45° 50′) is 57°·2, the mean winter 50°·7 F. The rainfall on the eastern coast is much the same as on the English lowlands, being 33 inches at Dunedin and 25 inches at Christchurch; but on the western coast, at Hokitaka, it is 118 inches. Thus the snowfall on the mountains is heavy, and the line of permanent snow is full three thousand feet lower than on the Alps. Hence the glaciers descend far below the level of those in Switzerland, coming down on the western side at one place to within 670 feet of the sea-level, while on the eastern they terminate at about 2000 feet; on this side, however, the limit of perpetual snow is about 750 feet lower than on the western. On the whole the area covered permanently by ice and snow in the Southern Alps is about 160 square miles, or 20 more than that in the Bernese Oberland. The Great Tasman Glacier is eighteen miles long, thus exceeding the Great Aletsch by three miles; further it is two miles wide at the end, while the other does not exceed a mile in any part.

The Southern Alps present another very singular feature. To the south of Mount Cook the chain is severed by a singular flat-topped pass—named after Dr. von Haast—the ill-marked summit of which is only about 1600 feet above the sea; yet to the south of it again the mountains rise rapidly, and attain elevations of full ten thousand feet. Thus a depression of a couple of thousand feet would convert the Southern Island of New Zealand into two mountainous islands, divided by a narrow channel, just as the Raftsund parts Hindö and Vaagö in the Lofotens.

The Alps of New Zealand are more ancient than those of Europe, as they were probably uplifted in Jurassic times. The oldest rocks—granites (or possibly in part granitoid gneisses) appear on the western side; these are overlain by crystalline schists, to which succeed slates, grits, &c., of Silurian and later ages. Probably when this district is fully surveyed the New Zealand Alps will be found to consist of a series of Archæan rocks overlain by sedimentary deposits of considerably later date. The highest rock on Mount Cook appears to be a quartzite, and Mr. Green mentions the occurrence, lower down the mountain, of some volcanic tuffs.

For Mr. Green's adventures during the ascent of Mount Cook we must refer readers to his volume. Suffice it to say that this proved to be no easy task. The difficulties were twofold: those of conveying the necessary supplies of food and covering to a sufficiently elevated bivouac, and those presented by the mountain itself. The former of course will be overcome as the country is opened up, but it is evident that Mount Cook is equal in difficulty to most of the first class Alpine peaks. Mr. Green first attacked it by the southern ridge, but, after reaching a height of 7500 feet, found that route impracticable. An attempt was then made to reach the north-eastern face of the mountain by a route which also had to be abandoned. Mr. Green then mounted by a ridge on the left bank of the Hochstetter Glacier, and, after bivouacking at a height of about 7000 feet, succeeded in attaining the summit by a circuitous and difficult climb near the ridge connecting Mount Cook with Mount Tasman. His usual ill-fortune pursued him. The weather was bad, as it seems often to be in these parts—and the approach of night compelled him to return without actually setting his foot on the very highest point. The ascent however was practically accomplished, only a slight detour to avoid a crevasse and a little more plodding along a snow ridge remained; but even the quarter of an hour or twenty minutes which this would have added to the expedition could not be spared. The summit of Mount Cook is not the place on which to spend a night in bad weather, nor is it a peak which can be descended in the dark. As it was, notwithstanding their utmost exertions, the travellers were compelled to halt for the night at an elevation of some 10,000 feet above the sea, on a ledge so dangerous that they dared not sleep—even one at a time!

Mr. Green afterwards visited the neighbourhood of Mount Earnslaw, a high peak south of Haast Pass, but his usual ill-fortune pursued him, and the weather prevented him from doing more than make a reconnaissance.

We lay down this volume with regret that the Fates were not kinder to Mr. Green in giving him the opportunity of writing a longer tale of adventure. He tells his story so well and pleasantly that we regret he could not carry further his explorations of New Zealand peaks and glaciers. He is evidently a close observer and devoted student of nature, so that without any attempt at book-making he has contrived to incorporate with his narrative many interesting facts relating to the natural history and physiography of these remarkable islands, which raises his work far above the level of an ordinary book of travel.

T. G. BONNEY

DOBSON'S "MONOGRAPH OF THE INSECTIVORA"

A Monograph of the Insectivora, Systematic and Anatomical. By G. E. Dobson, M.A., F.R.S. Parts I. and II. 4to. Pp. 1-172, 22 Plates. (London: Van Voorst, 1882-83.)

THE Insectivora constitute an order of Mammals at the same time but little known and of great scientific interest. Until recently they were not considered an attractive group. Small in size, shy and retiring in habits, difficult of capture, none of them of commercial value or capable of domestication, they have received little notice even from professed zoologists, and to the general public their existence, except in the case of two or three of the commonest species, has been almost unknown. The fact, however, on which Prof. Huxley insisted many years ago, in his lectures at the College of Surgeons, that in this order we find some of the most generalised members of the Eutherian or placental Mammals, little-modified representatives of what appear to be ancestral forms, whose study is an excellent introduction to a knowledge of the more modified or specialised members of the class, has done much to elevate them in the eyes of naturalists who are seeking the key to unlock the history of the evolution of the Mammalia. Mr Dobson, whose excellent work in the Chiroptera is familiar to all zoologists, has done well then to take up the Insectivora, and to give us, for the first time, a thoroughly reliable and exhaustive monograph upon them.

Aided by wisely-bestowed grants from the Government Fund administered by a committee of the Royal Society, and with the assistance of numerous scientific friends, he has been enabled to collect abundant materials, and publish the results of his investigations in a copiously illustrated form. To facilitate comparison and avoid repetition, Mr. Dobson commences with a detailed account of the anatomy, paying especial attention to the myology, of two species, *Gymnura rafflesi* and *Erinaceus europæus*, which have been selected, the former as the nearest representative of an undifferentiated Eutherian, and the latter as being a well-known species, easily obtainable for examination. With these the anatomy of the species subsequently described is compared and contrasted. With regard to the general classification of the group, a knowledge of which can of course only be obtained from a thorough examination of their structure, Mr. Dobson has wisely reserved his views until the work is completed, adopting provisionally that which has been gradually elaborated by Peters, Mivart, and Gill.

The two first parts of the work already issued contain the families *Erinaceidæ*, *Centetidæ*, *Solenodontidæ*, *Potamogalidæ*, *Chrysochloridæ*, and *Talpidæ*, each family, genus, and species being treated of fully, both anatomically and zoologically. The difficult group *Soricidæ*, as well as the *Macroscelidæ*, *Tupaiidæ*, and the aberrant *Galeopithecidæ*, will form the subject of the third and concluding part. If this part should be, as we have every reason to believe it will, equal to its predecessors in thoroughness of detail and beauty of illustration, we shall have a work which will do great credit to its author, and rank among those solid contributions to knowledge which form landmarks in the progress of science.

W. H. FLOWER

OUR BOOK SHELF

Manual of Mathematical Tables. By the Rev. J. A. Galbraith and the Rev. S. Haughton, F.R.S. (London: Cassell, Petter, and Galpin.)

"NOW what so pleasing can there be, if a man be mathematically given, as to calculate or peruse Napier's logarithms, or those tables of artificial sines and tangents, not long since set out by mine old collegiate, good friend, and late fellow-student of Christchurch in Oxford, Mr. Edmund Gunter, which will perform that by addition and subtraction only which heretofore Regiomontanus's tables did by multiplication and division?" We shall not take up the cudgels against quaint old Burton, but will simply say that, for those to whom the subject is a "pleasing" one, here is an exceedingly handy and neatly got up manual, whose *raison d'être* is justified by its having reached a fourth edition. If our readers are "philosophers," they will not require an account of what logarithms are (see Mr. Glaisher's excellent description in the "Encyclopædia Britannica," vol. xiv.); if they are not, with Mr. Squeers we say, "Then I am sorry for you, for I sha'n't be able to explain them."

The tables, are in the main, five-figure tables, except that the logarithms of 1001 to 1100 are given to seven places, and in the case of the logarithms of numbers extend to the logarithm of 10000. The other tables are logarithms of sines and tangents to every minute of the quadrant, and Gauss's sum and difference logarithms. Besides, there are a capital introduction, tables of useful constants with their logarithms, and solutions, by trigonometrical tables, of quadratic and cubic ($x^3 \pm px \pm q = 0$) equations. There are no tables of natural sines and tangents. We have no hesitation in commending these tables to a still wider public than they have already reached. R. T.

Principles of Theoretical Chemistry. By Ira Remsen. (Philadelphia: H. C. Lea's Son and Co., 1883.)

UNFORTUNATELY for some years past we have been treated with an immense number of "books" on chemistry in England of a most mechanical type: books in which no reasoning theory is apparent. A dry epitome of facts in a most unpalatable shape, embellished here and there with formulæ of various kinds, graphic, symbolic, empiric, or glyptic, but in very rare cases any attempt at showing the learner, easily, how these ideas of chemical constitution, represented by formulæ, are clearly arrived at. If a student is unable to see, in his mind, how the formula H_2SO_4 represents *a* knowledge of the constitution of sulphuric acid, he had much better only know its percentage composition, as it may otherwise lead him wrongly.

From the style of the present work, and some others we have recently seen from the other side, our cousins are taking up chemistry in a more philosophic manner than ourselves. And it is easy to see whence this view comes. Considering that we own a Dalton it is strange that the development of chemical theories is so lightly treated in English text-books. Are English students so superficial or so under the domination of *Exams.* that a work like Kopp's "Entwickelung" is too much for them?

This very condensed little work, just over 200 pages, is intended for somewhat advanced students who have a basement of facts to build upon. It commences with a general discussion of atoms and molecules, which is continued in a very simple and clear manner, with the exception of a few *newish* words like *chemism*. The chapters on atoms and molecules and on valency are about as clear and simple as they can be made, and the same may be said in regard to the opening chapter on carbon compounds. The author has evidently a reasonable notion of the value and permanence of a chemical theory, and no exception can be taken to the manner of discussion or expression. Speaking, for instance, of Avogadro's hypothesis, the author says: "It is at present almost universally accepted by chemists, some, indeed, going so far as to speak of it as a *law*." It is certainly one of the best additions to the list of *small* chemical books that has been made for some time.

Studies in Micrographic Petrography. (Ady and Hensoldt, 7, Muchell Road, Nunhead, S.E.)

THE growing interest taken in this country in the study of petrography is well shown by the rapidly increasing facilities offered for the prosecution of this branch of science. The most recent of these has just appeared under the foregoing title. It is to consist of the issue of two dozen microscopic slides of characteristic minerals and rocks prepared by Mr. Hensoldt of Wetzlar, with illustrative drawings and descriptive text by Mr. J. E. Ady, who is already favourably known for his microscopic preparations of British rocks. The first number of the "Studies" is devoted to "*Eozoon*, Led Beg, Sutherland." It contains two lithographic plates illustrative of the so-called eozoonal structure of a limestone in the north of Scotland, and four pages of descriptive text. The author gives a brief reference to the literature of the subject, and an account of the microscopic structure of some portions of the limestone in question, which he regards as akin to that of the Canadian *Eozoon*, but as being of inorganic origin. We are afraid his sketch is too slight to have much weight in the controversy regarding *Eozoon*. His effort to extend the opportunities of petrographical investigation, however, and to popularise this fascinating but difficult branch of geology is praiseworthy, and we hope that his "Studies" may meet with such success as may induce him to continue them.

LETTERS TO THE EDITOR

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

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

The Remarkable Sunsets

THE numbers of NATURE for October, which are the latest to be seen here at this date, contain in the correspondence accounts of the green appearance of the sun in India. Some solar phenomena observable at present and during the whole of the past month are probably related to these, and yet are sufficiently distinct to deserve a separate description. They have, indeed, attracted the attention of everybody here by their novelty and spectacular magnificence, and to some have an ominous significance in connection with recent seismic disturbances.

In November and December we have in this part of Japan a remarkably clear atmosphere, and this year has proved no exception. The great snow-capped mountain, Fujii, some ninety miles away to the west, is beautifully defined to view both at sunrise and sunset on most days, although during the greater part of the year—the warmer part that is—it is rare to catch a glimpse of it.

The phenomena of which I wish to record a description occur every day before and after sunset and sunrise, and serve to materially lengthen our day. In this latitude, although not in the tropics, the shortness of the twilight is very noticeable as compared with that of England, but at present at least an hour and a half elapses between the moment of sunset and that of the disappearance of the last of its rays, and this, with the same time between dawn and sunrise, causes our day to be very appreciably lengthened.

On some days there is round the sun, even while it is still high, a considerable area of silvery glare, 40° to 50° in diameter, and bordered by a lurid reddish-brown or purplish-brown halo. A similar lurid turbidity lies in the horizon, and as the sun descends the halo blends with this below, while above the sun it attenuates and disappears, the silvery glare remaining undiminished. When the sun sets there is still a nearly circular area of this intense glare with a diameter of about 12°. On other days there is before sunset only a thin silvery light round the sun diffusing away from it, and only about and after the setting is the more defined area of strong light strikingly visible, and on these days the horizon also shows little of the dull redness mentioned above. Besides the above peculiarities, the sun preserves its whiteness much more than usual, so as to be only golden orange when setting.

Now follow the more remarkable phenomena. The white glare, or patch of silvery light, gradually sets, spreading out along the horizon as it does so, and passing through the sunset colours until little more than a red line one or two degrees deep remains. This happens at about twenty minutes after sunset. At this moment, on the gray curtain of twilight appears a white luminosity, which rapidly intensifies over the sunset, and shades away over almost half the visible hemisphere. The brightnes over the sunset becomes vividly brilliant, and at the same time delicately coloured. Over a somewhat depressed circular area, about 12° high and 15° broad, it assumes a pale green tint. Above this comes an equally dazzling pale yellow-orange, and again above this a soft rose colour melts away to the zenith. The revival of the light, or return from commencing twilight, is peculiarly striking. Buildings become brilliantly illuminated, and strong shadows are cast. All this outglow occurs in no more than five minutes, and now continues for about a quarter of an hour, but the brilliancy gradually contracts in area and sets with a magnificent display of sunset colours reaching some 120° round the horizon, until, by fifty minutes after sunset, this light has also gone down to a red line of about 2° elevation. I should not have omitted to say that the green light passes to yellow.

By this time night has fairly well come in the eastern half of the heavens, but already another but more delicate silvery whitening begins to show itself on the western curtain, and this also diffuses very rapidly up to the zenith and round to north and south. It also then goes through a process of contracting, intensifying to considerable brightness, and gradually passing through the sunset colours. Night is now full—with or without moonlight, according to date—and from the west, or rather from a point well to the north of it, spreads a delicate but brilliant light, having an almost perfect resemblance to the burning of a vast distant city. The last crimson light of this reflection does not disappear till an hour and a half after sunset.

The phenomena I have attempted to describe cannot possibly, I think, be explained otherwise than as being the effects of reflection, and that from a canopy many miles above the earth's surface. The matter of this canopy is highly transparent, for not only are moon and stars brilliantly clear, but in the crescent moon the dark surface of its sphere was on some nights in both months visible and so distinct as to have been noticed independently by several persons. (It has been suggested that this greater visibility of the dark surface of the moon may be due to a stronger reflection from the present atmosphere of the earth.) The reflecting matter must, I suppose be water, but in what form and under what conditions it is there so high up day after day in varying weather, it is difficult to me to conceive. We have had wet days intervening, cloudy days, and very windy days, but on all occasions, except during rain, the phenomena have been visible with strange uniformity.

Not counting the setting of the silvery glare twenty minutes after sunset, which ought perhaps to be done, there are, it will be seen, two reflected sunsets following the true one. In the morning before sunrise the same phenomena in inverse order are perhaps still more remarkable to see. Indeed the whole phenomena, night and morning, have a most unnatural and magical appearance, very different from those of the ordinary sunset and sunrise.

One other phenomenon, also of reflection, has yet to be mentioned. Rarely with much distinctness, but always to be noticed, there appears high up in the *east*, just after the silvery glare following the sun has set, and lasting only a few minutes, a dim image of the white glare and the western horizon just after sunset. It is of a delicate rosy light, with a grayish central part.

I am informed that somewhat similar appearances are being seen in Shanghai. EDWARD DIVERS

Imperial Japanese College of Engineering, Tokio,
December 12, 1883

IF the red sunsets are to be attributed to smoke and dust in the atmosphere from volcanic eruptions, as seems likely from the contributions in the last number of NATURE at hand (December 20), then it becomes important to take into account other eruptions which may have happened simultaneously with or since that of Krakatoa on August 27, 1883. In any discussion of atmospheric currents as fixing the dates of the appearance of these sunset phenomena at different places this is of special importance, in order that no confusion may arise in trying to reconcile places and dates that may refer to dust and ashes brought from entirely distinct eruptions. For this reason I send you the following extracts.

The first is from the U.S. Signal Service *Monthly Weather Review* for October, 1883, and is as follows :—

"*Unalaska, Alaska, October* 22, 1883

"*Executive Officer, Signal Service, U.S.A., Washington, D.C.*

"SIR,—I forward by this mail a sample bottle of sand that fell during the storm of October 20, 1883.

"At 2.30 p.m. the air became suddenly darkened like night, and soon after a shower of mixed sand and water fell for about ten minutes, covering the ground with a thin layer. The windows were so covered that it was impossible to see through them.

"This sand is supposed to have come either from the Menkushin or the new volcano adjacent to Bogoslov. The former is at a distance of about nineteen miles south-west, but for years has only issued forth smoke or steam. The latter is a new one, which made its appearance this summer, and burst out from the bottom of Behring Sea. It has been exceedingly active, as it has already formed an island from 800 to 1200 feet high.

"According to the report of Capt. Anderson, the discoverer, who sails one of the company's vessels, and who went within 2000 yards of it, it presents a most magnificent sight. The fire, smoke, and lava are coming out at many crevices, even under the water line. Large boulders are shot high in the air, which, striking the water, send forth steam and a hissing sound.

"Bogoslov is about sixty miles from here, in a westerly direction. The new volcano is about one-eighth of a mile north-west of it. "I am, Sir, very respectfully,
"S. APPLEGATE,
"Sergt. Sig. Corps, U.S.A."

The other extract is from a recent paper as follows :—

"*San Francisco, Cal., December* 28, 1883

"Prof. Davidson received from Alaska to-day the particulars of the volcanic disturbances there in October last, near the entrance to Cook's Inlet. On the morning of October 6 a settlement of fishermen on English Bay heard a heavy report, and, looking in the direction from whence the sound came, immense volumes of smoke and flame were seen to burst forth from the summit of Mount Augustine. The sky became obscured, and a few hours later great quantities of pumice dust began to fall, some of it being fine and smooth, and some gritty. At half-past three o'clock on the same day an earthquake wave thirty feet high came rushing in over the hamlet, sweeping away all the boats and deluging the houses. The tide at the time being low saved the settlement from utter destruction. This wave was followed by two other waves eighteen feet high, which were succeeded at irregular intervals by others. The pumice ashes fell to a depth of five inches, making the day so dark that lamps had to be lit. At night the surrounding country was illuminated by flames from the crater. Ordinarily Mount Augustine is covered with snow, but this year it is completely bare. Upon examination after the disturbances had subsided, it was found that the mountain had been split in two from base to summit, and that the northern slope had fallen to the level of the surrounding cliffs. Simultaneously with the eruption, a new island made its appearance in the passage between Chernaboura Island and the mainland. It was seventy-five feet high, and a mile and a half long. So violent was the volcanic action that two extinct volcanoes of the Peninsula of Alaska, lying to the westward of the active volcano Iliamua, 12,000 feet high, burst into activity, and emitted immense quantities of smoke and dust. Flames were visible at night. It is stated that the wives of a party of Aleut Indians, who were engaged in otter-hunting in that locality, became afraid of the subterranean noises, and refused to stay, returning to their homes. None of those who remained can be found."

The approximate positions of some of the points mentioned in these reports are as follows :—

	Lat.		Long.
Iliamua...	60·1 N.	...	153·1 W.
Mount Augustine...	59·5 N.	...	153·5 W.
Unalaska	53·9 N.	...	166·5 W.
Bogoslov	54·0 N.	...	168·0 W.

Here we have the record of (1) a new volcano which appeared near Bogoslov some time during the summer, and had been continuously active and thrown up an island 1000 feet high up to some time in October ; (2) an explosive eruption of Mount Augustine on October 6, which split off the whole side of the volcano and distributed ashes to a depth of five inches many miles away, and started a wave in the ocean about thirty feet high ; and (3) of a shower of sand and water on October 20 at Unalaska, which probably arose from some fresh or renewed eruption of a neighbouring volcano.

Many of these phenomena resemble those reported from Krakatoa, though on a smaller scale. It is not necessary to point out that a continuous eruption of a new volcano for weeks or months would probably eject as much or more dust and ashes than accompanied the Krakatoa convulsion, though not to so great a height. If, however, Mr. Preece's theory of electric repulsion of the dust particles be true, then the finest of them, if highly electrified, might rise to great heights, independent of the force of ejectment from the volcano.

In this connection it is well to remember that there may have been many other volcanic outbursts during the last few months, of which we have not yet heard, and perhaps never may. The whole chain of islands from Java to Alaska, including the Philippines and Japan, is full of volcanoes, and seems to be a sensitive seam in the earth's crust. A convulsion like that of Krakatoa is likely to be accompanied or followed by others along this line, the northern portion of which is only visited by otter-hunters.

Without presuming to question the theory as to the rapid transmission of Krakatoa dust by the upper currents of the atmosphere until we see the evidence on which it rests, it occurred to me that the above considerations might possibly modify or supplement it in some degree.

Referring to the remarkable results deduced by General Strachey, showing an atmospheric wave travelling three times round the globe from the Krakatoa eruption, which seems to be of even more scientific interest from a physical point of view than the transmission of the dust and ashes, and which deserves a thorough and careful re-examination when the data are in from all available barometric records, I would say that I have been kindly allowed to examine the barometric records of the Signal Office here at Washington, and I find no trace of any such disturbance following the reported Alaskan eruptions of October 6 and October 20. In connection with the record of the waves following the Krakatoa catastrophe there are some interesting points which I wish to examine more carefully before discussing them. H. M. PAUL

Washington, January 8

REFERRING to Mr. Burder's letter in NATURE of January 10 (p. 251), is it so certain that, if there be no resisting medium in interplanetary space, the whole of the earth's atmosphere must "rotate with the earth as if it were part and parcel of it"? Take a stratum of the atmosphere at, say, forty-five miles in altitude at the equator. According to the received theory, this ought of course to move with a velocity greater than that of the surface of the earth immediately below. But each successive inferior stratum moves with less velocity. And thus they must tend to retard the superior strata with which they may be assumed to be in contact. Of course the merging of stratum into stratum is gradual, but this does not affect the amount of friction and retardation.

In like manner, imagine a section of the atmosphere taken along the equator. Sections taken along successive parallels of declination north and south would tend to retard the velocity of this central layer.

These two causes combined might have a considerable effect in retarding the velocity of the upper atmosphere in equatorial regions. And it seems to me doubtful whether the upper atmosphere near the poles would be actually carried round with each terrestrial rotation. The rarity of the upper regions of the atmosphere and the lessened force of gravity would both help towards the result indicated, inasmuch as they would tend to make the atmosphere less rigid.

As I am writing, I venture to make another suggestion. Gilbert White mentions that in the summer of 1783, when, as at present, the atmosphere was filled with dust consequent on volcanic eruptions, and "a peculiar haze or smoky fog prevailed for many weeks in this island and in every part of Europe, and even beyond its limits," "all the time the heat was so intense that butchers' meat could hardly be eaten the day after it was killed, and the flies swarmed so in the lanes and hedges that they rendered the horses half frantic, and riding irksome." May not the present May-like weather be due to a like cause? Sweet violets, primroses, wallflowers, roses, and several other flowers are now blooming in my garden under the Cleveland Hills.

Had the halos round the moon seen here last and the previous night any possible connection with the dust in the atmosphere? I computed the diameter of the inner dirty white to be twice, the dirty orange one and three-quarters, and the outer green three and a quarter times the moon's apparent diameter.

JOHN HAWELL

Ingleby Greenhow Vicarage, Yorks, January 15

I THINK a few notes relating to the recent sunsets may still have an interest for some readers of NATURE. Notwithstanding the length of time these remarkable phenomena have been apparent, the sunsets of January 11 and 12 were as brilliant as regards the *second* after-glow as any that have preceded them, the final glow having lasted on the 12th till 5.55; while the sun set that evening at 4.12.

The pink halo so often seen of late could not be discerned that day though the sky was cloudless; but it has been often visible when clouds partly obscured the sun, or portions of the sky, and could then be recognised between them, separating the blue of the remoter sky from the whitish light surrounding the sun, as a ring-formed glow of a strong pink colour.

These broad pink halos have been less commented on than the splendid sunsets which have invariably succeeded them, but they have been nearly as persistent in their presence. You have had so many accounts of the succession of colours and effects of the two after-glows, that I will not allude further to them here; but as I have retained a record of many remarkable sunsets and sunrises which I observed in Wales in former days (possibly the very same mentioned by Prof. Piazzi Smyth in NATURE, December 13, 1883, p. 149, as observed by him thirty years ago), and as I carefully noted in them the time and hour of the changes in the sky down to that of the complete extinction of the after light, it may interest others than myself to compare displays of that date with those of this winter.

What is worthy of especial interest is the great difference between the periods of prolongation then and now of the illumination of the western sky, showing that the second after-glow of recent sunsets is a phenomenon distinct from and additional to those belonging to normal sunsets.

The following table exhibits the two series of observations made in 1855, 1856, 1857, and in 1883–84 respectively:—

Date	Sunset at	First after-glow or cone of pink light				Second after-glow in 1883-84, which begins as the first after-glow sets
		Appears as sunset colours are fading	Brightest at	Sets: 1st series, 1855-56-57	Sets: 2nd series, 1883-84	
Nov. 11, 1856 ...	4.13 }	4.50	4·57	5.10		
,, 12, ,, ...	4.14 }					
,, 23, 1855 ...	...	...	...	4.55		
Dec. 7, ,, ...	3.50	...	...	4.20		
,, 8, ,, ...	...	...	...	4.20		
,, 10, ,, ...	...	...	...	4.20		
,, 11, 1883 ...	...	...	...	...	about 4.45	5.45
,, 14, ,, ...	...	...	...	...	...	5.45
,, 15, 1856 ...	...	4.15	4·21	4.35		
,, 18, ,, ...	...	...	4.20	4.30		
,, 19, ,, ...	3.50	...	...	4.30		
,, 24, 1883 ...	3.53	...	...	...	about 5.0	5.45
Jan. 11, 1884 ...	4.13	...	...	...	,, 5.0	5.40
,, 12, ,, ...	...	...	...	...	,, 5.0	5.55
,, 15, 1857 ...	...	4.50	...	4.55		
,, 16, ,, ...	...	...	...	5.0		
,, 19, ,, ...	...	...	5.10	5.18		
,, 26, ,, ...	...	...	5.20	5.25		
Feb. 8, ,, ...	5	...	...	...		

The colours associated with the actual sunset are quite in accord in both.

The first after-glow, or pink cone or dome of light appearing after the sunset colours have nearly faded, is also similar in both series, but its time of setting has been apparently somewhat prolonged in the recent observations.

It is the 1883-84 series alone, however, that shows the *second* after-glow, and the duration of this strange phenomenon, which I have the advantage of observing over a wide bird's-eye view in North Wiltshire, has extended on evenings when it could be well observed to about one hour after the first after-glow had disappeared below the horizon. The exact moment of this disappearance has been more difficult to determine than in the earlier observations where darkness followed; as recently the heavens and the earth have been reilluminated just as the natural night would have begun. T. STORY-MASKELYNE

Salthrop, January 13

As the "halo" exactly opposite the sun, reported by Mr. T. W. Backhouse in NATURE, January 10 (p. 251) may prove to be of considerable importance, I beg to add my observations of it on the 12th. I had noticed a mass of ruddy colour under the given conditions, previously, but had not detected its strange nature. The sunset on the 11th was very fine. The 12th, until after sunset, was cloudless, except for the hazy masses which seem to precede every sunrise, and, more especially, sunset, at present. Our sunshine record is an unbroken scorch from 9.15 a.m. to 2.52 p.m. (sun seen clear of horizon at 8.26, and touched at 4.0); I doubt if, previously, we have recorded even five hours in early January. At 7.45 a.m. on the 12th (sun rose at 8.22) the cloud-glow had turned to silvery green below, and rose from 15° to 30° in the south-east. At 7.47 the rose reached 60°, but was fainter. I first noticed the "halo" at 7.52. It was then so well defined that, calling a lady's attention by asking what she saw there, she spoke of it as "a broad rainbow." Position, by compass, 30° north of west. It was a semicircle situated 10° above the horizon, standing on the dark gray arch of dawn, Jupiter being on a line with the base of the left end of the rosy arch. The inner arc of this measured 10°, and the outer 24° in radius, but it spread out to 30° at the base. The centre was of the same blue as the sky to the right and left of the rosy semicircle, above the gray. The base, sinking faster than Jupiter, spread out so that, at 8 o'clock, the arch having now broken above, its outline was rather like a railway chair. The base now reached from west-north-west to north-north-west by north. After sunset there were signs of a similar phenomenon, but clouds prevented certainty.

Is not *fifty* miles an underestimate for the altitudes of the light-reflecting material? If Mr. Symons is nearer the mark in his suggestion (100 to 200 miles), then more than half of the eastward velocity of the original erupted dust is accounted for by retardation, due to matter having velocity belonging to an earth radius of 4000 miles, revolving in a circle of 4100 to 4200 miles radius. Would it need an eruptive force of more than two to four miles per second (six to twelve times greater than a cannon ball) to attain such altitudes? The constant uprush would minimise the air-resistance enormously.

York, January 14 J. EDMUND CLARK

P.S.—January 15.—This morning, at 7.47, the "halo" began to form, but was not nearly as perfect as on the 12th. The arch (upper part only) was *rayed*, as if it were the opposite point of sight for rays from the sun. All over before 8, or fully twenty minutes before sunrise.—J. E. C.

WITH reference to Herr Wetterhan's inquiry as to the absence of the sky-glow in a clear sky at other places than Freiburg on the morning of January 11, I find that at San Remo, in Northern Italy, where I spent the week ending on that day, a similar falling off of effect occurred at the same time. The sunrise was "very fine, but nothing to compare with the sunset of yesterday," and "the filmy streaks were very thin, and stretched this morning from south-west by south to north-east by north." Nevertheless there was the strange bluish-white glare above the eastern horizon, casting shadows, and a thin pink film up to about 75° at 28 min. before sunrise. The sunset glow of this day and of the day before was magnificent, the procession of colours beginning about 15 min. after sunset, and lasting a full hour. I see that your Constantinople correspondent also mentions the sunset of the 11th as a remarkably fine one. The air on the 10th, not the 11th, as at Freiburg, was wonderfully transparent at San Remo, the whole range of Corsican mountains, over eighty miles distant, standing out sharply for 15 min. before and after sunrise, and the sun himself bursting forth in great splendour from below the sea line.

London, January 19 F. A. R. RUSSELL

Unconscious Bias in Walking

SOME ten or twelve years ago I made some experiments upon the subject of Mr. Larden's letter in NATURE (Jan. 17, p. 262), namely, unconscious bias in walking. The experiments were not numerous, but they left no doubt in my mind as to the cause of divergence from a straight path. My notes were sent, at my father's suggestion, to the late Mr. Douglas Spalding, who was about to undertake experiments on the curious power which animals have of finding their way. I rather think he made some trials with pigs, but I believe he never published anything on the subject. In stating my results I am compelled therefore to rely on memory only.

I began with walking myself, and getting various friends to walk, with eyes shut in a grass field. We all walked with amazing crookedness in paths which were not far removed from circles. I myself and Mr. Galton on the first trial described circles of not more than fifty yards in diameter, although we thought we were going straight, and afterwards I was generally unable to impose a sufficiently strong conscious bias in one direction to annul the unconscious bias in the other. I believe we all diverged to the right excepting one of us who was strongly left-handed.

I then got eight village schoolboys, from ten to twelve years of age, and offered a shilling to the boy who should walk straightest blindfold. Before the contest, however, I dusted some sawdust on the ground, and after making each of the boys walk over it, measured their strides from right to left and left to right. They were also made to hop, and the foot on which they hopped was noted; they were then made to jump over a stick, and the foot from which they sprang was entered; lastly, they were instructed to throw a stone, and the hand with which they threw was noted. Each of these tests was applied twice over.

I think they were all right-handed in throwing a stone, but I believe that two of them exhibited some mark of being partly left-handed. The six who were totally right-handed strode longer from left to right than from right to left, hopped on the left leg, and rose in jumping from that leg. One boy pursued the opposite course, and the last walked irregularly, but with no average difference between his strides. When told to hop, he hopped on one leg, and in the repetition on the other, and I could not clearly make up my mind which leg he used most in jumping. When I took them into the field, I made the boys successively take a good look at a stick at about forty yards distance, and then blindfolded them, and started them to walk, guiding them straight for the first three or four paces. The result was that the left-legged boys all diverged to the right, the right-legged boys diverged to the left, and the one who would not reveal himself won the prize. The trial was repeated a second time with closely similar results, although the prize-winner did not walk nearly so straight on a second trial.

I also measured the strides of myself and of some of my friends, and found the same connection between divergence and comparative length of stride. My own step from left to right is about a quarter of an inch longer than from right to left, and I am strongly right-handed.

Comment on these experiments seems needless, and they entirely confirm Mr. Larden in his view.

It seems to be generally held that right-leggedness is commoner than the reverse; this I maintain to be incorrect. I believe that nine out of ten strongly right-handed persons are left-legged. Every active effort with the right hand is almost necessarily accompanied by an effort with the left leg, and a right-handed man is almost compelled to use his left leg more than the other. I believe that Sir Charles Bell considered that men were generally right-legged, and sought to derive the custom of mounting a horse from the left side from the fact that the right leg is stronger than the other. I suggest as almost certain that we mount on that side because the long sword is necessarily worn on the left, and would get between our legs if we went to the off-side of the horse. Some of your readers may perhaps be able to tell us whether the Chinese do not wear their short swords on the right and mount their horses from the right.

I will not hazard a conjecture as to why the rule of the road in Great Britain, and inside of the towns of Florence and of Salzburg (?), is different from that adopted by the rest of the world. For an armed horseman the English rule is, I presume, more advantageous, both for attack and defence.

January 20 G. H. DARWIN

THE question whether a man will walk to the right or left in a mist, in darkness, or if blindfolded, has led to no little controversy and dispute. Almost every conceivable reason has had its advocates for the fact that some men persistently turn to the left, and others to the right, when walking without the aid of sight. I am familiar with some ambidextrous men, and about the same number of left-handed men, but I cannot recall a single instance of a left-legged man, and think they must be somewhat rare. In the present question it might, perhaps, be well to put aside peculiarities of the arms—as occupation and education enter very largely into the method of their use—and confine observations to the legs alone. Mr. Larden has, I think, very nearly arrived at the solution of the problem with his definition of right or left strong-legged men circling to the right or left respectively. I take exception, however, to his referring the peculiarity to the *strength* of the limb, and think the following suggestion may afford help in the matter, being founded upon observations, and providing a reason for circling in walking in either right- or left-legged men:—It has been frequently remarked of late years that short-leggedness on one side or the other is of common occurrence—the cause is doubtless attributable to a retardation in the growth of the limb caused by one or more of the many illnesses to which we are subject in the earlier years of our life. Excepting when the retardation in the growth of the limb is considerable, it produces no inconvenience, and the possessor of a limb shorter than its fellow by some tenths of an inch may never be aware of the deficiency. To apply this fact to the question (it is another matter why the left leg is more frequently the short one), Mr. Larden's strong leg should correspond to my long leg. The long leg makes a longer step in proportion to the difference in its length over its fellow. If the right be the longer leg, as is oftener the case, the walker will circle to the left, and *vice versâ*. In my experiments I fixed a drawing-pin into the sole of each boot, selected a hard, level, untrodden piece of sand on the seashore, about 250 yards in length, and used a measuring-tape which would take ten or twenty paces in one measurement for obtaining the difference in length of the paces; the drawing-pins afford a definite and precise mark in the sand. To insure a good and regular start I always allowed my man a few yards start with his eyes open and fixed on the distant mark. He then, without stopping, put over his head and face a cardboard cylinder open at the top. This allows the eyes to be open, whilst effectually preventing any lateral vision. I think this, small detail as it is, important, as a bandage tied round the head across the eyes is sometimes unpleasant and often confusing.

97, Adelaide Road THOS. HAWKSLEY

Diffusion of Scientific Memoirs

PROF. TAIT's letter in your issue of December 27 (p. 196) raises two questions of interest to the Cambridge Philosophical Society. Prof. Tait states that during the last thirty years he has received very few of the publications of the Society. I cannot find from the records of the Society that Prof. Tait has ever expressed the wish to have the publications sent to him. The Cambridge Philosophical Society, like the Royal Society of London, the Royal Astronomical Society, and, I believe, other scientific societies, sends its publications to all Fellows who claim them within a reasonable time from the date of issue. Any Fellow requesting that *all publications* may in the future be sent to him receives them as they appear. The second point is the free distribution of copies. I find that at the present date the *Transactions* or *Proceedings* of the Society, or both, are sent either gratis or in exchange for other publications to the following number of centres:—

Home		Foreign	
London	16	Germany	22
Rest of England	16	France	9
Scotland	8	United States	12
Ireland	6	British Colonies	8
		Other foreign countries ...	23
	—		—
Total	46	Total	74

Honorary Fellows... ... ... about 40
Total number distributed ... ... ,, 160

Of this 160 about 40 have been added since the year 1869.

In Edinburgh at present there are three centres receiving the publications of the Society. I doubt very greatly if there are many societies which do as much as the Cambridge Philosophical Society towards spreading their publications.

R. T. GLAZEBROOK,
Secretary Cambridge Philosophical Society

Cambridge, January 19

Recent Low Temperatures in America

ON or about December 19 some very low temperatures are reported to have been registered in Manitoba. At Emerson, in lat. 49°, a cold of 46° below zero, and in Dakota (United States) − 49° are recorded.

I do not presume to say that these temperatures are incorrectly given, but they must be received with some distrust, arising from possible, I may almost say probable, defect in the thermometers used.

These sources of error are two, and by no means uncommon. First, the construction of the instrument may be defective. Second, it is not unusual during the heat of summer for a portion of the spirit to become vaporised, and afterwards condensed in the upper end of the tube. If the spirit is colourless, and if the detached fluid extends down to the metal band which keeps the tube in its place, the error, which may amount to 8° or more, is not readily noticed, unless specially looked for. I had several examples of this error in thermometers used by me in Canada, and one not long ago at the house of an English gentleman, who had perfect faith in the correctness of his thermometer.

Of the errors arising from defective construction there were two notable examples among some twenty thermometers which were tested by freezing mercury at Great Bear Lake in the winter of 1848–49. Eighteen of these thermometers agreed very closely with each other, indicating − 36°·5, or about 2° too high. Two others, beautifully finished, and made by a London maker of high repute, showed at the same time, and under similar circumstances, 57° below zero, or about 19° of error.

JOHN RAE

Meteors—Unpublished Notes of November 30, &c.

ON November 30, at 8.27 p.m., a large meteor passed from Dubhe, in the Plough, through the lower part of Auriga, exploding in sparkling reddish light; and at 9 another described nearly the same line, but without explosion. The latter left a very vivid bluish light in its path, which lasted about ten seconds. At 10.55 a very large meteor dropped right down from Psi Ursæ Majoris, and disappeared in a black cloud a few degrees above the horizon. At 11.10 one sped rapidly from Beta Ursæ Minoris through between Epsilon and Zeta (Mizar) Ursæ Majoris, and exploded in very brilliant white light. At 11.20 one proceeded from a point about 1° below Benetnasch, and disappeared in the right shoulder of Hercules without explosion. At 11.25 one blazed out from a point 2° above Etanin, and disappeared near Beta Cygni. At 11.30 a large and brilliant but a transient meteor went from Omicron Ursæ Majoris, and disappeared in the tail of the Dragon. At 11.35 one dashed out from a point about 1° above Pi Ursæ Majoris, and I thought that it would go through Merak, but just before it reached Merak it curved suddenly from it and exploded. About 12 a number of small ones were seen. December 1—Meteors seen at 0·13 a.m., 0.18, 1.12, 1.23, 1.45, 3.30, 3.40, 4, 4.23, 4.40, 4.55, 5.7, 5.10, 5.18. December 4—At 2.15 a.m., 2.20, 2.25, 2.28; and a number of meteors were observed between 5 and 6 p.m. December 5—A goodly number of meteors seen from 1 a.m. to 6, and from 8 p.m. to 10. December 6—1.12 a.m., 1.15, 1.22, 2.10, 2.30, 3.40, 5.21, 5.25. December 7—Three meteors seen. December 8, 9, 10, and 12—Only a few meteors were observed here; and from the unfavourable state of the weather, not a meteor could I manage to see since. I have ascertained the paths of all the above meteors, but to give them all would encroach too much on your space. I will supply particulars if required. On November 30 and December 1 last there was a brilliant display of meteors. A few Leonids, Leo Minorids, Taurids, and Geminids were seen. Six Andromedes made their appearance from December 4 to 8. On December 8 a beautiful bolide rushed through the clouds from south-west to south-east, at 6 p.m. Not a star in that part of the heavens could be seen at the time, but the moon shone dimly a little to the left of it. The point at which it appeared was a few degrees higher than the moon, and it disappeared a few degrees above the earth. It blazed in and out three different times on its way through the black clouds, and a little before the end of its journey it swelled out into a huge magnificent ball of red fire, and by its explosion it illumined the western heavens and earth with its bright crimson light. A few of the spectators were alarmed at the unusual apparition. No intonation. Left in its wake a red belt of fire. The light of most of the meteors was blue, or the colour of electric light. A umber of the meteors curved suddenly round just before disappearing. Numbers of meteors were seen dropping into black clouds, others seen dropping out of them down to the horizon.

Mossvale, Paisley, January 14 DONALD CAMERON

BRITISH APHIDES[1]

ENTOMOLOGISTS are fond of attaching themselves to some special group of insects—bees, beetles, or butterflies; but there are very few, we believe, who take an interest in collecting the winged or wingless forms of the Aphides. One is very apt to overlook the value of the work of a mere collector, but it comes home to us when amid a group so large, and so important from an economic point of view, as this of the plant lice is, we find only some half a dozen of our British naturalists collecting specimens of the species or making observations on the marvellously strange habits of their heterogeneous forms. Under these circumstances it was most fortunate that a society like the Ray Society was in existence, for the number of those interested in the subject of the history of British Aphides would have been too miserably small to have justified any publisher, no matter how energetic, from publishing an account of these insects; but, thanks to the Ray Society, we have, as the works published by them for their subscribers for the years 1875, 1877, 1880, and 1883, four handsome octavo volumes by Mr. G. Bowdler Buckton, F.R.S., which seem well entitled to their designation of a "Monograph of the British Aphides." These volumes, besides the text, contain over 140 plates, of which ten are devoted to anatomical details, and the rest to coloured portraits of the species both in their immature and various mature forms, and in some few instances there are representations of the various parasites which feed on them. It is to be specially noted that these figures are both drawn and lithographed by the author, and certainly a more interesting series of life-like figures of Aphides is nowhere to be found.

While it seems true that the Aphides are not general favourites of the collector, it is also true that no group of insects has attracted more attention. For nearly a century and a half the mysteries of their growth and development have been laboriously inquired into, and the researches of Réaumur and Charles Bonnet in the eighteenth, and those of Huxley in this our nineteeth century, have not exhausted all the marvels of these strange forms. Their history makes them in many ways attractive. Thus, to those interested in the details of embryology, these Aphides present questions for solution of the greatest importance, and concerning which there is still no absolutely settled opinion. Even the brilliant investigations as to this branch of the subject by Huxley still left work to be done. To the general naturalist they present a source for abundant study—not only their varied and often strange forms, but their curious habitations and the defences which they seem to have against hosts of different insect foes; while to the practical economist they have an immense interest when he thinks that by their success in the struggle for life they cause distress to human nations, often bringing about decrease in the amount of our food material and an increase in the amount of our taxation. To name the Hop Fly or the Vine Aphis is to at once illustrate our meaning.

It is not our intention to write a criticism on Mr. Buckton's learned monograph; it pleases us better to introduce it to our readers as a scientific work full of many easily read and wonderful histories of our native species of plant lice—one that the reader will not lay down in a hurry when he once takes it up; one in which, open where he will, he shall find something in it to interest and attract him. In order that we may in some measure prove this we will give a brief sketch of the chief subject-matter of these volumes. Passing over the disquisition as to the origin and meaning of the word "aphis," we have a general history of the group; included under this heading we find a sketch of their anatomy, an account of the most noteworthy contributions to their history by the early writers, and a sketch of what is known as to their metamorphoses and their very strange reproduction. This is followed by the classificatory portion, in which full diagnoses are given of the genera and species.

Mr. Buckton would account for the want of activity in our entomologists in their study of this group by the confusion into which the group has fallen with reference to its synonomy. One species of Aphis possesses no less than thirty synonyms, while in another case the same name has been given to no less than six different species of the group. There is this further difficulty in their study, that the distinctive characters are far less marked than in most other insects. As to colour, not only are the young sometimes in this respect quite unlike their parents, but their hues vary with the hour, and even the adult forms may undergo as great a change in their tints as the autumn leaves amongst which they nestle.

The family itself belongs to the order of the Hemiptera and to the sub-order Homoptera, where it is located between the families Coccidæ and Psyllidæ. Among the anatomical peculiarities it may be noted that the winged forms are provided with no less than three different kinds of eyes—ocelli, compound eyes, and supplementary eyes. The larvæ of some have eyes; in others the eyes are quite rudimentary; while in some subterranean forms they are absent. Though all the winged forms have ocelli, yet their nocturnal habits are not marked. All the Aphides are suctorial in their habits; as the source of their food varies so does the structure of the mouth parts, especially the rostrum and setæ. In *Stomaphis quercis*, feeding in the alburnum of the oak, the rostrum is nearly twice the length of the insect, and the setæ are much longer; and in the genera Lachnus and Schizoneura, in the young forms, the rostrum projects beyond the end of the abdomen, and is carried as if it were the tail of the insect; while in the young of *Chermes laricis* the long and delicate setæ are coiled into a spiral, which would seem to act as a kind of spring cable by which the insect moors itself so to its feeding ground that it is not easily dislodged by the rough winds of early spring as they play among the larch branches. The punctures are not made by the rostrum, which seems only to act as a sheath, but by the setæ, which can be seen to lance open a number of the parenchymatous cells, and so cause a plentiful flow of cell-contents.

On the question as to the function of the cornicles, the author does not agree with Kaltenbach that they are organs connected with the respiratory apparatus, but rather regards them as the external terminations of excretory ducts. As to honey-dew, the remarks of Kirby and Spence, ascribing it to a secretion of Aphides, is accepted as true by almost all who have written on the subject—including the author—though others, among whom may be mentioned Liebig, Sir J. Hooker (1873), Boussingault (1872), still combat this view.

The chapter on the bibliography begins by alluding to the work of the celebrated anatomist and philosophical lens grinder, Leuwenhoek, in 1690, glances at that of Réaumur (1737), Charles Bonnet (1779), De Geer (1778); the more modern writings of Schrank, Hausmann, Burmeister, Harting, Kaltenbach, Kyber, Morren, Leuckart, von Siebold, Ratzeburg, and Koch among the Germans; Passerini among the Italians; Signoret, Balbiani and Claparède among the French writers; Newport, F. Walker, Haliday, and Huxley among the English writers on the subject.

Aphides are to be found almost everywhere throughout Britain. Some are hardy enough to thrive on the stony

[1] "Monograph of the British Aphides." By George Bowdler Buckton, F.R.S., &c. Four volumes; being the volumes issued by the Ray Society of London to their subscribers for the years 1875, 1877, 1880 and 1883.

heaths of Scotland and Northumberland, whilst others will live almost in the reach of the spray on the sea-shore; terrestrial and aquatic plants are alike subject to their attacks. Some feed on succulent herbs, others on hard timber trees; others again on the roots of flowering plants. Sometimes the white water lily (*Nymphæa alba*) is almost destroyed by the myriads of *Rhopalosiphum nymphææ* which crowd on its leaves and flowers. While certain trees and shrubs appear to be attacked exclusively by their own peculiar Aphis, other trees give nourishment indiscriminately to numerous species. Thus the oak is attacked by at least six, the willow and birch by eight, and the conifers by the same number. Some families of plants are free or almost free from them, such as the Gentian and Irid families. But one species of the large group of the ferns is as yet known to be attacked by them; indeed the cryptogams are as a general rule very free from Aphides; but we have known a species of Marsilea to swarm with them.

The migration of the Aphides is still involved in some mystery, and we seem to have as yet no certain knowledge of the winter habitats of numerous species which seem to occur only during a few weeks of midsummer, such as *Siphonophora millefolii*, which may be found from July to September, and then entirely eludes our notice for the rest of the year.

The peculiar habits of the species opens an immensely interesting subject: some are almost sedentary, others are fairly active; some form receptacles which strangely mimic fruits; some if disturbed drop to the ground, others run to the opposite side of a leaf or twig; some throw up their hind legs when alarmed, which action gives a signal to the rest of the colony, which responds by going through the same performance; some assimilate their colours to their food plants, so as to be difficult to perceive. An interesting phenomenon in connection with these insects is their dimorphism. Thus the early spring form of *Chermes laricis* is different from that of all her progeny till the last, and the same is the case with *Aphis mali*. These variations often relate to size and colour, but often also to considerable change in form and modification of parts. The most extraordinary instance occurs in *Chaitophorus aceris*, "the early spring forms of which occasionally are so diverse that they have been described as belonging to not only different genera but even to distinct families. Thus Mr. Thornton, the original discoverer of this strange insect, gives it the name of *Phyllophorus testudinatus*; afterwards Mr. L. Clark called it *Chelymorpha testudo*, placing it between the Aphididæ and the Coccidæ." But a nearly equally striking example occurs in the dreaded *Phylloxera vitis*, which has two entirely different habits of life and form. In one it is active and winged; in the other it is apterous and subterranean.

We would have liked more ample information as to the geographical distribution of the group. We read that "it is confined to the more temperate regions of the globe," and "that as we approach the tropics it appears to give way to such forms as Coccus." Over the whole continent of Europe they are spread, and across Europe into the Amur district of China. They abound in North America; seem not to be indigenous in New Zealand, though in this country, according to Prof. Hutton, imported species were often very destructive to the crops; and nothing is said as to their occurrence in Australia or the Cape of Good Hope district.

Mr. Buckton divides the family into four sub-families: Aphidinæ, Schizoneurinæ, Pemphaginæ, and Chermesinæ.

Volume i. is taken up with an account of the first half-dozen genera of the first sub-family, and is illustrated with three plates of anatomical details, and forty-two coloured plates of species. Among the more familiar species whose life-histories are given are the Rose Aphis (*Siphonophora rosæ*), the Wheat Aphis (*S. granaria*), the destructive Hop Fly (*Phorodon humuli*), the Cherry Aphis (*Myzus cerasi*), and the Peach Aphis (*M. persicæ*), this last one of the most beautifully coloured of our native species.

Volume ii., with forty-eight plates, concludes the descriptive details of the genera and species of the sub-family Aphidinæ with seven-jointed antennæ, including the type-genus Aphis. Full details are given of that troublesome insect *Rhopalosiphum dianthe*, the *Aphis vastator* of Smee, which feeds on almost every cultivated plant, often swarming on the potato, turnips, pinks, not to mention hyacinths, tulips, and oleanders, but which the author agrees has nothing to do with the production of either the potato disease or clubbing in crucifers. Forty-five species of the genus Aphis are enumerated, and a very useful analytical table of these is appended. No less than seven synonyms are quoted to *A. rumicis*, Lin., which commits such destruction often on the bean and turnip crop, and which is not very particular as to its food plants. Seven species of the genus Chaitophorus are described, and a full account is given of the very extraordinary dimorphism existing in *C. aceris*. In this volume we have accounts of the aphidivorous Hemerobiidæ and Hymenoptera.

Volume iii., with twenty-seven plates, contains the description of the forms of the sub-family Aphidinæ with six-jointed antennæ, of the sub-family Schizoneurinæ, and of some of the forms of the sub-family Pemphiginæ. Among the more familiar species we have here the Aphis (*Pterocallis tiliæ*) which abounds on the lime tree, and so bedews it with its sweet secretion; the Beech Aphis (*Phyllaphis fagi*), so well known as often covering the leaves of the beech tree with its white cottony or rather waxy fluff; the Sallow Aphis (*Lachnus viminalis*), which sometimes swarms on our willows. The "American blight" (*Schizoneura lanigera*) on our apple trees is an introduced species, apparently from America. It appears that they descend into the soil in winter and attack the roots of the apple trees. *S. lanuginosa* is the aphis which produces the wonderful fig-like galls on the elm tree. These galls are about the size of small green figs, with a small opening at their summits; they contain thousands of the plant lice. In 1866 Mr. McLachlan, travelling in the south of France, gathered a number of these galls, which were in extreme profusion—elm trees twenty feet high being one mass of galls—with the intention of bringing them home; but they made such an awful mess from the viscid liquid in the galls, that he was compelled at last to throw them away. *Pemphigus lactucarius* is the species found living in little earth cavities in the vicinity of the roots of various plants. If a stump of lettuce be pulled up in spring, these "downy flocks" will be very often detected.

The last volume, with twenty-four plates, concludes the account of the species of Pemphiginæ, and gives descriptions of those of the sub-families Chermesinæ and Rhizobiinæ. Mr. Buckton agrees with Passerini, and retains Chermes among the Aphididæ. The Greek verse on the title-page of this volume having caught our eye, we are reminded how little the families treated of in it are the subjects of parasitism; the reason why seems obscure: with these forms the big and little fleas seem to lie down together, not causing each the other any alarm. The Fir Aphis (*Chermes abietis*) is the maker of the curious cone-like galls of the spruce, and a closely related species is often very destructive to larch plantations. Of the genus Phylloxera two native species are described, and a full account of the Vine Aphis (*P. vitis*) now introduced into our hothouses is also given. In this account we have a very interesting and important communication from that eminent entomologist, Jules Lichtenstein, in which he gives a summary of his views on the metamorphoses of the plant lice. This volume has appended to it chapters on Aphides in their economical relations to ants; on the reproduction of Aphides; on the biology and morphology of Aphides; on the antiquity of the Hemiptera, and particularly with regard to the Aphidinæ as represented in the sedimentary rocks and in amber; diagnoses of the Aphides found in amber are given, with figures; and we have also an account of those known to occur in a fossil state in America. Directions for the mounting and preservation of Aphides are given, and we find a very complete bibliography of authors who have treated about Aphides, and a very excellent general index.

In conclusion it only remains for us to congratulate the author on the very successful accomplishment of this important work, which is certain to excite an interest in this marvellous group of insects, and the Ray Society on being the medium of publishing the most beautifully illustrated work on the Aphides that has as yet appeared.

EARTHQUAKES AND BUILDINGS

A COMPLETE discussion of the effects which earthquakes produce upon buildings would form a treatise as useful as it would be interesting. Not only would it involve a discussion of the practical lessons to be derived from the actual effects of earthquakes, but it would include deductions based on our present knowledge of the nature of earthquake motion. Such knowledge is obtained from the records of seismographs.

In the following few notes I intentionally overlook this latter portion of the subject, and confine myself to a few of the more important practical conclusions respecting the effect of earthquakes on buildings, which may be of value to those whose mission it is to erect buildings in earthquake countries.

With regard to the situation of a building, it is sometimes observed that after an earthquake it is the portion of a town situated on low ground which has principally suffered, whilst adjoining portions on hills may have practically withstood the disturbance. In 1855 this was the rule governing the distribution of ruin in Tokio. The reverse, however, has been the rule in Yokohama. Speaking generally on this point it may be said that there is no universal rule,—each small area in an earthquake region having its special rule. As a site for a building, theory seems to indicate that soft earth or marshy ground, which would absorb much of the momentum communicated to it, and therefore act as a buffer between a building and a shock approaching through other strata, would prove a safe foundation. This seems also to have been an old opinion, for we read that the temple of Diana was built on the edge of a marsh to ward off the effects of earthquakes, but experience has repeatedly shown us, as in the case of Tokio and Manila, that swamp-like ground, as an earthquake palliative, has but little effect. On the other hand, hard rocky strata, where the amplitude of motion is small, but the period quick as compared with the motion in the inelastic material of the plains, has, as was markedly illustrated in 1755 at Lisbon, and in 1692 at Jamaica, proved the better foundation. Places to be avoided are the edges of cliffs, scarps, and cuttings. For emergent waves, these are free surfaces, and from their faces materials are invariably shot off, much in the same way that the last car in an uncoupled train of carriages may be shot forward by an engine bumping at the opposite end.

As foundations for a building there are two types. In one, which is the European method of building, the structure is firmly attached to the ground by beds of concrete, brick, and stone. In the other, which is illustrated in the Japanese system of building, the structure rests loosely on the upper surface of stones or boulders. As an indication of the relative value of these two forms of building, it may be mentioned that in Yokohama, in 1880, many of the European buildings were more or less shattered, whilst in the Japanese portion of the town there was no evidence of disturbance.

The houses, like the foundations, are also of two types. In the European house built to withstand earthquakes, of which there are examples in Tokio and San Francisco, and for which in America patents have been granted, we have a building of brick and cement bound together with hoop iron and numerous tie rods. A building like this, which from time to time is jerked backwards and forwards by the moving earth, to which it is secured by the firmest of foundations, is expected to resist the suddenly-applied and varying stresses to which it is exposed by the strength of its parts. This type of structure may be compared to a steel box, and if its construction involves any principle, we should call it that of strength opposing strength. Some of the buildings in Caraccas, which are low, slightly pyramidal, have flat roofs, and which are bound along their faces with iron, belong to this order. These so-called earthquake-proof buildings, with the exception of their chimneys, have certainly satisfactorily withstood small earthquakes in Japan. As to how they would withstand a disturbance like that at Casamicciola is yet problematical. Unfortunately these structures are very expensive.

The second type of building may be compared to a wicker basket. This is certainly as difficult to shake asunder as the steel box type, and at the same time is not so expensive. The Japanese house belongs to this type. It is largely used on the west coast of South America; and in Manila, since the disaster of 1880, it has rapidly been replacing the heavy stone form of structure. Briefly, it is a frame house with a light roof of shingle, felt, or iron. As put up in Japan, its stability chiefly appears to depend on the fact that it is *not* firmly attached to the earth on which it rests, and that its numerous joints admit of considerable yielding. The consequence is that, whilst the ground is rapidly moving backwards and forwards, the main portions of the building, by their inertia and the viscous yielding of their joints, remain comparatively at rest.

A house that my experience suggests as being aseismic, and at the same time cheap, would be a low frame building, with iron roof and chimneys supported by a number of slightly concave surfaces resting on segments of stone or metal spheres, these latter being in connection with the ground. Earthquake lamps, which are extinguished on being overturned, would lessen the risk of fire, while strong tables and bedsteads would form a refuge in case of sudden disturbances.

In earthquake towns the streets ought to be wide, and open spaces should be left, so that the inhabitants might readily find a refuge from falling buildings. Brick chimneys running through a wooden building, unless they have considerable play and are free from the various portions of the building, are exceedingly dangerous. In consequence of the vibrational period of the house not coinciding with that of the chimney, the former by its sudden contact with the latter when in an opposite phase of motion almost invariably causes an overthrow. In 1880 nearly every chimney in the foreign settlement in Yokohama was overthrown in this manner, and the first alarm inside the houses was created by a shower of bricks falling on beds and tables. Since this occurrence the chimneys in Yokohama have had more or less play given to them where they pass through the roofs.

Chimneys with heavy tops, like heavy roofs, must be avoided. Another point requiring attention is the pitch of a roof. If this is too great, tiles or slates will be readily shot off. Archways over openings should curve into their abutments, otherwise, if they meet them at an angle, fractures are likely to be produced.

If for architectural reasons, or as a precaution against fire, it is necessary to have buildings which are substantial, their upper portions ought [to be as light as is consistent with the requisite strength. Hollow bricks, light tiles, with *papier-maché* for internal decorations, have been recommended as materials suitable for superstructures. At the present time the city of Manila, partly through Government interference, and partly through the desire of the inhabitants to reduce the chances of farther disasters, presents a singular appearance of light superstructures rising from old foundations. Iron roofs are visible in all directions, whilst on the massive basements of old cathedrals and churches upper stories of wood, with cupolas and spires of corrugated iron, have been erected.

Although the suggestions embodied in the above notes are few in number, it is hoped that they may be of some practical value. Without extending them, they show us that, even though we may not be in the position to escape from earthquakes by forewarning ourselves of their approach, we can at least mitigate the effects of these disasters by proper construction. JOHN MILNE

Tokio

THE LATE ERUPTION OF VESUVIUS

OUR visit to the crater of Vesuvius on January 11, 1884, was a most interesting one. In my former letter I gave the rough details of this new eruption as well as could be ascertained from the base of the cone. The lava that issued on Tuesday night continued to flow till Wednesday evening, but seemed to have arrested its progress about 10 o'clock that night, when I was in the Atrio del Cavallo. This stream proved to have welled out at the base of the little cone of eruption and to have flowed across the solid lava plain in the crater of 1872, and then to have poured down the north-north-west slope of the cone till it reached the Atrio, across which it extended but little. Within the crater of 1872 we have a somewhat convex plain of lava, which is continuous with, or, more properly, overlaps, the crater edges, except for a short distance on the south-south-west side. The north-east part of this is covered by the remnants of the crater of January, 1882. Within this were a series of crater rings that have since filled up to a certain extent the cavity of 1882. For some time the vent has travelled south, so that the present cone of eruption overlaps the crater ring of January, 1882, on its south side, whereas there is a deep crescentic fossa between the present cone and the north crater ring of two years since. The vent was giving forth great volumes of vapour, and there was an almost continuous fountain of fragments of molten lava, which often attained the height of one or two hundred yards. As a consequence much filamentous lava, often as fine as cotton, was raining around the crater, and as we sat there eating our lunch, it was so covered with these rock fragments, that it required a long climb on foot to make such a gritty meal palatable. The ejectamenta are composed solely of lava in detached pieces, ejected in a plastic state with a few bombs, consisting of older solid lava fragments partially fused and rounded on the surface, which is varnished irregularly by the fluid magma that enveloped them. This indicates that the lava is very near the top of the chimney, which must be full, as it has been for some time. Photography was no easy matter amidst this fiery bombardment, for such was the abundance of the ejectamenta that we could see how rapidly the cone of the eruption was growing. I made a rough calculation of the quantity of new material expelled, and I think six cartloads in four seconds as quite a fair estimate. The lava that had flowed was solid and cold enough to allow my dog to cross it with ease, though through a few cracks it was seen to be still incandescent, and a green staff thrust in immediately blazed. The lava that was flowing in the direction of Pompeii is still doing so in one or two points, apparently at the same rate and place as two weeks since.

Altogether this eruption seems to be of very little importance, and during the last four years there have been many similar ones. Prof. Palmieri, in the *Corriere del Mattino* of January 11, prophesies a great eruption, but on what grounds it seems difficult to make out. No one would deny that such could occur and is not improbable; but there seems to be no more reason now than two months since.

The smoke or vapour yesterday had, when seen by reflected light, the same colour as usual, namely, a salmon tint. The sky was very clear, and I looked at the sun through this vapour, bearing in mind the recent remarkable sunsets and green suns. The transmitted light ranged from a *burnt sienna* brown to a dirty orange, having much the same colour as when we look through a dark London fog. I noticed that the light that traversed the vapour column and fell on the opposite escarpment of Monte Somma was of a colour that would be obtained by mixing a mauve with about equal quantities of brown.

Naples, January 13 H. J. JOHNSTON-LAVIS

THE EGYPTIAN SUDAN AND ITS INHABITANTS

AS some degree of vagueness seems still attached to the term Sudan, it may be well to state at once that it is simply the Arabic equivalent of the older and more intelligible expressions, Nigritia, Negroland, which have in recent times somewhat unaccountably dropped out of use. In its widest sense it comprises the more or less fertile zone lying between the Atlantic on the one hand and the Red Sea and Abyssinian Highlands on the other, and stretching from the Sahara and Egypt Proper southwards to the Gulf of Guinea, the still unexplored Central Equatorial regions, and further east to Lakes Albert and Victoria Nyanza. This vast tract, which may on the whole be regarded as the true domain of the African Negro race, is commonly and conveniently divided into three great sections:—(1) *Western Sudan*, comprising roughly the basins of the Senegal and Quorra-Binue (Niger) with all the intervening lands draining to the Atlantic; (2) *Central Sudan*, comprising the basins of the Komadugu and Shari with all the lands (Kanem, Bornu, Baghirmi, Wadai) draining to Lake Chad; (3) *Eastern Sudan*, comprising everything east of Wadai, that is mainly the Upper and Middle Nile basin.

Politically, this third section, with which alone we are here concerned, has for some years formed part of the Khedive's possessions, hence is now more generally known as *Egyptian Sudan*. Until 1882 it formed a single administrative division under a Governor-General resident at Khartum. But in that year a sort of Colonial Office was created for this region, which was placed under a Cabinet Minister and broken up into four separate departments or divisions, each under a Hukumdar, or Governor-General, directly responsible to the Minister for Sudan at Cairo. The various provinces hitherto forming the single administration of Egyptian Sudan thus became distributed as under:—

WEST SUDAN, comprising Darfur, Kordofan, Bahr-el-Ghazal, and Dongola, with capital Fasher.

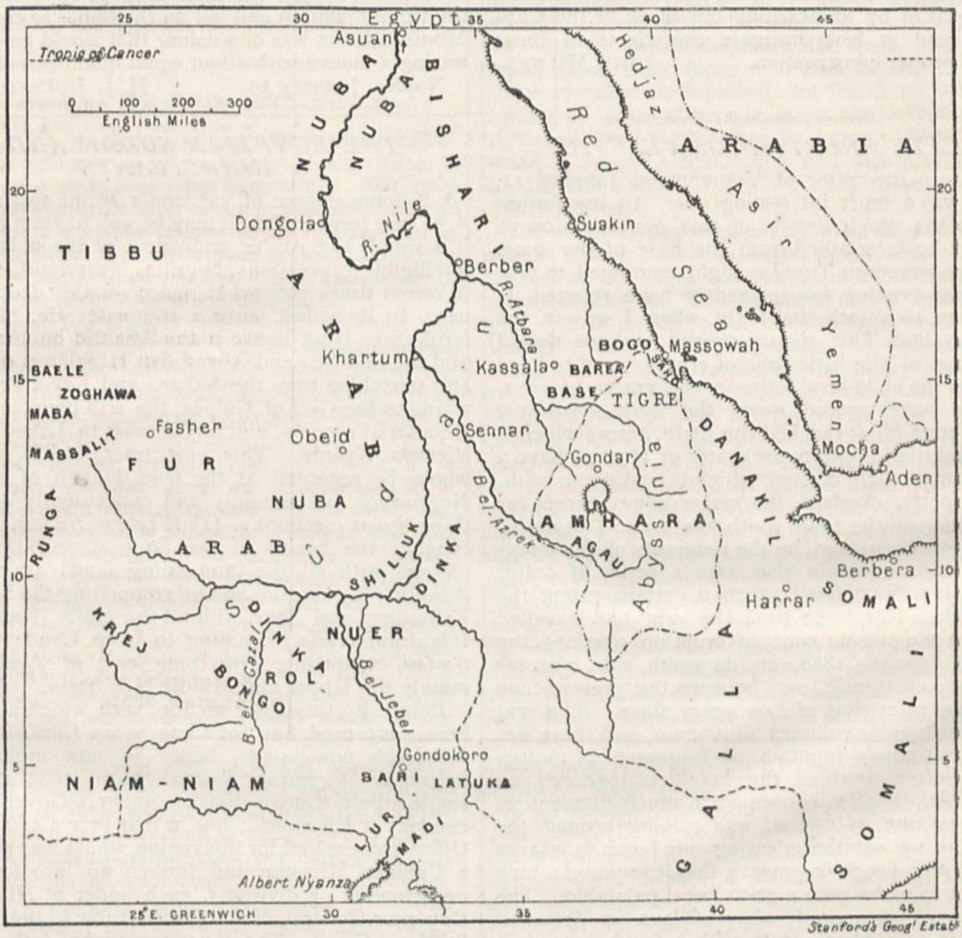
CENTRAL SUDAN, comprising Khartum, Senaar, Berber, Fashoda, and the Equator (Hat-el-Istwa), with capital Khartum.

EAST SUDAN, comprising Taka, Suakin, and Massowah, with capital Massowah.

HARRAR, comprising Zeyla, Berbera, and Harrar, with capital Harrar.

The complete development of this scheme has been somewhat rudely interrupted by the successful revolt of the "Mahdi," who has for the moment wrested the greater part of the country from Egyptian control. But should this arrangement be carried out after the restoration of order, a further element of confusion will be introduced into African geographical nomenclature, for we shall then have three political subdivisions of Egyptian Sudan bearing the same names as the three above described physical subdivisions of the whole region.

These however are matters of detail, with which statesmen do not usually concern themselves, and apart from the terminology the projected arrangement in this instance really recommends itself both on geographical and ethnological grounds. Thus the provinces of Darfur, Kordofan, and Dongola, forming the bulk of "Central Sudan," present a certain physical uniformity in the somewhat steppe-like character of the land, destitute of forest timber and covered mostly with prickly grass, scrub, gum trees, mimosas, and other thorny plants. It is intersected by no large streams, and generally open except towards the west, where the Marrah range forms a water-parting between the few rivers and intermittent torrents flowing south-east to the Nile and south-west through the Bahr-es-Salamat to the Shari. The inhabitants also are of a somewhat homogeneous character, the aborigines belonging mainly to the old Nuba stock almost everywhere interspersed with nomad and slave-hunting Arab tribes. This region communicates with the Nile through two historical caravan routes, one running from El Obeid north-north-east to Khartum, the other from Fasher north-east to El Dabbeh above Old Dongola. Through these outlets the produce of the land—gums, ivory, ostrich-feathers, and slaves—have for ages been forwarded down the Nile to Egypt, the natural emporium of East Central Africa.



Ethnological Map of the Eastern Sudan.

The Nile itself imparts a distinct geographical unity to the more fertile and better watered provinces of Khartum, Senaar, Berber, Fashoda, and the Equator, forming the second division of "Central Sudan." Here the great artery forms a broad, somewhat sluggish stream, often choked with "sudd," or floating masses of tangled vegetable matter, but nevertheless generally navigable from the confluence of the White and Blue Niles at Khartum nearly to Lake Albert Nyanza. The Bahr-el-Jebel, as its upper course is called from the lake to the Sobat junction, is thickly peopled on both sides and along the tributary valleys by numerous tribes and even great nations (Dinka, Shilluk, Mittu, &c.) of pure Negro and Negroid stock. Lower down the White Nile, that is, the section from the Sobat to the Azrek confluence, is held mainly by intruding "Baggara" and other cattle-breeding Arab tribes, interspersed with isolated groups of Nuba, Funj, and other peoples now mostly assimilated to them in speech, usages, and religion.

Although more varied in aspect, the third division of "Eastern Sudan" enjoys a certain unity at least in its outlines, its three provinces of Suakin, Taka, and Massowah being comprised between the middle course of the Nile and the Red Sea, and stretching from the Egyptian frontier southwards to Abyssinia. Here the main stream from Khartum to Asuan (Syene), where it enters Egypt, is essentially a mountain torrent, describing great bends to the right and left while forcing its way over six cataracts and other obstacles through the sandstone and granitic ridges intersecting the Nubian wilderness on the

Race	Main Divisions	Locality	Remarks
Hamite	*Tibbu:* Baele; Zoghawa; Wanyanga	N. and N.W. Darfur	*Hamite* is here equivalent to the *Kushite* of some writers; but is taken in a wider sense, answering to the African Division of the Mediterranean or Caucasic anthropological type of mankind. For the removal of the Tibbu from the Negro to this connection, see NATURE, March 1, 1883 ("North African Ethnology"). Most of these are zealous Muhammadans.
	Bishari (Beja): Hadendoa; Hallenga; Ababdeh; Beni-Amer	Between Red Sea and Nile, 15°–25° N.	
	Danakil: Adaiel; Dahimela, &c.	Between Abyssinia and the coast, 10°–15° N.	
	Saho; Bogos; Habab	Massowah district	
	Somali: Idur; Isa; Mijarten, &c.	Gulf of Aden Coast	
	Galla (Orma): Yeju; Wollo; Mecha, &c.	E. and S. of Gojam	
Semite	*Arab:* Kababish; Sheygieh; Robabat, &c.	W. from Nile between Dongola and Khartum	The *Arab Semites* are recent intruders, mainly *viâ* Isthmus of Suez and Egypt; the *Himyarites* are intruders from prehistoric times from South Arabia *viâ* Strait of Bab-el-Mandeb. The former are all fierce Muhammadans, the latter mostly monophysite Christians.
	Arab: Homran; Rekhabin; Alawin	Senaar	
	Arab: Homran; Hamr, El-Homr; Habanieh, &c.	Kordofan and Darfur	
	Arab: Ziaieh; Bahemid	N. Darfur	
	Himyaritic: Tigré; Dembela; Lasta	N. and E. Abyssinia	
	Himyaritic: Harrari	E. from Shoa	
Nuba	*Barabra* (mixed): Kenus; Mahasi; Dongolawi	Nile Valley from Egypt to Old Dongola	The Nubas hold an intermediate position between the Negro and Hamite; but the speech is distinctly Negro, and has no connection with the Fulah of West Sudan, as has been supposed by Fr. Müller and others. The Kordofan Nubas represent the original stock and are mainly pagans; those of the Nile are Negroid and a historical people, Christians from the sixth to the fourteenth century, since then Muhammadans of a mild type. They represent the Uaua of the Old Egyptian records, the *Nubæ* of Strabo, and the *Nubatæ* of later times.
	True Nuba: Kargo; Kulfan; Kolaji; Jebel Nuba; Tumali	Kordofan	
	Fur: Fur; Konjara; Fongoro, &c.	Darfur	
	Sub-Nuba: Takruri	Gallibat	
	Sub-Nuba: Barea; Basé (Kunama)	Taka (Mareb Valley)	
	Sub-Nuba: Funj; Hamagh	Senaar	
Negro	*Sudanese:* Birkit; Masalit; Abu-Sarib, &c.	Darfur	Most of these Negroes have been reduced in recent years, and are still virtually pagans. Some, such as the Mittu, Krej, and Bongo, are of a red-brown rather than a black complexion, but the type is Negro, although the speech of all except the Dinka shows grammatical gender. They are very brave and fierce, but easily controlled by firmness and kindness.
	Nilotic: Shilluk; Dinka; Nuer	White Nile and B. el Arab	
	Nilotic: Fallaugh; Kumkung; Ninak, &c.	Sobat basin	
	Nilotic: Krej; Bongo (Dor); Mittu (Moro)	About W. tributaries White Nile	
	Nilotic: Bari; Madi; Lur; Latuka	B. el Jebel, N. of Lake Albert Nyanza	
Bantu	Waganda; Wanyoro; Wasoga; Wagamba	Extreme S. frontier, N. side Lake Victoria Nyanza	The Bantus have not been reduced, although included in the Moudirié de l'Equateur of Messedaglia's official "Carte du Sudan" (Khartum, 1883).

east and the Libyan desert on the west. It is thus practically useless for navigation, and the communications with the upper provinces have to be maintained by difficult caravan routes subtended like arcs to the curves of the stream, or radiating from Berber near the Atbara confluence to Suakin on the Red Sea. But south of these dreary solitudes the Atbara basin itself, comprising parts of the Berber and Taka provinces, is a magnificent subtropical land, the flower of the Khedive's possessions, diversified with a varied succession of dense woodlands, rich pastures, and well-watered arable tracts. Hence the route traversing this region from the Nile, through Kassala to the Red Sea at Massowah, although much longer, will be found far more practicable than the more northern highway to Suakin. Like the land itself, the inhabitants of this division present a great diversity of type, the narrow valley of the Nile being occupied by Nubas from the Egyptian frontier to the Old Dongola, and thence on the left bank by Kababish Arabs to Khartum, while the whole region between the Nile and Red Sea, and from Egypt southwards to Abyssinia, is the almost exclusive domain of the great Hamitic Bishari nation. Along the northern frontier of Abyssinia these come in contact at various points with Arab, Amhara, and Tigré peoples, and in one instance even with an isolated Negroid or Nuba tribe, the Basé (Kunama) of the Khor-el-Gash (Mareb) Valley.

The fourth division of Harrar, with its three provinces of Zeyla, Berbera, and Harrar stretching along the northern verge of Somaliland eastwards to Cape Gardafui, is practically separated from the rest of Egyptian Sudan by the intervening "Empire" of Abyssinia, and will be totally severed whenever that state resumes possession of its natural outport of Massowah. It is mainly an arid strip of coastlands fringing the Red Sea and Gulf of Aden, and inclosing the recently-founded Italian and French settlements on Assab Bay and at Obokh on the Gulf of Tajurrah. With the exception of the small Amharic inclave at Harrar, the whole of this division is inhabited by peoples of Hamitic stock and speech—Saho and Danakil, between the Red Sea and Abyssinia, Idur, and other Somali tribes along the Gulf of Aden.

Egyptian Sudan thus stretches north and south across nearly twenty-four degrees of latitude from Egypt to the equator, or about 1650 miles, and west and east across twenty-two degrees of longitude from Wadai to the Red Sea at Massowah, or from 1200 to 1400. Within these limits it has a total area of at least 2,500,000 square miles, with a population that cannot be estimated at less than 12,000,000. Of these probably three-fourths are of pure or mixed Negro descent, and mostly pagans or nominal Muhammadans. The rest belong to various branches of the Semitic and Hamitic stocks, and are nearly all Muhammadans of a more or less fanatical type. In his valuable "Report on the Sudan for 1883" Lieut.-Col. Stewart remarks: "Besides the main division of the people into Arab and Negro, they are again subdivided into a number of tribes and sub-tribes, some sedentary and others nomad. Of the Negro tribes all are sedentary and cultivators, but the Arabs are for the most part nomads or wanderers, each tribe within certain well-known limits. All these Arab tribes are large owners of cattle, camels, horses, and slaves. These last, along with the Arab women, generally cultivate some fields of doora (a kind of millet) or corn, sufficient for the wants of the tribe. The Arab himself would consider it a disgrace to practise any manual labour. He is essentially a hunter, a robber, and a warrior, and, after caring for his cattle, devotes all his energies to slave-hunting and war" (p. 8).

This presents a fairly accurate picture of the natural relations of the people in all respects except as regards the main division into two ethnical groups—Arab and Negro. From what has been already stated it is obvious that this is a totally inadequate distribution. It is another and signal instance of that official ignorance or disregard of the racial conditions that has ever been such a fruitful source of political troubles and disasters in lands governed or controlled by foreign administrators. As a matter of fact, Egyptian Sudan is a region of great ethnical complexity, and so far from being occupied by Arabs and Negroes alone, there are scarcely any Arabs or Negroes at all anywhere east of the Nile between Khartum and Egypt. To designate as Arabs the tribes at present blocking the Suakin-Berber route, as is currently done, betrays a depth of ethnological ignorance analogous to that of the writer who should group Basques, for instance, and Slavs in the same category. The Arabs themselves are comparatively recent intruders, although it is possible that some, such as the Beni-Omr, now fused with the Funj and Hamagh Negroid peoples of Senaar, may have found their way across the Red Sea into the Nile basin in pre-Muhammadan times. But the Bishari tribes about Suakin are the true autochthonous element, lineal descendants of the Blemmyes and other historic peoples whose names are enrolled in Greek, Roman, and Axumite records. But these and other points will be made clear by the above synoptical table, with accompanying map, of the East Sudanese races and tribes.

Khartum, the centre of administration for all these discordant elements, has been brought within the sphere of civilisation since 1819, when it was occupied by the Egyptian troops under Ismael Pasha. At that time it was a mere outpost of the Hamagh kingdom, Senaar; but, thanks to its convenient position at the confluence of the two Niles midway between the Mediterranean and the equator, it soon rose to importance under the strong government of Mehemet Ali. Under Khurshid Pasha (1826–37) its skin and reed hovels were replaced by substantial brick houses, and at present it is by far the largest and most flourishing place in Central Africa, with a motey population of over 40,000, including the garrison roops. Here considerable quantities of goods in transit are always in deposit; here are resident many Europeans interested in the African trade, and in the more philanthropic work of African culture and exploration. Khartum has thus become inseparably associated with all the work done during the last half century towards developing the material resources of the land and raising the moral status of its inhabitants. At its mention, the names of Petherick, Beltrami, Schweinfurth, Baker, Gordon, Marno, Junker, Linant de Bellefonds, Emin Bey, Gessi, and many other heroic pioneers in the cause of African progress, are irresistibly conjured up. Such names plead silently but eloquently for its preservation to civilisation in the better sense of the word, and make us feel how great a crime against humanity would be its abandonment to barbarism and the villainous Arab slave-dealers of Central Africa.

A. H. KEANE

NOTES

WE understand that subscriptions to a memorial to the late Mr. F. Hatton are being asked for in a paper in which the name of Prof. Huxley is mentioned as one of the committee and an intending subscriber. We are authorised to state that the name of Prof. Huxley has been employed without his knowledge.

WE have received the following subscriptions on behalf of the Hermann Müller Fund:—Prof. W. H. Flower, F.R.S., 1*l.*; Mr. W. E. Hart, 1*l.*; K., 10*s.*

MR. FRANK E. BEDDARD, M.A., of the University of Oxford, Naturalist to the *Challenger* Commission, has been selected out of thirteen candidates for the post of Prosector to the Zoological Society of London, in succession to the late Mr. W. A. Forbes. Mr. Beddard was a pupil of the late Prof. Rolleston, and for the past year has been employed on editorial and other work connected with the issue of the official reports on the scientific results of the *Challenger* Expedition. He has also been intrusted with the examination and description of the *Isopoda* collected by the Expedition, and has the reputation of being a most promising and enthusiastic naturalist.

AMONG other legacies in the will of the late Sir William Siemens are 1000*l.* each to the Scientific Relief Fund of the Royal Society and the Benevolent Fund of the Institution of Civil Engineers.

THE Cunningham Medal of the Royal Irish Society was presented on the 15th inst. to Mr. John Birmingham of Tuam, for his "Contributions to the Advancement of Knowledge in Astronomy."

MR. ARCHIBALD GEIKIE, F.R.S., Director-General of the Geological Survey of the United Kingdom, will give the first of a course of five lectures on the Origin of the Scenery of the British Isles, on Tuesday next (January 29), at the Royal Institution of Great Britain.

IN January, 1883, one of the officers of the Geological Survey of Ireland, Mr. E. T. Hardman, was selected to proceed to Western Australia for the purpose of taking part in an exploration of the Kimberley district of that colony. He took the field in April last, and continued on active service in the bush until near the end of September, having in this interval travelled at least 1500 miles, and having obtained materials for a first geological sketch-map of about 12,800 square miles of country. He has determined the sequence of formations which begin with certain quartzites, schists, and other metamorphic rocks, which he classes provisionally as altered Lower Silurian, but which may be of Archæan age. These are succeeded by limestones and sandstones with gypsum, &c., which are referred to Upper Carboniferous horizons. Certain basalts and felstones occur, the age of which is uncertain. The youngest deposits are Pliocene sands, gravels, conglomerates, and marly limestones ("pindar" of the natives) overlaid by river gravels, extensive plains of alluvium, and, along the sea-coast, by raised beaches.

MR. BARNUM'S so-called white elephant arrived safely last week at the Zoological Gardens from Burmah, and has already attracted many visitors. Prof. Flower, writing to the *Times*, says:—"The Burmese elephant now deposited in the Zoological

Society's Gardens, Regent's Park, is apparently not quite full grown, being between 7 feet and 8 feet in height, and has a well-formed pair of tusks about 18 inches in length. It has a remarkably long tail, the stiff bristly hairs at the end of which almost touch the ground. The ears are somewhat larger than in the ordinary Indian elephant, and are curiously jagged or festooned at the edges, whether as a natural formation or the result of early injuries it is difficult to say. It is chiefly remarkable, however, for a peculiarity of coloration which is quite unlike that of any elephant hitherto brought to this country. In this elephant the general surface of the integument is quite as dark as, if not darker than, that usually seen in its kind, being, perhaps, of rather a more bluish or slaty hue. There are, however, certain definite patches, disposed with perfect bilateral symmetry, in which the pigment is entirely absent, and the skin is of a pale reddish brown or 'flesh colour.' These patches are of various sizes, sometimes minute and clustered together, producing only an indistinct mottling of the surface, sometimes in large clear spaces, but which are mostly, especially at their edges, dotted over with circular pigmented spots of the prevailing dark colour about half an inch or more in diameter, which give a remarkable and even beautiful effect. The largest and clearest light-coloured tract is on the face, extending from the level of the eyes to the base of the trunk. . . . The animal is not a pale variety of the ordinary elephant, as some have supposed the so-called 'White Elephant' to be, but one characterised by a local deficiency of the epidermic pigment, in symmetrically disposed patches, and chiefly affecting the head and anterior parts of the body. It does not result from any disease of the skin, as has been suggested, but is doubtless an individual congenital condition or defect."

IN *Cosmos les Mondes* for January 19 Prof. P. Guy describes the remarkable sunrise witnessed by him at Perpignan on January 8. From his bedroom window, looking southwards, he noticed a sudden flash, which lit up the whole room, and which was followed by a lovely pale light diffused throughout the southern sky from horizon to zenith. This was at 4 a.m., and consequently could not have been produced by the clouds reflecting the light of the moon, which had set at 2.42 a.m. The luminous matter presented a milk-white appearance, not unlike that of the Milky Way, and scarcely more intense. So transparent was it that the stars remained perfectly visible without any diminution of their brightness through the vapours which seemed to cause the effulgence. Mars and Jupiter, visible near the zenith, were encircled by a halo like that often visible round the moon. Along the southern horizon there stretched a dark band formed by clouds at an elevation of about 15°, the upper edge of which was lit up intermittently by the action of successive waves of light resembling the sheet lightning so often seen in summer. About 4.45 a.m. the light gradually faded away, after which the sky became overcast and quite dark. The local and intermittent light, Prof. Guy thinks, was obviously due to electricity, to which with less certainty may also be attributed the more general manifestation. The upper regions of the atmosphere contain a large quantity of electricity, as shown by the potential increasing with the increased altitude. To its presence are probably due such faint and phosphorescent diffusions of light as are here described, and have often been observed elsewhere.

AFTER more than a fortnight's working without the slightest hitch of any kind, the experiment of the direct electric lighting of one of the District Railway trains between Kensington and Putney may, it is stated, be fairly looked upon as a distinct success. The fitting of the Putney train is of a rather heterogeneous character, being a collection of plant procurable without special manufacture, the whole consisting of a launch boiler, a small Willan's three-cylinder steam-engine, running at 500 revolutions, and driving direct off its own shaft, a Siemens' shunt-wound dynamo supplying current for 50 Swan 20-candle power incandescent lights. In addition there are two water-tanks, and a coal-box, the whole being placed in a separate van, and this tentative arrangement has this advantage—that by the removal of the van to other lines more extended trials can be made on longer trains, as in the present case only 30 of the lamps are employed for the actual service of the train, the remaining 20 being kept lighted in the van itself. The effect on the train is very brilliant, although the arrangements are not what are ultimately proposed—namely, to place a small high-speed engine and the dynamo on the tender and take steam from the locomotive itself, and so dispense with the attendant now required in the special van.

THE fiftieth anniversary of the birth of Philipp Reis, the inventor of the telephone which bears his name, was celebrated by the Elektrotechnische Gesellschaft of Frankfort on January 7 by a special meeting in the afternoon, followed by a banquet, to which the son of the deceased inventor and a number of his surviving scientific friends and comrades were invited. A memorial discourse was pronounced by Herr Postrath Grawinkel, dwelling on the inventions of Reis and his now generally admitted claims. At the banquet a speech was made by Dr. Petersen, president of the Physical Society of Frankfort, on behalf of that body, at whose session in 1861 the telephone first saw the light. The speeches and toasts lasted till after midnight.

WE mentioned last week that the Scottish Fishery Board on the recommendation of Prof. Cossar Ewart had taken steps to utilise the abundant machinery at their disposal for collecting material that will assist in solving some of the important fish problems. As a firstfruit of this organisation a splendid specimen of a torpedo was forwarded to the University of Edinburgh by the fishery officer at Wick on Saturday last. Prof. Ewart exhibited this, apparently the only torpedo ever found off the Scottish coast, at the last meeting of the Royal Physical Society of Edinburgh (January 16). After giving a short account of the torpedo group, Prof. Ewart mentioned that the specimen exhibited was taken about five miles off Lybster, that it was 28 inches in length and 19½ inches across the pectoral fins, and that it belonged to the species *hebetans*, several specimens of which have been found in the English Channel. This torpedo will in all probability be presented by the Fishery Board to the Edinburgh Museum of Science and Art.

THE members of several scientific societies in the east of Scotland having had under consideration the advantages that would result from a federation of the various societies, believing that thereby the value of their scientific work would be greatly increased and their objects promoted, have determined to call a meeting of delegates from the various scientific bodies in the east of Scotland, to be held at the Perthshire Natural History Museum, Perth, on Saturday, February 9 next. At this meeting it is purposed to consider the question of federation, and how it may best be carried out, and also to adopt a constitution, and to arrange for a first general meeting. Some of the advantages of such an association are thus briefly stated :—(1) Increased value of work by having an aim in common ; (2) Increased zeal amongst members by definite work being put before them ; (3) Improvements in method of carrying out excursions ; (4) Increased facilities for intercourse amongst members of the different societies. The idea of a federation of societies is not a new one. In England the societies of three large districts have formed associations, with excellent results ; and though in Scotland no unions of a similar nature have yet been formed, the joint meetings (inaugurated by the Inverness Scientific Society) of some of the northern societies, which have taken place annually during the past two or three years, have been a step in the same direction.

THE Geographical Society at Antwerp has given a reception to the distinguished geographer, Dr. Chavanne, editor of the *Mittheilungen* of the Vienna Geographical Society. He has undertaken the task of drawing up a complete map of the Congo territory, showing the stations of the African Association. He will leave for the Congo at the beginning of next month.

THE first maps of the Algerian survey have been published and presented to the Paris Academy by Col. Perrier.

THE largest ice cavern in Carniola has lately been discovered by Prof. Linhart of Laibach, having hitherto been known only to a small circle of woodcutters and hunters. It is now called the Friedrichstein Cavern, and can be reached in about two to three hours from Gottschee. The upper aperture is large and rectangular, the back is formed by a limestone rock rising some 80 metres perpendicularly; there is also a colossal gate fringed by icicles some metres in length. The sides are very steep. The area of the cave is about 450 square metres, nearly circular in shape, the level ground being covered with ice several feet deep. Altogether the cave seems to offer one of the grandest aspects imaginable.

NEWS about the Russian expedition to Western Africa under Herr Schulz von Rogosinski was communicated at a recent meeting of the Berlin Geographical Society. The expedition has investigated the district north and east of the Cameroon Mountains, and discovered a large native settlement or town, Kumba by name, on the Mungo River east of the mountains mentioned. They intend to penetrate still further to the east. Dr. Pauli and Dr. Passavant of Basle have started also for the same districts on an exploring tour. A letter was also read, dated Ibi, September 30, in which Robert Flegel makes some official business communications.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles geoffroyi*) from Central America, presented by Mr. Colin Wm. Scott; two Yellow-bellied Liothrix (*Liothrix luteus*) from India, a Goldfinch (*Carduelis elegans*), British, presented by Mrs. Edwards; an Indian Elephant (Mottled Variety) (*Elephas indicus* ♂) from Burmah, a Slow Loris (*Nycticebus tardigradus*) from Sumatra, a Gray Ichneumon (*Herpestes griseus*) from India, deposited; a Rufous-necked Wallaby (*Halmaturus ruficollis*) from New South Wales, a Brush Bronze-wing Pigeon (*Phaps elegans*) from Australia, received on approval; an Axis Deer (*Cervus axis*), three Brown-tailed Gerbilles (*Gerbillus erythrurus*), a Babirussa (*Babirussa alfurus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

A SOUTHERN COMET.—A telegram from Melbourne addressed to Prof. Krueger of Kiel, editor of the *Astronomische Nachrichten*, notifies the discovery of a small comet on January 12 in R.A. 22h. 40m., and N.P.D. 130° 8′, and consequently in the constellation Grus. It is stated to be moving quickly to the south-east.

Possibly this comet may add to the very small number of cases where one of these bodies has been telescopically discovered in the other hemisphere, and the elements of the orbit have wholly depended upon southern observations. We can call to mind only two such instances: (1) the comet of 1824 detected by the late Carl Rümker at Parramatta, and observed there by him and by Sir Thomas Brisbane, the founder of that observatory, and Governor of the Colony. The orbit was first calculated by Rümker, and has lately been more completely investigated from the Parramatta observations by Dr. Doberck; (2) the comet of 1833, discovered by Dunlop (Rümker's successor) at Parramatta at the end of September, and observed there from October 1 to 16: orbits by Henderson, Peters, and Hartwig.

PONS' COMET.—For the convenience of readers who are observing in the southern hemisphere we subjoin an ephemeris of this comet, deduced from the provisionally corrected ellipse of MM. Schulhof and Bossert. The positions are for Greenwich mean noon:—

1884		R.A. h. m. s.	Decl. ° ′	Log. distance from Earth	Log. distance from Sun
Feb.	5	0 44 33	−31 38·8	9·9506	9·9024
	9	0 55 27	35 10·7		
	13	1 5 10	38 14 2	0·0019	9.9284
	17	1 14 0	40 54·4		
	21	1 22 14	43 15·8	0·0440	9 9628
	25	1 30 7	45 22·4		
	29	1 37 52	47 17·2	0·0772	0·0011
March	4	1 45 40	49 2·8		
	8	1 53 40	50 41·4	0·1029	0·0401
	12	2 2 0	52 14·9		
	16	2 10 50	53 44·6	0·1225	0·0781
	20	2 20 19	55 11·3		
	24	2 30 34	56 36·0	0·1374	0·1143
	28	2 41 44	57 59·4		
April	1	2 53 58	59 22·0	0·1489	0·1483
	5	3 7 27	60 43·6		
	9	3 22 23	62 4·1	0·1583	0·1800
	13	3 38 59	63 22·5		
	17	3 57 27	−64 37·4	0·1668	0·2095

The theoretical intensity of light on February 5 is sixty-nine times that on the day of discovery; on April 17 only six times the same. Probably the comet may be discernible with the naked eye until the end of February.

Dr. G. Müller of the Astro-physical Observatory at Potsdam records a second remarkably sudden increase in the brightness of this comet. On January 1 at 5h. 47m. M.T. its appearance was very similar to that of the preceding days, the nucleus large and diffused; photometric comparisons showed that it was following pretty nearly in the calculated light-curve, and harmonised with the measures on December 29 and 30. At 7h. 20m. he was astonished at the altered aspect of the comet. In place of the previously diffused nucleus, there was now an almost stellar point, equal in brightness to a star of the seventh magnitude, so that he was at first under the impression that a bright star was seen through the comet. By comparisons with two neighbouring stars, estimated in the *Durchmusterung* 7·0 and 6·8, the following magnitudes were determined:—

h. m.		h. m.	
At 7 28	7·53 m.	At 8 27	7·03 m.
7 41	7·35	8 38	7·00
7 58	6 97	9 0	7·13
8 7	6·89	9 7	7·33

With the help of a curve the observations appeared to fix the maximum of the development of light to 8h. 12m. M.T. at Potsdam corresponding to 7h. 20m. Greenwich M.T. At 9h. 30m. the comet's aspect had again changed and resembled that presented at the previous day's observations. The whole variation amounted to about 1·3 mag. On that evening the comet's distance from the sun was 0·90, and that from the earth 0·665.

Attention will be no doubt directed in the other hemisphere to these abnormal variations in the light of the comet. It will be remembered that the first remarkable change occurred about September 22, three weeks after the discovery by Mr. Brooks, when the distance from the sun was 2·18, and from the earth 2·14.

PROFESSOR HAECKEL ON THE ORDERS OF THE RADIOLARIA[1]

II.

[THE following translation of a recent paper of mine, by Miss Nellie Maclagan, has been revised by myself.—ERNST HAECKEL.]

Systematic Survey of the 4 *Orders*, 10 *Sub-orders*, *and* 32 *Families of the Class Radiolaria*. (Compare the former survey of the families in my Monograph, 1862, and in "Prodromus," *l.c.* 1881).

1. Order I. ACANTHARIA, Hkl. (*Acantharia*, Hkl., 1881 = *Acanthometreæ*, Hertwig, 1879 = *Panacantha*, Hkl., 1878).

Central capsule originally (and usually permanently) spherical; nucleus usually early divided into numerous small nuclei. Cap-

[1] "Separat-Abdrück aus den Sitzungsberichten der Jenaischen Gesellschaft für Medicin. und Wissenschaft." Jahrg. 1883. Sitzung. von 16 Februar. Concluded from p. 276.

sule membrane spherical, pierced on all sides by innumerable fine pores. Extracapsularium, a voluminous gelatinous sheath, without phæodium, usually without zooanthella. Skeleton always intracapsular, consisting of acanthine spicules, which meet in the centre of the central capsule, and pierce the membrane.

1A. Sub-order I. Acanthometræ, J. Müller, 1858. Acantharia, in which the acanthine skeleton is composed merely of radial spicules, but does not form a fenestrated shell.

Family 1. Actinelida, Hkl., 1865. Skeleton composed of a varying number of spicules, not distributed according to J. Müller's law (*Astrolophida, Litholophida*).

Family 2. Acanthonida, Hkl., 1881. Skeleton composed of twenty radial spicules, distributed regularly according to J. Müller's law, in five quadriradiate zones (*Acanthometrida, Acanthostaurida, Acantholonchida*).

1B. Sub-order II. Acanthophractæ, Hertwig. Acantharia, in which the skeleton is composed of twenty radial spicules regularly distributed according to J. Müller's law, and forming a fenestrated or solid shell round the central capsule by means of connected transverse processes.

Family 3. Dorataspida, Hkl., 1862. Fenestrated shell, spherical, spheroidal, or ellipsoidal, simple or double (*Phractaspida, Sphærocapsida, Phractopelmida*.

Family 4. Diploconida, H., 1862. Shell shaped like an hour-glass or a double cone, having in its axis a pair of strong spicules running in opposite directions (*Diploconus*).

2. Order II. SPUMELLARIA, Ehrenberg (= *Peripylea* + *Thalassicollea* + *Sphærozoea*, Hertwig, 1879 = *Sphærellaria* + *Collodaria* + *Polycyttaria*, Hkl., 1881).

Central capsule originally (and usually permanently) spherical, more rarely discoid or polymorphous. Nucleus usually divided only immediately before the formation of spores into a number of small nuclei. Capsule membrane simple, pierced on all sides by innumerable fine pores. Extracapsularium a voluminous gelatinous sheath, without phæodium, usually with zooxanthella. Skeleton consisting of silicium, or of a silicate, originally usually forming a central reticulate sphere, later extremely polymorphous, more rarely rudimentary or entirely wanting.

2A. Sub-order III., Collodaria, H., 1881 (*sensu ampliori*). Spumellaria without skeleton, or with a rudimentary skeleton composed mainly of detached siliceous spicules scattered outside the central capsule.

Family 5. Thalassicollida, H., 1862. Skeleton entirely wanting. Central capsules living solitary, monozoic (*Actissa, Thalassolampe, Thalassicolla*, &c.

Family 6. Collozoida, H., 1862. Skeleton entirely wanting. Central capsules social, thickly embedded in a common gelatinous body, polyzoic (*Collozoum*).

Family 7. Thalassosphærida, H., 1862. Skeleton composed of numerous detached spicules, scattered round the solitary central capsule. Monozoic (*Thalassosphæra, Thalassoxanthium*, &c.).

Family 8. Sphærozoida. Skeleton composed of numerous detached spicules, scattered round the social central capsules, or embedded in their common gelatinous body (*Sphærozoum, Rhapidozoum*).

2B. Sub-order IV. Sphærellaria, Hkl., 1881. Spumellaria having a reticulate or spongiose siliceous skeleton, forming a single connected plexus of siliceous fibre, originally evolved from a simple fenestrated sphere.

Family 9. Sphæroida (vel *Sphæridea*, H., 1879. "Protistenreich," p. 103; "Prodromus," 1881, pp. 448, 449). Skeleton either a simple fenestrated sphere, or composed of several concentric fenestrated spheres, with or without radial spicules. Central capsule solitary, monozoic. The family of Spumellaria richest in specific forms (*Monosphæria, Diosphæria, Triosphæria, Tetrasphæria, Polysphæria, Spongosphæria*).

Family 10. Collosphærida, H., 1862. Skeleton either simple reticulate spheres, or composed of two concentric reticulate spheres, severally inclosing the spherical, social, central capsules. Polyzoic (*Acrosphærida, Clathrosphærida*).

Family 11. Pylonida, Hkl., 1881 ("Prodromus," p. 463). Skeleton subspherical, ellipsoid, or polymorphous, distinguished by large fissures or gaps, which break through the originally spherical or ellipsoidal fenestrated shell, at definite points. Fenestrated shell, simple or composed concentrically, with or without spicules. Geometrical fundamental form with three unequal, equipolar axes, perpendicular one to another (*Pylocaspida, Pylophonnida*).

Family 12. Zygastida, Hkl., 1881. Skeleton an ellipsoida or almost cylindrical fenestrated shell prolonged in the direction of one axis and constricted annularly in the middle, perpendicular to the said axis, often articulated by repeated annular strictures. One or two concentric, small, fenestrated shells, often inclosed in the middle. Both poles of the principal axis equal (*Artiscida, Cyphinida*).

Family 13. *Lithelida*, Hkl. ("Monogr. Prodrom." 1881, p. 464). Skeleton spheroidal or irregular, composed of a small, central, fenestrated sphere, and of series or heaps of chambers piled round it, sometimes spirally or axially according to definite, complicated laws, sometimes quite irregularly (*Phorticida, Soreumida, Spireumida*).

Family 14. Discoida (vel *Discidea*, Hkl., 1879, "Protistenreich," p. 103, "Prodrom." p. 456). Skeleton flattened like a disk, originally circular, lenticular, later often polymorphous by means of peripheric processes; sometimes distinctly composed of rings, sometimes spongiose (*Phæodiscida, Coccodiscida, Porodiscida, Spongodiscida*).

3. Order III. NASSELLARIA, Ehrenberg (= Monopylea, Hertwig, 1879; *Monopylaria*, Hkl., 1881).

Central capsule originally invariably uniaxial, oval, or conical, with two different poles of the axis; at one pole the characteristic porous area through which the whole of the pseudopodia project like a bush. Nucleus usually divided late, immediately before the formation of spores, into numerous small nuclei. Capsule membrane simple. Extracapsularium, a voluminous gelatinous sheath without phæodium, usually without zooxanthellæ. Skeleton consisting of silicium or of a silicate, originally (it is probable universally) a ring or a triradiate framework of spicules, later extremely polymorphous, usually forming a dipleuric fenestrated shell (wanting only in the simplest form, *Cystidium*).

3A. Sub-order V., Plectellaria, Hkl. Nassellaria, in which the skeleton consists of a simple siliceous ring or of a triradiate framework of spicules, usually furnished with processes forming simple or branched spicules. The branches of the latter may be united into a loose plexus, without, however, forming a chambered fenestrated shell. The skeleton is entirely wanting only in the simplest form (*Cystidium*).

Family 15. Cystidina, Hkl, nov. fam. Skeleton entirely wanting (*Cystidium*).

Family 16. Plectoida (vel *Plagonida*), Hkl., 1881. Skeleton originally composed of three spicules or siliceous rods, radiating from one point (near the mouth of the central capsule), the latter often ramifying into loose plexus (*Plagonida, Plectanida*).

Family 17. Stephoida (vel *Stephanida*), Hkl., 1881. Skeleton originally (?) forming a simple siliceous ring (with or without spicules), later often several connected siliceous rings or a loose plexus, not, however, developed into a regular fenestrated shell *Monostephida, Parastephida, Dyostephida, Triostephida*).

3*b*. Sub-order VI. Cystellaria (Hkl., 1881). Nassellaria, having a chambered (usually dipleuric) fenestrated shell, the primary foundation of which consists either of a simple ring (like the Stephoida), or of a triradiate framework (like the Plectoida), sometimes of a combination of both. Primary foundation sometimes entirely lost.

Family 18. Spyroida (vel *Sphyridina*, Ehrenberg). Skeleton dipleuric, forming a fenestrated twin-shell, the two halves of which (right and left chamber) are connected by a vertical ring, lying in the median plane. At the upper (aboral) pole of the longitudinal axis, usually an occipital apical thorn, at the lower (oral) pole an oscular network, with four (rarely three, five, or more) openings, and three (rarely more) spicules. (*Triospyrida, Diospyrida, Tetraspyrida, Pentaspyrida, Polyspyrida, Perispyrida, Pleurospyrida*) = Zygocystida.

Family 19. Botryoida (Hkl., 1881 = Polycystida, 1862). Skeleton an irregular fenestrated shell, composed of several unequal chambers, piled usually irregularly (rarely in definite order varying from that of the Cyrtida) round a primary capitulum (derivable from the twin-shell of the Spyroida), with or without spicules (*Pylobotryida, Cannobotryida*).

Family 20. Cyrtida, Hkl., 1862. Skeleton, dipleuric (at least originally), consisting either of a primary capitulum (derivable from the twin-shell of the Spyroida?) or (usually) of one or more chambers, joined to the oral pole of the said capitulum in the longitudinal axis. Osculum sometimes open, sometimes reticulate. Usually three radial spicules (one median and two lateral), rarely four or more spicules, or none at all (having undergone retrograde formation?). The family most rich in specific forms of all Nassellaria (*Cystocorida, Cystopilida, Cystophonnida, Cystocapsida, Cystoperida, Cystophatuida*, "Prodrom.," 1881, p. 426).

4. Order IV. PHÆODARIA, Hkl., 1879 (= *Pansolenia*, Hkl., 1878 = *Tripylea*, Hertwig, 1879).

Central capsule always uniaxial, sometimes almost spherical, sometimes lenticular or oval, always with two different poles of the axis. At one pole invariably the characteristic principal opening with radiated operculum, from which the bush of pseudopodia project through a tube; at the other pole, frequently (though not invariably) two or more accessory openings. Nucleus usually only late divided into numerous small nuclei. Capsule membrane double. Extracapsularium usually (or always ?) with zooxanthellæ distinguished by the *phæodium*, a voluminous body of pigment lying excentrically in the gelatinous sheath round the principal opening. Skeleton always extracapsular, consisting of silicium or of a silicate, usually composed of hollow tubes, polymorphous (wanting only in the most simple forms, *Phæodina*, &c.).

4A. Sub-order VII. Phæocystia, Hkl., 1879. Phæodaria, without skeleton, or with a rudimentary skeleton formed merely of detached siliceous tubes (or of reticulated pieces of silex) scattered outside the central capsule.

Family 21. Phæodinida, Hkl., 1879. Skeleton entirely wanting (*Phæodina, Phæodella*).

Family 22. Cannoraphida, Hkl., 1879. Skeleton consisting of detached hollow tubes or reticulated pieces of silex, deposited tangentially round the central capsule (*Cannoraphis, Thalassoplaneta, Dictyocha*).

Family 23. Aulacanthida, Hkl., 1862. Skeleton consisting of a superficial pallium of fine tangential tubes and a number of strong radial spicules (simple or branched) which pierce the mantle (*Aulocantha, Aulospathis, Auloraphis, Aulodendrum*, &c).

4B. Sub-order VIII. Phæogromia, Hkl., 1879. Phæodaria with a dipleuric single-chambered shell having a large opening, usually armed with one or more teeth at the basal pole; besides the primary, often several secondary openings.

Family 24. Lithogonida, Hkl., nov. fam., single-chambered dipleuric shell, with solid wall of peculiar crystalline structure, like porcelain (*Lithogromia*, Tuscarora).

Family 25. Challengerida, John Murray, 1876. Single chambered shells, varying greatly in form, with porous glass-like wall, and very fine, perfectly regular, hexagonal pores (resembling the structure of diatoms) (*Challengeria, Gazelletta, Porcupinia*, &c.).

4C. Sub-order IX. Phæosphæria, Hkl., 1879. Phæodaria having a spherical, or subspherical, fenestrated shell, usually consisting of one single, rarely of two concentric spheres; sometimes with a large principal opening, sometimes without; partly with, partly without, radial spicules. Beams of the reticulum sometimes solid, sometimes hollow.

Family 26. Castanellida, Hkl., 1879. Fenestrated shell, spherical, simple, composed of solid rods, having at one point a large principal opening (often armed with a corona of spicules), with or without radial spicules (*Castanella, Castanidium*, &c.).

Family 27. Circoporida, Hkl., 1879. Fenestrated shell, spherical, subspherical, or polyhedric, composed sometimes of reticulate plates, usually with hollow, radial spicules, always with one large, principal opening, and with several detached porous areæ (*Circoporus, Porostephanus, Porospathis*, &c.).

Family 28. Sagenida, Hkl., nov. fam. Fenestrated shell, sometimes spherical, sometimes subspherical or polymorphous, forming a spongiose plexus of solid beams, without principal opening (*Sagena, Sagenidium*, &c.).

Family 29. Aulosphærida, Hkl., 1862. Fenestrated shell, spherical, more rarely subspherical or polymorphous, composed in a peculiar fashion of hollow tubes, usually with hollow, radial spicules, without principal opening (*Aulosphæra, Auloplegma*, &c.).

Family 30. Cannosphærida, Hkl., 1879. Fenestrated shell, spherical or subspherical, double. The inner (medullar layer) composed simply of solid beams, the outer (cortical layer) of hollow tubes with radial spicules at the nodes of junction; both layers connected by hollow, radial rods (*Cannosphæra, Cœlocantha*, &c.).

4D. Sub-order 10. Phæoconchia, Hkl., 1879. Phæodaria, having a bivalve fenestrated shell, composed like that of a mussel, of two convex, separate, perforated valves, with or without hollow, radial tubes.

Family 31. Concharida, Hkl., 1879. Fenestrated shell, without radial spicules, composed of two smooth, hemispherical or lenticular valves, the edges of which usually catch one another by rows of teeth (*Concharium, Conchidium, Conchopsis*, &c.).

Family 32. Cœlendrida, Hkl., 1862. Fenestrated shell composed of two hemispherical or lenticular valves, having processes in the form of large, hollow, radial spicules, usually dendritically branched at their apical, centre points or at the two poles of the transverse axis of the shell (*Cœlodendrum, Cœlothamna*, &c.).

Differential Characters of the Four Orders of Radiolaria

Holotrypasta

Radiolaria having the capsule membrane pierced on all sides.

I. ACANTHARIA.	II. SPUMELLARIA.
Central capsule originally spherical. Homaxonous.	Central capsule originally spherical. Homaxonous.
Capsule membrane pierced equally everywhere by innumerable fine pores. (*Peripylea*).	Capsule membrane pierced equally everywhere by innumerable fine pores. (*Peripylea*).
Skeleton acanthine. Zooxanthellæ usually (or invariably ?) wanting. Without phæodium.	Skeleton siliceous. Zooxanthellæ usually present. Without phæodium.

Merotrypasta

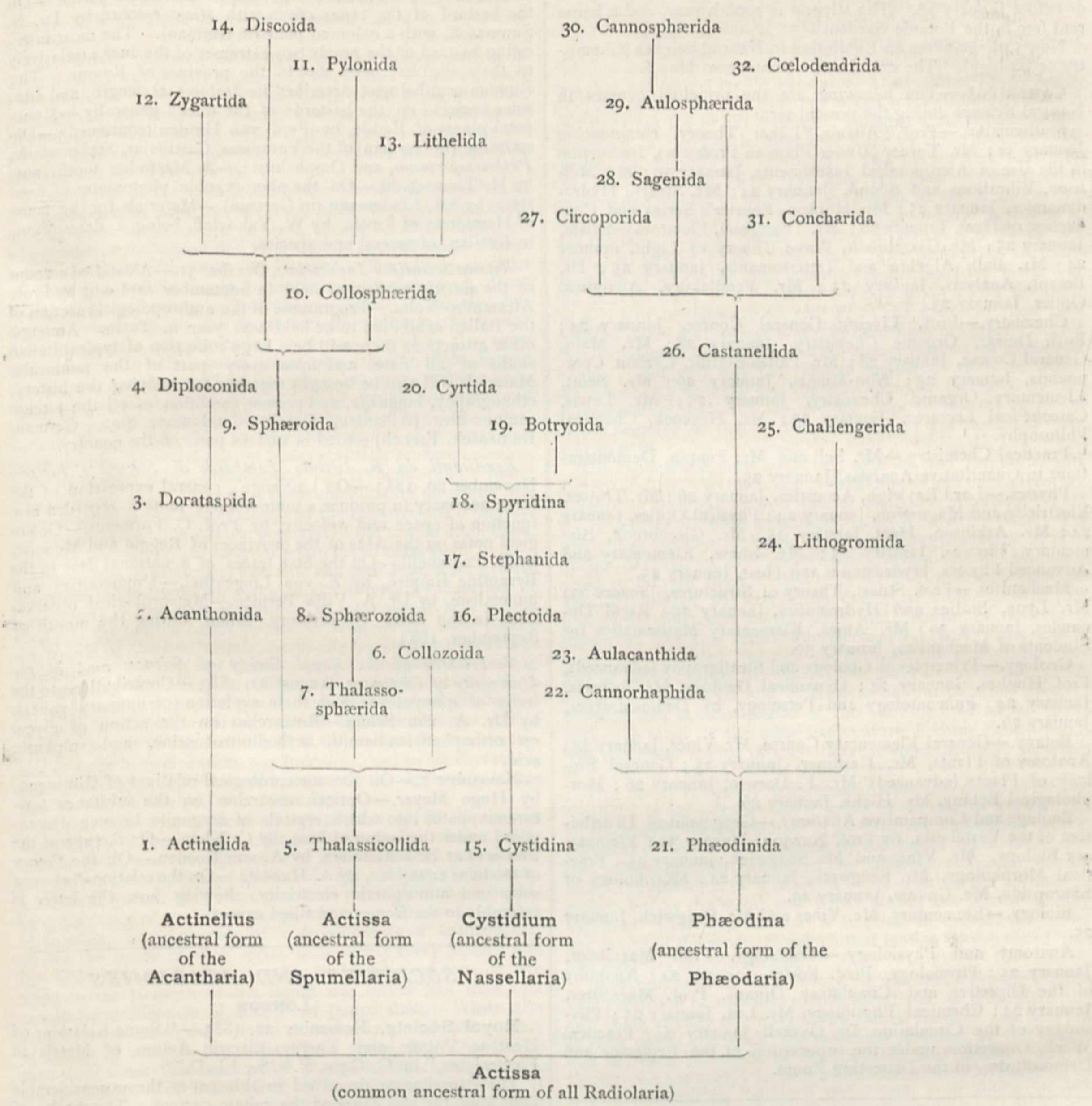
Radiolaria having the capsule membrane partially pierced.

III. NASSELLARIA.	IV. PHÆODARIA.
Central capsule oval or conical. Monaxonous.	Central capsule oval or subspherical. Monaxonous.
Capsule membrane with a single area of pores at the oral pole of the principal axis. (*Monopylea*).	Capsule membrane with a single simple principal opening and often several accessory openings. (*Tripylea*).
Skeleton siliceous. Zooxanthellæ usually present. Without phæodium.	Skeleton siliceous. Zooxanthellæ usually (or invariably ?) wanting. Always with phæodium.

Conspectus Ordinum et Familiarum Radiolarium classis

Ordines	Subordines	Familiæ	Genus typicum
I. Ordo: Acantharia Holotrypasta skeleto acanthinico	I. Acanthometra (sine testa)	1. Actinelida	Actinelius
		2. Acanthonida	Acanthonia
	II. Acanthophracta (testa completa)	3. Dorataspida	Dorataspis
		4. Diploconida	Diploconus
II. Ordo: Spumellaria Holotrypasta skeleto deficiente aut siliceo polymorpho	III. Collodaria (sine testa)	5. Thalassicollida	Actissa
		6. Collozoida	Collozoum
		7. Thalassosphærida	Physematium
		8. Sphærozoida	Sphærozoum
	IV. Sphærellaria (testa completa)	9. Sphærida	Phormosphæra
		10. Collosphærida	Collosphæra
		11. Pylonida	Tetrapyle
		12. Zygartida	Didymocyrtis
		13. Lithelida	Porodiscus
		14. Discoida	Lithelius
III. Ordo: Nassellaria Merotrypasta membrana capsulæ simplici, sine phæodio	V. Plectellaria (sine testa completa)	15. Cystidina	Cystidium
		16. Plectoida	Plagiacantha
		17. Stephanida	Lithocircus
	VI. Cyrtellaria (testa completa)	18. Spyroida	Dictyospyris
		19. Botryoida	Botryocyrtis
		20. Cyrtida	Dictyophimus
IV. Ordo: Phæodaria Merotrypasta membrana capsulæ duplici, cum phæodio	VII. Phæocystia (sine testa)	21. Phæodinida	Phæodina
		22. Canr:orhaphida	Thalassoplancta
		23. Aulacanthida	Aulacantha
	VIII. Phægromia (testa dipleura)	24. Lithogromida	Lithogromia
		25. Challengerida	Challengeria
	IX. Phæosphæria (testa globosa aut subglobosa)	26. Castanellida	Castanella
		27. Circoporida	Circoporus
		28. Sagenida	Sagena
		29. Aulosphærida	Aulosphæra
		30. Cannosphærida	Cannosphæra
	X. Phæoconchia (testa bivalva)	31. Concharida	Concharium
		32. Cœlodendrida	Cœlodendrum

HYPOTHETICAL ANCESTRAL TREE OF THE RADIOLARIA (1882)



UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following courses of lectures and instruction in Natural Science will be held during the present term. In the Department of Physics Prof. Clifton lectures on "The Distribution of Potential in a Circuit," and on the Galvanometer. Mr. Heaton lectures on Elementary Mechanics. Practical instruction in Physics is given daily by Prof. Clifton and Messrs. Heaton and Walker in the Clarendon Laboratory. At Christ Church Mr. Baynes lectures on the Kinetic Theory of Gases, and gives practical instruction in magnetic and electric measurements. At Balliol Mr. Dixon lectures on Elementary Heat and Light.

In the Chemical Department Prof. Odling continues his course on the Naphthalene Compounds. The Courses on Organic and Inorganic Chemistry are continued by Dr. Watts and Mr. Fisher. At Christ Church Mr. Vernon Harcourt has a class for Quantitative Analysis.

Prof. Story-Maskelyne continues his course on Crystallography, and Prof. Prestwich concludes his course on Dynamical Geology, and lectures on Stratigraphical Geology.

In the Department of Morphology practical instruction is given by Prof. Moseley and Messrs. Robertson and Hickson on Human and Comparative Anatomy. Prof. Moseley lectures on the Comparative Anatomy of the Vertebrata, Mr. Hickson on the Elements of Animal Morphology, Mr. Jackson on Mimicry and Parasitism, Mr. Poulton on Descriptive Histology, Mr. Morgan on Odontography, and Mr. Barclay-Thompson on the Anatomy of Amphibia and Reptilia.

In the Department of Physiology (which is much cramped for room pending the erection of new buildings) Prof. Burdon Sanderson lectures on the Nervous System, while practical instruction is given by the Professor and Mr. Gotch on the Elementary Physiology of the Nervous System and of the Sense Organs, and by Mr. Dixey on Histology. At Magdalen Mr. Yule has a class for instruction in Practical Physiology.

The new Reader in Anthropology will give a course of six lectures on the Development of Civilisation and the Arts of Life.

Candidates for the Professorship of Botany are requested to send in their applications to the Registrar of the University on or before January 26. The stipend is 700*l.* a year, and a house rent free in the Botanic Garden.

New College offers an Exhibition in Natural Science (Chemistry or Biology). The examination commences May 6.

CAMBRIDGE.—The following are the principal courses in Natural Science during the present term :—

Mathematics.—Prof. Adams, Lunar Theory, commencing January 31; Mr. Turner (Under Plumian Professor), Instruction in the Use of Astronomical Instruments, January 30; Mr. Mollison, Vibrations and Sound, January 24; Mr. Stearn, Hydrodynamics, January 25; Mr. Hobson, Fourier's Series and Conduction of Heat, January 28; Mr. Thompson, Electromagnetism, January 25; Mr. Glazebrook, Wave Theory of Light, January 24; Mr. Ball, Algebra and Determinants, January 25; Dr. Besant, Analysis, January 23; Mr. Pendlebury, Analytical Optics, January 23.

Chemistry.—Prof. Liveing, General Course, January 24; Prof. Dewar, Organic Chemistry, January 28; Mr. Main, General Course, January 28; Mr. Pattison-Muir, Carbon Compounds, January 25; Non-Metals, January 26; Mr. Scott, Elementary Organic Chemistry, January 25; Mr. Lewis, Catechetical Lectures, January 25; Mr. Heycock, Chemical Philosophy.

Practical Chemistry.—Mr. Sell and Mr. Fenton, Demonstrations in Quantitative Analysis, January 25.

Physics.—Lord Rayleigh, Acoustics, January 26; Mr. Trotter, Electricity and Magnetism, January 24; Physical Optics, January 24; Mr. Atkinson, Heat, January 25; Mr. Glazebrook, Elementary Physics, January 25; Mr. Shaw, Elementary and Advanced Physics, Hydrostatics and Heat, January 25.

Mechanism.—Prof. Stuart, Theory of Structures, January 29; Mr. Lyon, Statics and Hydrostatics, January 29; Rigid Dynamics, January 30; Mr. Ames, Elementary Mathematics for Students of Mechanism, January 30.

Geology.—Principles of Geology and Stratigraphy (advanced), Prof. Hughes, January 24; Dynamical Geology, Mr. Roberts, January 24; Palæontology and Petrology, by Demonstrators, January 26.

Botany.—General Elementary Course, Mr. Vines, January 24; Anatomy of Plants, Mr. Gardiner, January 25; General Biology of Plants (advanced), Mr. F. Darwin, January 26; Morphological Botany, Mr. Hicks, January 26.

Zoology and Comparative Anatomy.—Geographical Distribution of the Vertebrata, by Prof. Newton, January 30; Elementary Biology, Mr. Vines and Mr. Sedgwick, January 25; Practical Morphology, Mr. Sedgwick, January 24; Morphology of Sauropsida, Mr. Gadow, January 23.

Biology.—Elementary, Mr. Vines and Mr. Sedgwick, January 25.

Anatomy and Physiology.—Osteology, Prof. Macalister, January 25; Physiology, Prof. Foster, January 24; Anatomy of the Digestive and Circulatory Organs, Prof. Macalister, January 24; Chemical Physiology, Mr. Lea, January 25; Physiology of the Circulation, Dr. Gaskell, January 24; Practical Work, Dissection, under the supervision of the Professor and Demonstrator, in the Dissecting Room.

SCIENTIFIC SERIALS

Bulletin de la Société des Naturalistes de Moscou, année 1883, No. 2.—Researches into the compounds of the acetylenes, by A. P. Sabanéeff. The author has studied these imperfectly known compounds, namely, di-brom-acetylene, and the double compounds of acetylene with bromine and chlorine, and with chlorine and iodine. He has discovered a new method of preparing larger quantities of the former by acting with zinc on an alcoholic solution of the four-brom-acetylene, and describes its various reactions.—On the periodical changes of level of the ocean, by H. Trautschold (in German). The author, who already in 1869 supported the idea that the geological changes are due, not to the rise of the continents, but to the falling of the level of the ocean, finds in the disposition of the series of deposits of all ages up from the Silurian, on the plains of Russia, new and very interesting arguments for his idea. He maintains that the level of the ocean was falling from the Silurian epoch to the end of the Trias, when the seas had, around the now Russian plains, nearly the same shape as now. The level of the ocean rose, however, during the Jurassic period, retiring again about the end of the Chalk period.—On the bastard of the *Anas crecca* with *Anas boschas*, by Dr. N. Sewertsoff, with a coloured plate (in German). The most interesting bastard of the nearly two extremes of the ducks (relatively to their size) has been shot in the province of Ryazan. The Russian ornithologist describes its features at length, and adds some remarks on the bastards of the ducks generally.—Monopetal plants of Radde, by Ferd. von Herden (continued).—Description (in German) of the Veronicas, Castillejas, *Siphonostegia*, *Phtheirospermum*, and Omphalotrix.—A Mastodon tooth, note by H. Trautschold.—On the photographic photometry of fixed stars, by Ed. Lindemann (in German).—Materials for the fauna of Hemiptera of Russia, by W. Yakovleff, being a description, in Russian, of several new species.

Rivista Scientifico-Industriale, October 31.—A detailed account of the electric exhibition held in September at Lodi, by Prof. Alessandro Volta.—Programme of the anthropological section of the Italian exhibition to be held next year in Turin. Amongst other attractions there will be a large collection of typical Italian skulls of all dates and from every part of the peninsula. Materials will also be brought together for studying the history, ethnography, language, and present condition of all the foreign communities (Albanian, Greek, Catalonian, Slav, German, Rumansch, French) settled in various parts of the country.

Rendiconti del R. Istituto Lombardo di Scienze e Lettere, November 29, 1883.—On Lagrange's general expression of the force necessary to produce a tautocronous motion regarded as a function of space and velocity, by Prof. C. Formenti.—Geological notes on the Alps of the provinces of Reggio and Modena, by D. Pantanelli.—On the first traces of a national debt in the Byzantine Empire, by Z. von Lingenthal.—Unimetalism and bimetalism, by Dr. A. Villa Pernice.—Meteorological observations in the Brera Observatory, Milan, during the month of September, 1883.

Nachrichten of the Royal Society of Sciences and of the University of Göttingen, August 22, 1883.—Contributions to the study of spermatozoa and their evolution (preliminary paper), by Dr. A. von Brunn.—Researches on the action of glycol on orthophenylendiamin, orthodinitrobenzine, and sulphuric acid.

November 7.—On the meteorological relations of Göttingen, by Hugo Meyer.—Optical researches on the substance (calcareous spath) into which crystals of aragonite become decomposed under the action of heat, by C. Klein.—On the age of the iron ores at Hohenkirchen, by A. von Koenen.—On the theory of modular equations, by A. Hurwitz.—On the relations between solar and atmospheric electricity, showing how the latter is referable to the former and allied causes.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 22, 1883.—"Some Relations of Heat to Voltaic and Thermo-Electric Action of Metals in Electrolytes," by G. Gore, F.R.S., LL.D.

The experiments described in this paper throw considerable light upon the real cause of the voltaic current. The results of them are contained in twenty tables; and by comparing them with each other, and also by means of additional experiments, the following general conclusions and chief facts were obtained.

When metals in liquids are heated, they are more frequently rendered positive than negative in the proportion of about 2·8 to 1·0; and whilst the proportion in weak solutions was about 2·29 to 1·0, in strong ones it was about 3·27 to 1·0, and this accords with their thermo-electric behaviour as metals alone. The thermo-electric order of metals in liquids was, with nearly every solution, whether strong or weak, widely different from the thermo-electric order of the same metals alone. A conclusion previously arrived at was also confirmed, viz. that the liquids in which the hot metal was thermo-electro-positive in the largest proportion of cases were those containing highly electro-positive bases, such as the alkali metals. The thermo-electric effect of *gradually* heating a metal in a liquid was sometimes different from that of *suddenly* heating it, and was occasionally attended by a reversal of the current.

Degree of strength of liquid greatly affected the thermo-electric order of metals. Increase of strength usually and considerably increased the potential of metals thermo-electro-negative in liquids, and somewhat increased that of those positive in liquids.

The electric potential of metals, thermo-electro-positive in weak liquids, was usually about 3·87 times, and in strong ones 1·87 times, as great as of those which were negative. The potential of the strongest thermo-electric couple, viz. that of aluminium in weak solution of sodic phosphate, was ·66 volt for 100° F. difference of temperature, or about 100 times that of a bismuth and antimony couple.

Heating one of the metals, either the positive or negative, of a voltaic couple, usually increased their electric difference, making most metal more positive, and some more negative; whilst heating the second one also, usually neutralised to a large extent the effect of heating the first one. The electrical effect of heating a voltaic couple is nearly wholly composed of the united effects of heating each of the two metals separately, but is not however exactly the same, because whilst in the former case the metals are dissimilar, and are heated to the same temperature, in the latter they are similar, but heated to different temperatures. Also, when heating a voltaic pair, the heat applied to two metals, both of which are previously electro-polar by contact with each other as well as by contact with the liquid; but when heating one junction of a metal and liquid couple, the metal has not been previously rendered electro-polar by contact with a different one, and is therefore in a somewhat different state. When a voltaic combination, in which the positive metal is thermo-negative, and the negative one is thermo-positive, is heated, the electric potential of the couple diminishes, notwithstanding that the internal resistance is decreased.

Magnesium in particular, also zinc and cadmium, were greatly depressed in electromotive force in electrolytes by elevation of temperature. Reversals of position of two metals of a voltaic couple in the tension series by rise of temperature were chiefly due to one of the two metals increasing in electromotive force faster than the other, and in many cases to one metal increasing and the other decreasing in electromotive force, but only in a few cases was it a result of simultaneous but unequal diminution of potential of the two metals. With eighteen different voltaic couples, by rise of temperature from 60° to 160° F., the electromotive force in twelve cases was increased, and in six decreased, and the average proportions of increase for the eighteen instances was ·10 volt for the 100° F. of elevation.

A great difference in chemical composition of the liquid was attended by a considerable change in the order of the volta-tension series, and the differences of such order in two similar liquids, such as solutions of hydric chloride and potassic chloride, were much greater than those produced in either of those liquids by a difference of 100° F. of temperature. Difference of strength of solution, like difference of composition or of temperature, altered the order of such series with nearly every liquid; and the amount of such alteration by an increase of four or five times in the strength of the liquid was rather less than that caused by a difference of 100° F. of temperature. Whilst also a variation of strength of liquid caused only a moderate amount of change of order in the volta tension series, it produced more than three times that amount of change in the thermo-electric tension series. The usual effect of increasing the strength of the liquid upon the volta-electromotive force was to considerably increase it, but its effect upon the thermo-electromotive force was to largely decrease it. The degree of potential of a metal and liquid thermo-couple was not always exactly the same at the same temperature during a rise as during a fall of temperature; this is analogous to the variations of melting and solidifying points of bodies under such conditions, and also to that of supersaturation of a liquid by a salt, and is probably due to some hindrance to change of molecular movement.

The rate of ordinary chemical corrosion of each metal varied in every different liquid; in each solution also it differed with every different metal. The most chemically positive metals were usually the most quickly corroded, and the corrosion of each metal was usually the fastest with the most acid solutions. The rate of corrosion at any given temperature was dependent both upon the nature of the metal and upon that of the liquid, and was limited by the most feebly active of the two, usually the electrolyte. The order of rate of corrosion of metals also differed in every different liquid. The more dissimilar the chemical characters of two liquids the more diverse usually was the order of rapidity of corrosion of a series of metals in them. The order of rate of simple corrosion in any of the liquids examined differed from that of chemico-electric and still more from that of thermo-electric tension. Corrosion is not the cause of thermo-electric action of metals in liquids.

Out of fifty-eight cases of rise of temperature the rate of ordinary corrosion was increased in every instance except one, and that was only a feeble exception—the increase of corrosion from 60° to 160° F. with different metals was extremely variable, and was from 1·5 to 321·6 times. Whether a metal increased or decreased in thermo-electromotive force by being heated, it increased in rapidity of corrosion. The proportions in which the most corroded metal was also the most thermo-electro-positive one was 65·57 per cent. in liquids at 60° F. and 69·12 in the same liquids at 160° F.; and the proportion in which it was the most chemico-electro-positive at 60° F. was 84·44 per cent., and at 160° F. 80·77 per cent. The proportion of cases therefore in which the most chemico-electro-negative metal was the most corroded one increased from 15·56 to 19·23 per cent. by a rise of temperature of 100° F. Comparison of these proportions shows that corrosion usually influenced in a greater degree chemico-electric rather than thermo-electric actions of metals in liquids. Not only was the relative number of cases in which the volta-negative metal was the most corroded increased by rise of temperature, but also the average relative loss by corrosion of the negative to that of the positive one was increased from 3·11 to 6·32.

The explanation most consistent with all the various results and conclusions is a kinetic one:—That metals and electrolytes are throughout their masses in a state of molecular vibration. That the molecules of those substances, being frictionless bodies in a frictionless medium, and their motion not being dissipated by conduction or radiation, continue incessantly in motion until some cause arises to prevent them. That each metal (or electrolyte), when unequally heated, has to a certain extent an unlike class of motions in its differently heated parts, and behaves in those parts somewhat like two metals (or electrolytes), and those unlike motions are enabled, through the intermediate conducting portion of the substance, to render those parts electro-polar. That every different metal and electrolyte has a different class of motions, and in consequence of this they also, by contact alone with each other at the same temperature, become electro-polar. The molecular motion of each different substance also increases at a different rate by rise of temperature.

This theory is equally in agreement with the chemico-electric results. In accordance with it, when in the case of a metal and an electrolyte, the two classes of motions are sufficiently unlike, chemical corrosion of the metal by the liquid takes place, and the voltaic current, originated by inherent molecular motion under the condition of contact, is maintained by the portions of motion lost by the metal and liquid during the act of uniting together. Corrosion therefore is an effect of molecular motion, and is one of the modes by which that motion is converted into and produces electric current.

In accordance with this theory, if we take a thermo-electric pair consisting of a non-corrodible metal and an electrolyte (the two being already electro-polar by mutual contact), and heat one of their points of contact, the molecular motions of the heated end of each substance at the junction are altered; and as thermo-electric energy in such combinations usually increases by rise of temperature, the metal and liquid, each singly, usually becomes more electro-polar. In such a case the unequally heated metal behaves to some extent like two metals, and the unequally heated liquid like two liquids, and so the thermo-electric pair is like a feeble chemico-electric one of two metals in two liquids, but without corrosion of either metal. If the metal and liquid are each, when alone, thermo-electro-positive, and if, when in contact, the metal increases in positive condition faster than the liquid by being heated, the latter appears thermo-electro-negative, but if less rapidly than the liquid, the metal appears thermo-electro-negative.

As also the proportion of cases is small in which metals that are positive in the ordinary thermo-electric series of metals only become negative in the metal and liquid ones (viz. only 73 out of 286 in weak solutions, and 48 out of the same number in strong ones), we may conclude that the metals, more frequently than the liquids, have the greatest thermo-electric influence, and also that the relative largeness of the number of instances of thermo-electro-positive metals in the series of metals and liquids, as in the series of metals only, is partly a consequence of the circumstance that rise of temperature usually makes substance —metals in particular—electro-positive. These statements are also consistent with the view that the elementary substances lose a portion of their molecular activity when they unite to form acids or salts, and that electrolytes therefore have usually a less degree of molecular motion than the metals of which they are partly composed.

The current from a thermo-couple of metal and liquid, therefore, may be viewed as the united result of difference of molecular motion, first, of the two junctions, and second, of the two heated (or cooled) substances; and in all cases, both of thermo- and chemico-electric action, the immediate true cause of the current is the original molecular vibrations of the substances, whilst contact is only a static permitting condition. Also that whilst in the case of thermo-electric action the sustaining cause is molecular motion, supplied by an external source of heat, in the case of chemico-electric action it is the motion lost by the metal and liquid when chemically uniting together. The direction of the current in thermo-electric cases appears to depend upon which of the two substances composing a junction increases in molecular activity the fastest by rise of temperature, or decreases the most rapidly by cooling.

Zoological Society, January 15.—E. W. H. Holdsworth, F.Z.S., in the chair.—The Secretary exhibited, on the part of Mr. H. Whitely, an immature specimen of the Night-Heron (*Nycticorax griseus*), which had been shot in Plumstead Marshes, Kent, in December last.—A communication was read from Mr. J. C. O'Halloran, Chief Commissioner and Police Magistrate for Rodriguez, accompanying a specimen of a large lizard found only in that island, and very rare there. The specimen had been identified by Mr. Boulenger as *Phelsuma newtoni*, belonging to the family Geckotidæ.—Sir Joseph Fayrer exhibited some additional specimens of the horns of deer gnawed by other deer, in confirmation of previous remarks on the subject.—Canon Tristram, F.R.S., exhibited and made remarks upon some specimens of species of the genus *Pachycephala*, which appeared to have been ignored or wrongly united to other species in a recently published volume of the Catalogue of Birds of the British Museum.—Mr. W. F. R. Weldon read a paper in which he gave a description of the placenta in *Tetraceros quadricornis*. The author showed that this placenta is intermediate between that of *Moschus* and that of the typical Bovidæ, having few cotyledons with diffuse vascular ridges between them. Associated with this primitive character is a uniserial psalterium.—A second paper by Mr. Weldon contained some notes on the anatomy of a rare American monkey, *Callithrix gigot*, which had recently died in the Society's Gardens. The author gave a description of the external characters, and the principal viscera were compared with those of *C. moloch* and of *Mycetes*.—A communication was read from Mr. E. J. Miers, F.Z.S., giving an account of a collection of Crustacea from the Mauritius, which had been forwarded to the British Museum by M. V. de Robillard. In the collection was an example of a new species of *Callianassa*, proposed to be called *C. martensi*.—Mr. Francis Day read a paper on races and hybrids among the Salmonidæ, and exhibited a series of specimens of young salmon and hybrid Salmonidæ reared at Sir J. Gibson Maitland's Howie-town Fish Establishment.—Prof. F. Jeffrey Bell read a paper on the generic position and relations of *Echinanthus tumidus* of Tenison-Woods, from the Australian seas, which he showed to belong to a different genus, proposed to be called *Anomalanthus*.

Chemical Society, January 17.—Dr. W. H. Perkin, president, in the chair.—The following gentlemen were elected Fellows:—B. H. Brough, G. Daubeney, C. C. Hutchinson, W. S. Kilpatrick, E. Matthey, H. Peile, J. Pallister, R. Romanis, S. G. Rawson, F. M. Rogers, W. Robinson, T. Stenhouse, W. O. Senier, J. A Voelcker.—The following papers were read:—On camphoric peroxide and barium camphorate, by C. T. Kingzett. In 1863 Brodie described the formation of camphoric peroxide by triturating camphoric anhydride with barium peroxide in the presence of ice-cold water. The author has repeated the above experiments, and concludes that no camphoric peroxide is formed, but that the anhydride is first converted into camphoric acid, which decomposes the barium peroxide, yielding camphorate of barium and peroxide of hydrogen.—On the decomposition of silver fulminate by hydrochloric acid, by E. Divers and Michitada Kawakita. Formic acid and hydroxyammonium chloride are formed, as is the case with mercury fulminate, but the authors have only been able to obtain two-thirds of the calculated quantity of these bodies. Some ammonia and hydrocyanic acid are also formed.—Supplementary note on Liebig's production of fulminating silver without the use of nitric acid, by E. Divers and Michitada Kawakita. The authors have succeeded in preparing the fulminate, but only when the reaction was allowed to proceed for some time. The solution was then warm, and always contained nitric acid.—On hyponitrites, by E. Divers and Tamemasa Haga. The authors criticise the recent paper of Berthelot and Ogier, and give an account of fresh investigations, which confirm the formula originally proposed by Divers, AgNO. They have not been able to obtain hyponitrite, either by the method proposed by Mencke, *i.e.* heating potassium nitrate with iron filings, or the method proposed by Zorn, in which ferrous hydrate is used as the reducing agent.

Royal Meteorological Society, January 16.—Mr. J. K. Laughton, F.R.A.S., president, in the chair.—The Secretary read the Report of the Council, which showed that the past few months mark a very important epoch in the history of the Society. In October the Council received the intimation that Her Majesty had been graciously pleased to grant the Society permission to assume the prefix "Royal." In consequence the Society has become, and will henceforth be called, the Royal Meteorological Society. In December the Fellows made certain alterations in the by-laws by which the annual subscription has been increased. The Report also showed that the Society is doing a great deal of practical work, not only by holding meetings and publishing the papers read at the same, but also by the establishment of a large number of observing-stations, which are regularly inspected, so that the results obtained from them may be strictly uniform and comparable. The number of Fellows is 549 and of honorary members 19, thus making a total of 568.—The President then delivered his address, in which he referred to the experiments made by Mr. Saxon Snell, Mr. Bertram, and Mr. Hele Shaw, with the object of determining the coefficients of Biram's anemometers; as yet these can scarcely be considered quite satisfactory, for, though made with the utmost care, they give results differing from each other by nearly 25 per cent. and from the known truth in opposite directions. The reduction of barometric readings to sea-level is another problem of great interest and importance, the solution of which is far from perfect, and, as applied to the converse determination of altitudes, has been pronounced by Mr. Gilbert, of the U.S. Geological Survey, to be beset with difficulties "so numerous and so baffling that there is no reason to hope that they will ever be fully overcome." In many cases, too, the reduction, even if correct, implies an accumulation of air in places where no air exists; and isobars so drawn, traversing mighty mountain ranges such as the Rocky Mountains or the Himalayas, or elevated plateaus such as those of Central or Eastern Asia, convey an impression which may easily lead to serious mistakes. The great achievement of the year is unquestionably the gathering in of the observations taken, by international agreement, at nine Arctic stations, in which, amidst circumstances of more or less discomfort, parties continued through a full period of twelve months. With one station established by the United States on the shores of Lady Franklin Bay, it has been found impossible to communicate; this was established in the summer of 1881, and no trustworthy news has since been received. Preliminary reports have been published from the English station at Fort Rae on the northern shores of the Great Slave Lake; from the German station in Cumberland Sound; from the Austrian at Jan Mayen, and from some of the others; but the principal interest attaches not to the observations taken separately but to the collation and comparison of the whole, which may be expected to lead the way towards problems of the greatest importance to meteorology. In the present day one science is so mixed up with a number of others, and so involved in them, that it is impossible to separate them, or to define the exact limits of each. Many of the problems of meteorology belong as much to geography, or at times even to experimental physics, and an address which speaks of the progress of meteorology is perhaps apt to appear in some degree discursive. It is that the true student of nature, whilst limiting his detailed work to one particular direction, must consider her kingdom as a grand and comprehensive whole, one and indivisible.—The following gentlemen were elected the officers and Council for the ensuing year:—President: Robert Henry Scott, F.R.S.; Vice-Presidents: Hon. Ralph Abercromby, Edmund Douglas Archibald, M.A., John Knox Laughton, F.R.A.S., William Marcet, M.D., F.R.S.; Treasurer: Henry Perigral, F.R.A.S.; Trustees: Hon. Francis Albert Rollo Russell, M.A., Stephen William Silver, F.R.G.S.;

Secretaries: George James Symons, F.R.S., John William Tripe, M.D.; Foreign Secretary: George Mathews Whipple, F.R.A.S.; Council: William Morris Beaufort, F.R.A.S.; George Chatterton, John Sanford Dyason, F.R.G.S., William Ellis, F.R.A.S., Charles Harding, Richard Inwards, F.R.A.S., Baldwin Latham, F.G.S., Robert John Lecky, F.R.A.S., Edward Mawley, F.R.H.S., Cuthbert E. Peek, F.R.G.S., Capt. Henry Toynbee, F.R.A.S., Charles Theodore Williams, M.D.

Anthropological Institute, January 8.—Prof. Flower, F.R.S., president, in the chair.—The election of the following new members was announced:—Rev. E. S. Dewick, M.A., F.G.S., Prof. A. Macalister, M.D., F.R.S., and Mr. Oldfield Thomas as ordinary members, Dr. E. T. Hamy and Dr. Hermann Welcker as honorary members, and Mr. Lucien Carr and Dr. A. B. Meyer as corresponding members.—The President stated that Mr. Francis Galton had offered 500*l.* in prizes to those who should before May 1, 1884, furnish him with the best extracts from their family records according to the form prescribed in his "Record of Family Faculties," published by Macmillan and Co., and he urged all members of the Anthropological Institute to give Mr. Galton every assistance in their power.—Mr. H. H. Johnston read a paper on the races of the Congo and the Portuguese colonies in Western Africa. The author stated that Western Tropical Africa, between Senegambia to the north and the River Cunéné, offered a vast studying ground to the anthropologist, wherein types of nearly every well-marked African race might be observed. After detailing many of the various races, he proceeded to describe the Bushmen north of Cunéné, which he characterised as about the lowest type of men, but, of the five or six specimens which came more particularly under his notice, he remarked that their mental ability was strangely at variance with their low physical characteristics. The Hottentots were much finer men than the Bushmen as regarded height and build, but they exceeded the latter in baboon-like licentiousness. The western slopes of the Shella Mountains were peopled by a tribe called the A-ndombe, a sturdy race of carriers, which extended as far north as Benguela. Referring to the races of the lower Congo, Mr. Johnston observed that they depended almost entirely upon vegetable diet, whilst they were remarkable for their initiation ceremonies. Traces of phallic worship were noticed, especially in the interior, and more particularly in the neighbourhood of Stanley Pool. A Congo market was exceedingly interesting, and was held for about four or eight days. The natives would often go 100 miles to attend one of these markets, the women generally being the keenest traders. Between Stanley Pool and the coast there is only one great leading tongue spoken, though this has several dialects. This is the Congo language, one known to and studied by Europeans probably before any other Bantu tongue. It bears many signs of Portuguese influence.

Geological Society, January 9.—J. W. Hulke, F.R.S., president, in the chair.—Patrick Doyle, Alfred Harker, Rev. Frederick Hastings, Rev. John Milne-Curran, and William Ford Stanley, were elected Fellows; Prof. G. Capellini, of Bologna, a Foreign Member, and M. Alphonse Briart, of Mons, a Foreign Correspondent of the Society.—The following communications were read:—On the volcanic group of St. David's, by the Rev. Prof. J. F. Blake, F.G.S. The result of the author's examination of the rocks in the district of St David's which have been designated *Dimetian*, *Arvonian*, and *Pebidian*, is that they belong to one volcanic series, whose members are those usually recognised in eruptive areas, and whose age is anterior to and independent of the true Cambrian epoch. The independence of this series and the Cambrian is shown by the nature of the junction at all points of the circuit that have b en seen. The supposed isocline west of the granitic mass cannot be verified on an examination of the coast-section, there being great irregularity and gentle synclinals not far from where the apex of the isocline should be. With regard to the nature of the rocks which thus antedate the Cambrian, the author was unable to recognise any true alternations in the materials of the granitic axis, though the rock is a peculiar one in the arrangement of its constituents. The felsitic rocks are not independent of the granite, as they surround it on all sides, the line along the north and south being specially traced. They are also often intrusive into the ashes, and hence can have no definite strike. Attention was drawn to the highly acid character of the whole series, and to the small size of the centres of eruption, and it was suggested that such centres have continually decreased in number and increased in magnitude during geological time.—On further discoveries of vertebrate remains in the Triassic strata of the south coast of Devonshire, between Budleigh Salterton and Sidmouth, by A. T. Metcalfe, F.G.S. The author gave a brief stratigraphical account of the Triassic rocks of the coast. He then described some vertebrate remains, consisting chiefly of portions of jaw-bones with teeth in line, probably of Labyrinthodonts, found in the upper sandstones (Ussher's classification) at High Peake Hill, near Sidmouth, by H. J. Carter, F.R.S. At numerous places between Budleigh Salterton and Sidmouth, Mr. Carter and the author had found a large number of isolated bone fragments. Such fragments had been submitted to a microscopical examination by Mr. Carter. In some specimens the bone structure was visible throughout; in some the bony portion had been partially removed and replaced by an infiltration of mineral matter; in others the removal of the bony portion was complete. From these facts the author drew the conclusion that a comparative abundance of vertebrate life was maintained during the Triassic period; and that the rareness of Triassic fossils was due not so much to the paucity of animal life during that period as to the fact that Triassic strata afforded no suitable conditions for the *preservation* of organic remains.

EDINBURGH

Royal Physical Society, January 16.—J. A. Harvie-Brown, F.R.S.E., president, in the chair.—The following communications were read:—On intra-epithelial capillaries in Oligochæta, by F. E. Beddard, F.R.S.E.—On the geognosy of the Harz Mountains, part 1, by H. M. Cadell, B.Sc., of the Scottish Geological Survey. The writer stated that there was still some room for original investigation in that quarter, notwithstanding the great attention the German geologists had bestowed on the region. The Germans had not yet learned the art of detailed structural geological mapping and section-drawing as carried out in the British geological surveys, and many of their so-called geological maps were nothing more than mere petrographical pictures. The writer then went over the various formations of the Harz, and noticed the fact that graptolites were found at the top only of the lowest or Hercynian rocks, which he suggested might be cited as an example of one of Banaudes' "colonies." The older or "core rocks" of the Harz terminating in the Kulm were overlaid in violent unconformability by the border rocks, beginning at the coal measures and extending upwards to the Trias and Cretaceous systems. He agreed with those who consider the loess an "æolian" deposit swept as dust into sheltered valleys and nooks by the wind, and thought that water had had nothing directly to do with its origin. The paper was illustrated by the exhibition of rocks and metallic minerals from the region described.—Prof. Cossar Ewart, F.R.S.E., exhibited, with remarks, a large torpedo recently caught in a trawl off Wick, and believed to be the only specimen of the kind ever found north of the English Channel. The specimen exhibited was 28 inches in length and 19½ inches across the pectoral fins, and belonged to the species *hebetans*.

SYDNEY

Linnean Society of New South Wales, November 28, 1883.—C. S. Wilkinson, F.G.S., F.L.S., president, in the chair.—The following papers were read:—Some fishes of New Britain and the adjoining islands, by Charles W. De Vis, B.A. The names of the new specimens described are—*Serranus perguttatus* and *cruentus*, *Mesoprion flavirosea*, *Tetraroge vestita*, *Acanthurus zebra*, *Rynchichthys novæ-britanniæ*, *Harpage rosea* (a new genus of the Berycidæ), *Salarias æquipinnis*, *Amphiprion arion*, *Pomacentrus onyx* and *notatus*, *Nesiotes purpurascens* (a new genus of the Labridæ), *Exocœtus longibarba*, *Arius armiger*, *Herpetichthys cobra*, (a new genus of the Murænidæ), *Tetrodon insularium* and *lævis*.—Some results of trawl fishing outside Port Jackson, by William Macleay, F.L.S. In this paper are given—(1) An account of two trials of a large beam trawl in forty to fifty fathoms water, by the order of the Commissioner of Fisheries; (2) a list of the fishes captured; and (3) descriptions of two new species—a skate, *Raia australis*, and a gurnard, *Lepidotrigla mulhalli*. Mr. Macleay considers the result promising on the whole.—Baron Maclay read a note on the "Barometro Araucano" from the Chiloe Islands. He stated that this remarkable instrument had been shown to him among a number of other curiosities by Capt. C. de Amezaga, of the

Italian corvette *Caraciolo*, who informed him that it was used by the natives of the Chiloe Islands as a kind of barometer to foretell the approach of either dry or wet weather. This "Barometro Araucano," which consisted merely of the shell of a crab, pronounced by Mr. Haswell to be one of the *Anomura*, probably of the genus *Lithodes*, is most peculiarly sensitive to atmospheric changes. In dry weather it remains nearly white, but, with the approach of moisture, small red spots appear on the shell, increasing in number and size with the increase of humidity, until during the wet season it becomes completely red.

PARIS

Academy of Sciences, January 14.—M. Rolland in the chair.—On the researches of M. Guntz in the thermo-chemistry of the fluorides, in reply to the strictures of M. Tommasi, by M. Berthelot.—On a process of anæsthesis by the method of titrate mixtures of vapours and air; its application to the human subject in the form of vapours of chloroform, by M. Paul Bert. The chief advantages of this process are stated to be: delirium always slight, sometimes altogether absent, even in adults; absolute and regular insensibility obtained in six to eight minutes; quiet sleep; normal breathing, circulation, and temperature; no symptoms of nausea; normal and perfectly reassuring appearance of the patient while asleep; constant and always very protracted consecutive anæsthesis; great economy in the outlay for chloroform.—Generalisation and strictly mechanical demonstration of Joule's electrical formula, $w = ieT$, by M. A. Ledieu.—On the preparation in large quantities of artificial virus attenuated by rapid heating, by M. A. Chauveau. By this process sufficient virus for the prophylactic inoculation of from 4000 to 8000 sheep may be rapidly prepared in the same reservoir.—Observations of the Pons-Brooks comet made at the bent equatorial of the Paris Observatory, by M. Périgaud.—On the genus of some entire functions in mathematical analysis, by M. Laguerre.—On the geometrical curve known as Pascal's "limaçon," by M. A. Genocchi.—On linear differential equations with doubly periodical coefficients, by M. G. Floquet.—On the adiabatic expansion of the vapour of water, by M. P. Charpentier.—On the agreement of experience with the general theoretic law regulating capillary surfaces, especially in its application to water confined between two moistened plaques, vertical and parallel, by M. Quet.—On a new method of determining the magnetic inclination by means of the induction compass, by M. Wild.—On the observation of earth currents whose intensity is shown to be subject to secondary fluctuations depending on the degree of moisture and temperature of the zone comprised within the circuit, by M. Larroque.—Determination of the intensity of combustion in some acetones and in the two ethers of carbonic acid, by M. W. Louguinine.—On the phenomena of chemical dissociation, by M. Isambert. Here the author endeavours to resume the results of his experimental researches on dissociation in a simple theory based on the thermic data, by means of which alone it is possible to appreciate chemical phenomena.—On the preparation of the sulphate of the sesquioxide of pure chromium, by M. H. Baubigny.—Explanation of a method for determining the density of liquid oxygen, by M. Menges. The author obtains the equation $d = \frac{V_1 d_1}{v - v_1}$, where d = the density of the liquid gas, v = its volume, V = the volume of the gaseous portion, all known quantities.—On colloidal ferric ethylate and ferric hydrate, by M. Ed. Grimaux.—On a chlorurettted silicate of manganese, by M. Al. Gorgeu.—On the influence of plastering on the composition and the chemical properties of wine, by M. L. Magnier de la Source. The plastering process with chemically pure sulphate of lime has the effect of decomposing not only the cream of tartar, but also the neutral organic combinations of potassium which are present in a very considerable proportion in the perfectly ripe grape.—On the presence of the diamond in some graphic stone occurring near Bellary, Madras Presidency, by M. Chaper.—On the fossil Echinidæ of the Eocene formations at Saint-Palais (Charente Inférieure), by M. G. Cotteau.

BERLIN

Physical Society, January 4.—Prof. Neesen briefly communicated the contents of a paper sent in by Herr Friedrich C. S. Müller, describing three apparatus used in connection with the delivery of lectures: a tangent compass, a galvanometer, and a rheostat. These instruments were intended to take rapid measurements, and to render them visible to a large audience. Following up this subject, Prof. Neesen gave a short account of the contrivance by which in his lectures he measured the mutual attraction of two magnets by means of scales. In conclusion, he reported experiments instituted by him with a view to determining the influence of magnetisation on electrical conducting power. In these experiments he had made use of a magnetic substance of high specific resistance, a solution of chloride of iron. Two equal tubes were filled with the same solution, and inserted as the two branches of a Wheatstone bridge into the circuit of a galvanic battery; the two other branches being so arranged that the galvanometer stood at zero. The electrodes in the two tubes consisted of iron plates, and were exactly alike. The tubes, that is, the fluid conductors, had in the different experiments different shapes and different diameters. The contents of the one tube were then magnetised either by a magnetising spiral or by a powerful electromagnet, and the galvanometer was observed during this process of magnetisation. The result of the experiments was in every case a negative one. Very slight deflexions were indeed observed in the galvanometer needle in the case of the experiments with the magnetising spiral, but these proceeded from the slight heating of the fluid, an effect which, notwithstanding the solution of chloride of iron was surrounded by a casing of circulating water, had not been wholly avoided. In those experiments, on the other hand, in which the magnetisation was made by means of the electromagnet, the needle remained invariably at rest.—Prof. Rœber discussed and explained the principle of experiments made on the Rhone and reported in the *Comptes Rendus*. These experiments had for their object the towing of ships by means of ropes wound round the whole vessel.—Dr. Kœnig gave a short preliminary communication on the experiments, which, in cooperation with Dr. Dietrici, he had made, with a view to determining the precise position of different spectral colours and the sensitiveness of the eye for distinguishing colours. At the next meeting of the Society he would speak at greater length on the subject, illustrating it by numerical data.

CONTENTS

PAGE